z/OS

zSeries Platform Test Report for z/OS and Linux Virtual Servers

Version 1 Release 7

SA22-7997-02

z/OS

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SA22-7997-02

Note!
Before using this information and the products it supports, be sure to read the general information under “Notices” on page 467.

Third Edition, December 2005

This is a major revision of SA22-7997-01.

This edition applies to Parallel Sysplex environment function that includes data sharing and parallelism. Parallel Sysplex uses the OS/390 (5647-A01), z/OS (5694-A01), or z/OS.e (5655-G52) operating system.

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Opening remarks

A message from our team

We changed our title from the *z/OS® Parallel Sysplex Test Report* but it's still us! Same team, same testing, but we've gradually expanded our focus from Parallel Sysplex to a platform wide view of z/OS's and Linux on zSeries' place in the enterprise. To reflect that focus, we changed our title to be the ***zSeries® Platform Test Report*** .

As you read this document, keep in mind that ***we need your feedback.*** We want to hear anything you want to tell us, whether it's positive or less than positive. ***We especially want to know what you'd like to see in future editions.*** That helps us prioritize what we do in our next test phase. We will also make additional information available upon request if you see something that sparks your interest. To find out how to communicate with us, please see "How to send your comments" on page xxii.

We are a team whose combined computing experience is hundreds of years, but we have a great deal to learn from you, our customers. We will try to put your input to the best possible use. Thank you.

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Jessie Yu

Important—Currency of the softcopy edition

Each release of the *z/OS Collection* (SK3T-4269 or SK3T-4270) and *z/OS DVD Collection* (SK3T-4271) contains a back-level edition of this test report.

Because we produce our test reports toward the end of the product development cycle, just before each new software release becomes generally available (GA), we cannot meet the production deadline for the softcopy collections that coincide with the product's GA release. Therefore, there is normally a one-edition lag between the release of our latest test report edition and the softcopy collection in which it is included. That is, the test report that appears in any given softcopy collection is normally one edition behind the most current edition available on the Web.

If you obtained this document from a softcopy collection on CD-ROM or DVD, you can get the most current edition from the zSeries Platform Test Report Web site at:

www.ibm.com/servers/eserver/zseries/zos/integtst/

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About this document

This document is a test report written from the perspective of a system programmer. The IBM zSeries Integration Test team—a team of IBM testers and system programmers simulating a customer production Parallel Sysplex environment—wants to continuously communicate directly with you, the zSeries customer system programmer. We provide this test report to keep you abreast of our efforts and experiences in performing the final verification of each system release before it becomes generally available to customers.

An overview of Integration Test

We have been producing this test report since March, 1995. At that time, our sole focus of our testing was the S/390® MVS™ Parallel Sysplex. With the introduction of OS/390® in 1996, we expanded our scope to encompass various other elements and features, many of which are not necessarily sysplex-oriented. In 2001, OS/390 evolved into z/OS, yet our mission remains the same to this day. In 2005, we expanded to add a Linux Virtual Server arm to our overall environment, which will be used to emulate leading-edge customer environments, workloads, and activities.

Our mission and objectives

IBM's testing of its products is and always has been extensive. ***The test process described in this document is not a replacement for other test efforts.*** Rather, it is an additional test effort with a shift in emphasis, focusing more on the customer experience, cross-product dependencies, and high availability. We simulate the workload volume and variety, transaction rates, and lock contention rates that exist in a typical customer shop, stressing many of the same areas of the system that customers stress. When we encounter a problem, our goal is to keep systems up and running so that end users can still process work.

Even though our focus has expanded over the years, our objectives in writing this test report remain as they were:

- Run a Parallel Sysplex in a production shop in the same manner that customers do. We believe that only by being customers ourselves can we understand what our own customers actually experience when they use our products.
- Describe the cross-product and integrated testing that we do to verify that certain functions in specific releases of IBM mainframe server products work together.
- Share our experiences. In short, if any of our experiences turn out to be painful, we tell you how to avoid that pain.
- Provide you with specific recommendations that are tested and verified.

We continue to acknowledge the challenges that information technology professionals face in running multiple hardware and software products and making them work together. We're taking more of that challenge upon ourselves, ultimately to attempt to shield you from as much complexity as possible. The results of our testing should ultimately provide the following benefits:

- A more stable system for you at known, tested, and recreatable service levels
- A reduction in the time and cost of your migration to new product releases and functions.

Our test environment

The Parallel Sysplex that forms the core of our test environment has grown and changed over the years. Today, our test environment has evolved to a highly interconnected, multi-platform on demand enterprise—just like yours.

To see what our environment looks like, see the following:

- "Our Parallel Sysplex hardware configuration" on page 5
- "Our Parallel Sysplex software configuration" on page 14
- "Our networking and application enablement configuration" on page 119
- "Our workloads" on page 19

Who should read this document

System programmers should use this book to learn more about the integration testing that IBM performs on z/OS and certain related products, including selected test scenarios and their results. We assume that the reader has knowledge of MVS and Parallel Sysplex concepts and terminology and at least a basic level of experience with installing and managing the z/OS operating system, subsystems, network products, and other related software. See "Where to find more information" on page xxi.

How to use this document

Use this document as a companion to—***never*** *a replacement for*—your reading of other z/OS element-, feature-, or product-specific documentation. Our configuration information and test scenarios should provide you with concrete, real-life examples that help you understand the "big picture" of the Parallel Sysplex environment. You might also find helpful tips or recommendations that you can apply or adapt to your own situation. Reading about our test experiences should help you to confidently move forward and exploit the key functions you need to get the most from your technology investment.

However, you also need to understand that, while the procedures we describe for testing various tasks (such as installation, configuration, operation, and so on) are based on the procedures that are published in the official IBM product documentation, they also reflect our own specific operational and environmental factors and are intended for illustrative purposes only. Therefore, ***do not*** use this document as your sole guide to performing any task on your system. Instead, follow the appropriate IBM product documentation that applies to your particular task.

How to find the zSeries Platform Test Report for z/OS and Linux Virtual Servers

We make all editions of our test reports available on our z/OS Integration Test Web site at:

www.ibm.com/servers/eserver/zseries/zos/integtst/

If you cannot get to our Web site for some reason, see Appendix D, "Availability of our test reports," on page 461 for other ways to access our test reports.

We have traditionally published our test report on a quarterly basis where each quarterly edition was cumulative for the current year. At the end of each year, we freeze the content in our last edition; we then begin with a new test report the

following year. The most recent quarterly edition as well as all of the previous year-end editions are available on our Web site.

In 2003, our publication schedule changed from our traditional quarterly cycle as a result of the change in the development cycle for annual z/OS releases. We now publish our report twice a year, every June and December. In any event, the contents of our test reports remain cumulative for any given year.

We also have a companion publication, *OS/390 Parallel Sysplex Recovery*, GA22-7286-00, which documents the Parallel Sysplex recovery scenarios we've executed in our test environment, including operating system, subsystem, and coupling facility recovery. We describe how to be prepared for potential problems in a Parallel Sysplex, what the indicators are to let you know that a problem exists, and what actions to take to recover.

Note: The recovery book was written in the OS/390 V2R4 time frame; however, many of the recovery concepts that we discuss still apply to later releases of OS/390 and z/OS.

Where to find more information

If you are unfamiliar with Parallel Sysplex terminology and concepts, you should start by reviewing the following publications:

Table 1. Parallel Sysplex planning library publications

Publication title	Order number
z/OS Parallel Sysplex Overview	SA22-7661
z/OS MVS Setting Up a Sysplex	SA22-7625
z/OS Parallel Sysplex Application Migration	SA22-7662
z/OS and z/OS.e Planning for Installation	GA22-7504

In addition, you can find lots of valuable information on the World Wide Web.

- See the Parallel Sysplex for OS/390 and z/OS Web site at: www.ibm.com/servers/eserver/zseries/pso/
- See the Parallel Sysplex Customization Wizard at: www.ibm.com/servers/eserver/zseries/pso/tools.html
- See the z/OS Managed System Infrastructure (msys) for Operations Web site at: www.ibm.com/servers/eserver/zseries/msys/msysops/

Using LookAt to look up message explanations

LookAt is an online facility that lets you look up explanations for most of the IBM® messages you encounter, as well as for some system abends and codes. Using LookAt to find information is faster than a conventional search because in most cases LookAt goes directly to the message explanation.

You can use LookAt from these locations to find IBM message explanations for z/OS elements and features, z/VM®, VSE/ESA™, and Clusters for AIX® and Linux™:

- The Internet. You can access IBM message explanations directly from the LookAt Web site at http://www.ibm.com/servers/eserver/zseries/zos/bkserv/lookat/.

- Your z/OS TSO/E host system. You can install code on your z/OS or z/OS.e systems to access IBM message explanations using LookAt from a TSO/E command line (for example: TSO/E prompt, ISPF, or z/OS UNIX® System Services).
- Your Microsoft® Windows® workstation. You can install LookAt directly from the *z/OS Collection* (SK3T-4269) or the *z/OS and Software Products DVD Collection* (SK3T-4271) and use it from the resulting Windows graphical user interface (GUI). The command prompt (also known as the DOS > command line) version can still be used from the directory in which you install the Windows version of LookAt.
- Your wireless handheld device. You can use the LookAt Mobile Edition from http://www.ibm.com/servers/eserver/zseries/zos/bkserv/lookat/lookatm.html with a handheld device that has wireless access and an Internet browser (for example: Internet Explorer for Pocket PCs, Blazer or Eudora for Palm OS, or Opera for Linux handheld devices).

You can obtain code to install LookAt on your host system or Microsoft Windows workstation from:

- A CD-ROM in the *z/OS Collection* (SK3T-4269).
- The *z/OS and Software Products DVD Collection* (SK3T-4271).
- The LookAt Web site (click **Download** and then select the platform, release, collection, and location that suit your needs). More information is available in the LOOKAT.ME files available during the download process.

Using IBM Health Checker for z/OS

IBM Health Checker for z/OS is a z/OS component that installations can use to gather information about their system environment and system parameters to help identify potential configuration problems before they impact availability or cause outages. Individual products, z/OS components, or ISV software can provide checks that take advantage of the IBM Health Checker for z/OS framework. This book refers to checks or messages associated with this component.

For additional information about checks and about IBM Health Checker for z/OS, see *IBM Health Checker for z/OS: User's Guide*. z/OS V1R4, V1R5, and V1R6 users can obtain the IBM Health Checker for z/OS from the z/OS Downloads page at http://.

SDSF also provides functions to simplify the management of checks. See *z/OS SDSF Operation and Customization* for additional information.

How to send your comments

Your feedback is important to us. If you have any comments about this document or any other aspect of Integration Test, you can send your comments by e-mail to:

- dilorenz@us.ibm.com for z/OS questions
- jinxiong@us.ibm.com for Linux on zSeries questions

or use the contact form on our Web site at:

www.ibm.com/servers/eserver/zseries/zos/integtst/

You can also submit the Readers' Comments form located at the end of this document.

Be sure to include the document number and, if applicable, the specific location of the information you are commenting on (for example, a specific heading or page number).

Summary of changes

We periodically update our test report with new information and experiences. If the edition you are currently reading is more than a few months old, you may want to check whether a newer edition is available (see “How to find the zSeries Platform Test Report for z/OS and Linux Virtual Servers” on page xx).

This information below summarizes the changes that we have made to this document.

Summary of changes
for SA22-7997-02
December 2005

This document contains information previously presented in SA22-7997-01.

New information

- "Migrating WebSphere Application Server for z/OS Version 5.1 to Version 6" on page 259
- "Failover Testing for JDBC using the Sysplex Distributor" on page 261
- "Utilizing memory-to-memory replication" on page 261
- "Migrating to CICS Transaction Gateway Connector V6.0" on page 262
- "Migrating to IMS Connector for Java V9.1.0.1" on page 263
- "Using the LDAP User Registry for WebSphere Application Server for z/OS administration console authentication" on page 264
- "EIM Java API" on page 285
- "EIM C/C++ APIs – APF Authorization Alternative" on page 287
- "eimadmin Utility -U Flag" on page 288
- "EIM C/C++ APIs - Auditing" on page 289
- Chapter 22, "Migrating Linux Virtual Servers from the 2.4 to 2.6 Kernel," on page 341
- Appendix B, "Some of our RMF reports," on page 451

Changed information

- Our sysplex hardware configuration

This document contains terminology, maintenance, and editorial changes, including changes to improve consistency and retrievability. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

References to OpenEdition have been replaced with z/OS UNIX System Service or z/OS UNIX.

Summary of changes
SA22-7997-01
June 2005

This document contains information previously presented in SA22-7997-00.

New information

- "CFCC Dispatcher Rewrite testing" on page 9
- "Exploiting 64k cylinder logical volumes" on page 11
- "Testing greater than 16 CPU Support" on page 12
- "Our Integrated Cryptographic Service Facility (ICSF) configuration" on page 17
- "On/Off Capacity On Demand Testing" on page 13
- "z800 Concurrent upgrade testing" on page 13
- Chapter 5, "Migrating to DB2 Version 8," on page 53
- Chapter 6, "Migrating to IMS Version 9," on page 81
- "Migrating to System Automation for OS/390 Version 2 Release 3" on page 97
- Chapter 9, "Testing SPE Console Restructure (APAR OA09229)," on page 105
- "Issuing the su command and changing TSO identity" on page 189
- "Removing additional diagnostic data collection from OMVS CTRACE LOCK processing" on page 190
- "Setting up SSL client and server authentication between z/OS LDAP V1R6 server/client and Sun ONE Directory Server 5.2 server/client" on page 206

- “Setting up SSL client and server authentication between z/OS LDAP V1R6 server/client and IBM Tivoli Directory Server 5.2 server/client” on page 212
- “Migrating to DB2 V8” on page 224
- “FTP with Kerberos” on page 234
- “Working with Kerberos principals in RACF” on page 237
- “About our z/OS V1R6 test environment running WebSphere Application Server” on page 255
- “Migrating WebSphere Application Server for z/OS JDBC from DB2 V7 to DB2 V8” on page 260
- “Using DB2 UDB JCC Connectors” on page 260
- “Enabling Global Security and SSL on WebSphere Application Server for z/OS” on page 265
- “Using the WebSphere Application Server for z/OS 5.x plug-in for HTTP Server and Sysplex Distributor with our WebSphere Application Server for z/OS J2EE Servers” on page 266
- Chapter 19, “About our Linux virtual server environment,” on page 299
- Chapter 20, “Cloning Linux images on z/VM 5.1,” on page 301
- Chapter 21, “Establishing security in a heterogeneous Linux server environment,” on page 307
- Chapter 23, “Future Linux on zSeries projects,” on page 447
- Appendix B, “Some of our RMF reports,” on page 451

Changed information

- Our sysplex hardware configuration
- “WebSphere MQ workloads” on page 21
- “Websphere Business Integration Message Broker” on page 22
- “Migrating to System Automation for OS/390 Version 2 Release 3” on page 97

This document contains terminology, maintenance, and editorial changes, including changes to improve consistency and retrievability. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Summary of changes
for SA22-7997-00
September 2004

This document contains information previously presented in SA22-7663-11.

New information

- Enabling NFS recovery for system outages
- Automount enhancement for HFS to zSeries file system (zFS) migration
- Using multipliers with BPXPRMxx parameters
- Using the superkill command
- Added an ipV6 environment equivalent to our ipV4 environment. V1R6 now supports OSPF V3 for ipV6 and ipV6 support for DVIPA and Sysplex Distributor.
- Using wildcard characters in the automove system list (SYSLIST)
- Using the clear and uptime shell commands
- Enhanced latch contention detection
- Using distributed BRLM

- Using ISHELL enhancements
- zFS modify console command
- Using gskkyman support for storing a PKCS #7 file with a chain of certificates
- LDAP migration to z/OS V1R6
- Setting up a peer-to-peer replication network between an IBM Tivoli® Directory Server 5.2 and a z/OS LDAP Server
- Using LDAP DB2® restart/recovery function
- Using LDAP alias support
- Using the enhanced LDAP configuration utility (LDAPCNF)
- Using LDAP change logging with TDBM
- NAS accessing SYS1.SIEALNKE
- EIM enhancements in z/OS V1R6
- Updates to our z/OS V1R5 test environment running WebSphere® Application Server
- Migrating to WebSphere for z/OS V5.*X* on z/OS V1R6

Changed information

- Our sysplex hardware configuration

This document contains terminology, maintenance, and editorial changes, including changes to improve consistency and retrievability. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Summary of changes
SA22-7663-11
June 2004

This document contains information previously presented in SA22-7663-10.

New information

- XCF REALLOCATE processing
- Using zSeries Application Assist Processors (zAAPs)
- IBM Health Checker for z/OS and Sysplex Version 3
- Migrating to WebSphere Business Integration Message Broker Version 5.0
- Implementing shared channels in a distributed-queuing management (DQM) environment
- Setting up a Kerberos peer trust relationship between z/OS and Windows 2000
- Using the z/OS LDAP client with the Windows 2000 Active Directory service
- Using LDAP with Kerberos authentication

Changed information

- Our sysplex hardware configuration

This document contains terminology, maintenance, and editorial changes, including changes to improve consistency and retrievability. Technical changes or additions to the text and illustrations are indicated by a vertical line to the left of the change.

Summary of changes
for SA22-7663-10
March 2004

This document contains information previously presented in SA22-7663-09.

New information

- Migrating to z/OS V1R5 and z/OS.e V1R5
- Using DFSMS enhanced data integrity for sequential data sets
- Implementing the common service layer (CSL) and single point of control (SPOC) in IMS™ V8
- Using System Automation OS/390 (SA OS/390) V2R2
- Enhancements in z/OS UNIX in z/OS V1R5, including:
  - Remounting a shared HFS
  - Mounting file systems using symbolic links
  - Creating directories during z/OS UNIX initialization
  - Temporary file system (TFS) enhancements
- Setting up the LDAP server for RACF® change logging
- Support for additional bind types for EIM authentication
- Using WebSphere MQ shared queues and coupling facility structures
- Migrating to WebSphere for z/OS V5.0

Changed information

- Overview of our LDAP Server configuration

Deleted information

- System-managed coupling facility structure duplexing
- Verifying use of the cryptographic hardware
- Migrating to IMS Version 8 Release 1
- Using z/OS DFSMStvs
- Setting up the CICSPlex SM Web User Interface
- Using IBM HTTP Server
- LDAP Server enhancements in z/OS V1R4
- Using IMS Connect for z/OS Version 1.2
- Implementing the System SSL started task
- Using PKI Services
- Using WebSphere Studio Workload Simulator in z/OS Integration Test

Although the above information has been deleted from this edition, it continues to be available in our December 2003 edition.

Part 1. Parallel Sysplex

The above chapters describe the Parallel Sysplex® aspects of our computing environment.

Chapter 1. About our Parallel Sysplex environment

In this chapter we describe our Parallel Sysplex computing environment, including information about our hardware and software configurations and descriptions of the workloads we run.

Note: Throughout this document, when you see the term ***sysplex***, understand it to mean a sysplex with a coupling facility, which is a ***Parallel Sysplex.***

Overview of our Parallel Sysplex environment

We currently run a 13-member Parallel Sysplex that consists of the following:

- Four central processor complexes (CPCs) running z/OS in 13 logical partitions (LPs).

  The CPCs consist of the following machine types:
  - One IBM @server System z9
  - One IBM @server zSeries 990 (z990) processor
  - One IBM @server zSeries 900 (z900) processor
  - One IBM @server zSeries 890 (z890) processor

  The z/OS images consist of the following:
  - Eight production z/OS systems
  - One production z/OS.e system
  - Three test z/OS systems
  - One z/OS system to run TPNS (Our December 1998 edition explains why we run TPNS on a non-production system.)
- Three coupling facilities:
  - One failure-independent coupling facility that runs in a LP on a standalone CPC
  - Two non-failure-independent coupling facilities that run in LPs on two of the CPCs that host other z/OS images in the sysplex
- Two Sysplex Timer® external time references (ETRs)
- Other I/O devices, including ESCON- and FICON-attached DASD and tape drives.

The remainder of this chapter describes all of the above in more detail.

Outside of the Parallel Sysplex itself, we also have ten LPs in which we run the following:

- Two native Linux images
- Eight z/VM images that host multiple Linux guest images running in virtual machines

Our Parallel Sysplex hardware configuration

This section provides an overview of our Parallel Sysplex hardware configuration as well as other details about the hardware components in our operating environment.

Overview of our hardware configuration

Figure 1 on page 6 is a high-level, conceptual view of our Parallel Sysplex hardware configuration. In the figure, broad arrows indicate general connectivity

between processors, coupling facilities, Sysplex Timers, and other I/O devices; they do not depict actual point-to-point connections.

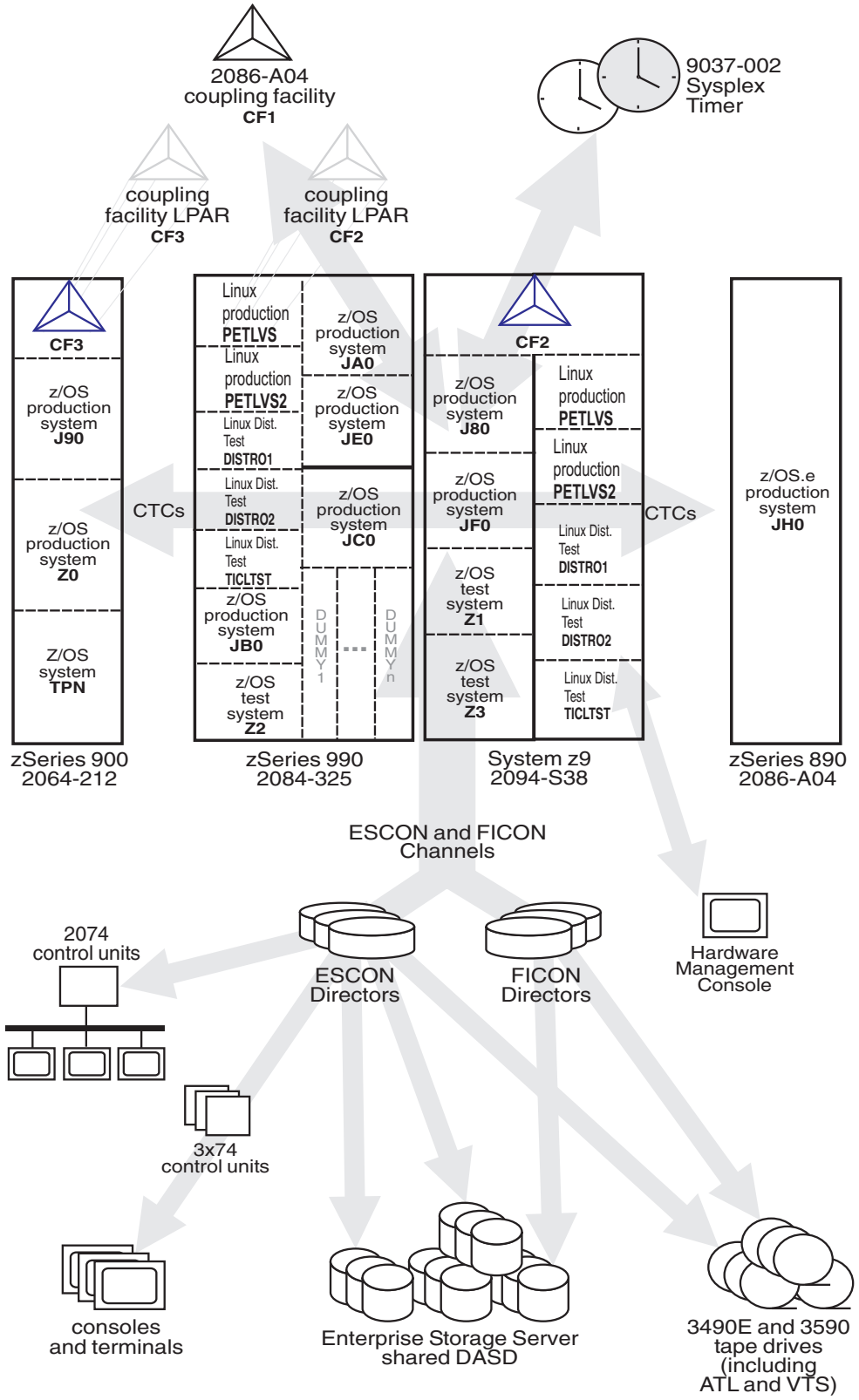


Figure 1. Our sysplex hardware configuration

Hardware configuration details

The figures and tables in this section provide additional details about the mainframe servers, coupling facilities, and other sysplex hardware shown in Figure 1 on page 6.

Mainframe server details

Table 2 provides information about the mainframe servers in our sysplex:

Table 2. Our mainframe servers

Server model (Machine type-model)	CPCs CPs	Mode LPs	HSA	Storage: Central Expanded	LCSS	System name, usage Virtual CPs (static, managed) Initial LPAR weight
IBM System @server z9 Model 104 (2094-S38)	1 CPC 38 CPs	LPAR 9 LPs	2112M	65536M	0-	**J80**, z/OS production system 30 shared CPs, 2 shared zAAPs
				32768M	0	**JF0**, z/OS production system 16 shared CPs, 2 SHARED zAAPS weight of 285
				16384M	0	**Z1**, z/OS test system 10 shared CPs, 2 shared zAAPs weight of 145
				12288M	0	**Z3**, z/OS test system 8 shared CPs, 2 shared zAAPs
				18432M	1	**PETLVS**, Linux production system 4 shared CPs weight of 10
				4096M	1	**PETLVS2**, Linux production system 4 shared CPs weight of 10
				3072M	1	**DISTR01**, Linux distribution test system 2 Shared IFLs (Integrated Facility for Linux) weight of 10
				2048M	1	**DISTR02**, Linux distribution test system 2 Shared IFLs weight of 10
				1024M	1	**TICLTST**, Linux distribution test 1 shared IFL weight of 10
IBM @server zSeries 890 Model A04 (2086-A04) (see note 2 below)	1 CPC 4 CPs	LPAR mode 1 LP	1344M	14336M		**JH0**, z/OS.e production system 3 shared CPs, 1 shared zAAP weight of 400
IBM @server zSeries 900 Model 212 (2064-212) (see note 1 below)	1 CPC 16 CPs (4 ICF)	LPAR mode 4 LPs (1 LP is a coupling facility)	256M	10240M		**J90**, z/OS production system 8 shared CPs weight of 285
				9216M		**Z0**, z/OS production system 8 shared CPs weight of 285
				6144M		**TPN**, z/OS system for TPNS 12 shared CPs

Table 2. Our mainframe servers (continued)

Server model (Machine type-model)	CPCs CPs	Mode LPs	HSA	Storage: Central Expanded	LCSS	System name, usage Virtual CPs (static, managed) Initial LPAR weight
IBM @server zSeries 990 Model 325 (2084-325)	1 CPC 32 CPs 2 IFL, 2 zAAP)	LPAR mode 20 LPs[3]	See note 4.	31G	2	**JA0**, z/OS production system 16 shared CPs, 2 shared zAAPs
				31G	0	**JB0**, z/OS production system 16 shared CPs, 2 shared zAAPs
				31G	0	**JC0**, z/OS production system 16 shared CPs, 2 shared zAAPs
				31G	2	**JE0**, z/OS production system 16 shared CPs, 2 shared zAAPs
				4096M	0	**Z2**, z/OS test system 16 shared CPs, 2 shared zAAPs
				18432M	1	**PETLVS**, Linux production system 4 shared CPs weight of 10
				4096M	1	**PETLVS2**, Linux production system 4 shared CPs weight of 10
				3072M	1	**DISTR01**, Linux distribution test system 2 shared IFLs weight of 10
				2048M	1	**DISTR02**, Linux distribution test system 2 shared IFLs weight of 10
				1024M	1	**TICLTST**, Linux distribution test 1 shared IFL weight of 10

Notes:

1. For our z900 server, we applied the IYP version of IOCP 1.1.0, which is available with the fix for APAR OW46633 (PTF UW90695). We also applied the fix for HCD APAR OW43131 (PTFs UW99341, UW99342, UW99343, UW99344, UW99345) and the fix for HCM APAR IR43534 (PTFs UR90329 and UR90330).
2. Since z/OS.e is engine licensed, customers must define the MSU capacity of a z/OS.e LP to be on an engine boundary. To do this, IBM recommends using the **Defined capacity** field in the activation profile on the z800 hardware management console (HMC). You must also send to IBM the Transmit System Availability Data (TSAD) for your z800 server, either by using the IBM Remote Support Facility (RSF) on the z800 or by mailing a diskette or DVD cartridge to IBM. For details, see *z/OS and z/OS.e Planning for Installation*, GA22-7504, and *z800 Software Pricing Configuration Technical Paper*, GM13-0121, available from the zSeries Library at www.ibm.com/servers/eserver/zseries/library/literature/.
3. We added several “dummy” logical partitions on our z990 server—LPs that are defined but not activated—in order to force the number of LPs to be greater than 15. Currently, you can define up to 30 LPs on the z990.
4. On the z990 and z890 support elements (SE), you no longer specify an HSA expansion percentage in the activation profile. Instead, the HSA size is now calculated from IOCP MAXDEV value.

Coupling facility details

Table 3 provides information about the coupling facilities in our sysplex. Table 4 further illustrates the coupling facility channel distribution as described in Table 3.

Table 3. Our coupling facilities

Coupling facility name	Model CPCs and CPs CFLEVEL (CFCC level) Controlled by	Storage: Central Expanded
CF1	zSeries 890 Model A04 (2086-A04) stand-alone coupling facility 1 CPC with 4 CPs CFLEVEL=14(CFCC Release 14.00, Service Level 00.17) Controlled by the HMC	6G
CF2	Coupling facility LP on a System z9 (2094-S38) 3 dedicated ICF CPs CFLEVEL=14(CFCC Release 14.00, Service Level 00.17) Controlled by the HMC	6G
CF3	Coupling facility LP on a zSeries 900 Model 212 (2064-212) 4 dedicated ICF CPs CFLEVEL=13 (CFCC Release 13.00, Service Level 04.08) Controlled by the HMC	6G

Table 4 illustrates our coupling facility channel configuration.

Table 4. Our coupling facility channel configuration.

Coupling Facility Channel Connections				
		Coupling Facility (CF) Images		
		2086-A04	2094-S38	2064-212
		CF1	CF2	CF3
z/OS and CF Images				
2084-325 JA0, JE0, JC0, JB0, Z2		1 CBP 3 CFP	1 CBP 3 CFP	4 CBP 4 CFP
2086-A04 JH0		1 CBP 4 CFP	1 CBP 2 CFP	1 CBP 2 CFP
2064-212 Z0, J90, TPN, CF3		6 CFP	2 CBP *	4 ICP
2094-S38 J80, JF0, Z1, Z3, CF2		4 CFP	4 ICP	2 CBP *
			* = Same Links	

CFCC Dispatcher Rewrite testing: CFCC Level 14 was installed on the z/990 and the z/890. The major change in CFLevel 14 was the Dispatcher Rewrite. The Dispatcher Rewrite provides the following enhancements:

- It improves efficiency of dispatching CF requests:
  - Incoming and suspended requests are processed in the order they were issued.
  - Ready work is put on a separate queue (rather than remaining on the suspend queue).
  - Latches are processed in the order they were issued.

  - Dispatching and completion of work in progress is favored over executing incoming work.
- It refines the calculation of CF utilization to eliminate time spent searching for work (as opposed to executing work)

One of the things we tested was the migration of some of the CFs to the new level and a mixture of different of CFLEVELs. Table 5 shows some of the different configurations we tested.

Table 5. CFs and CFLEVELS.

CF name	End of Duplex testing	Initial installation	Final installation
CF1	9672 - R06 CFLEVEL 11 7 CPs	9672 - R06 CFLEVEL 11 7 CPs	2086 - A04 CFLEVEL 14 4 CPs
CF2	2084 CFLEVEL 13 3 ICFs	2084 CFLEVEL 14 3 ICFs	2084 CFLEVEL 14 3 ICFs
CF3	2064 CFLEVEL 13 4 ICFs	2064 CFLEVEL 13 4 ICFs	2064 CFLEVEL 13 4 ICFs

As part of our migration to the new CFLevels, we downloaded and ran the recommended CF sizer program, found at:

`http://www.ibm.com/servers/eserver/zseries/cfsizer/altsize.html`

The program ran against all structures in our CFRM policy. We strongly recommend that you visit this website if you are migrating to a higher level of CFCC. We paid particular attention to the structures running on CFCC level 14 coupling facilities, although in our case, we didn't have to increase any structure sizes.

We ran several stress tests in the various CFCC environments and compared the coupling facility performance data against the baseline we had previously taken to make sure we saw no degradation in performance.

The Duplexing enhancements in CFCC level 14 can only be realized if both copies of a duplexed structure reside on CFs with CFLevel 14 installed. In the final configuration, when we had CFLevel 14 on both CF1 and CF2, we observed a noticeable improvement in our CF to CF service times. We also noted a substantial improvement in the response times of duplexed structures when we replaced the 9672-R06 with the 2086-A04.

Other sysplex hardware details

Table 6 on page 11 highlights information about the other hardware components in our sysplex:

Table 6. Other sysplex hardware configuration details

Hardware element	Model or type	Additional information
External Time Reference (ETR)	Sysplex Timer (9037-002 with feature code 4048)	We use the Sysplex Timer with the Expanded Availability feature, which provides two 9037 control units connected with fiber optic links. We don't have any Sysplex Timer logical offsets defined for any of the LPs in our sysplex.
Channel subsystem	CTC communications connections	We have CTC connections from each system to every other system. We now use both FICON® and ESCON® CTC channels on all of our CPCs. **Note:** All of our z/OS images use both CTCs and coupling facility structures to communicate. This is strictly optional. You might choose to run with structures only, for ease of systems management. We use both structures and CTCs because it allows us to test more code paths. Under some circumstances, XCF signalling using CTCs is faster than using structures. See *S/390 Parallel Sysplex Performance* for a comparison.
	Coupling facility channels	We use a combination of ISC, ICB, and IC coupling facility channels in peer mode. We use MIF to logically share coupling facility channels among the logical partitions on a CPC. We define at least two paths from every system image to each coupling facility, and from every coupling facility to each of the other coupling facilities.
	ESCON channels	We use ESCON channels and ESCON Directors for our I/O connectivity. Our connections are "any-to-any", which means every system can get to every device, including tape. (We do not use any parallel channels.)
	FICON channels	We have FICON native (FC) mode channels from all of our CPCs to our Enterprise Storage Servers and our 3590 tape drives through native FICON switches. (See *FICON Native Implementation and Reference Guide*, SG24-6266, for information about how to set up this and other native FICON configurations.) We maintain both ESCON and FICON paths to the Enterprise Storage Servers and 3590 tape drives for testing flexibility and backup. Note that FICON channels do not currently support dynamic channel path management. We have also implemented FICON CTCs, as described in the IBM Redpaper *FICON CTC Implementation* available on the IBM Redbooks™ Web site.
DASD	Enterprise Storage Server® (ESS, 2105-F20, 800, DS6000, DS8000)	All volumes shared by all systems; about 90% of our data is SMS-managed. We currently have four IBM TotalStorage® Enterprise Storage Servers, of which two are FICON only, and two that are attached with both ESCON and FICON. **Note:** Do not run with both ESCON and FICON channel paths from the same CPC to a control unit. We have some CPCs that are ESCON-connected and some that are FICON-connected.
Tape	3490E tape drives	16 IBM 3490 Magnetic Tape Subsystem Enhanced Capability (3490E) tape drives that can be connected to any system.
	3590 tape drives	4 IBM TotalStorage Enterprise Tape System 3590 tape drives that can be connected to any system.
Automated tape library (ATL)	3495 Model L40 with 16 additional 3490E tape drives and 12 3590 tape drives	All tape drives are accessible from all systems.
Virtual Tape Server (VTS)	3494 Model L10 with 32 virtual 3490E tape drives and 12 ESCON- and FICON-attached 3590 tape drives	All tape drives are accessible from all systems.

Exploiting 64k cylinder logical volumes

To fulfill our customers requirements for more space, more UCBs and our desire to simplify system administration with fewer devices, we implemented 3390 LVS (large volume support, greater then 32K cylinders volumes) on our IBM DS6000 and IBM

DS8000. The first thing we did was to ensure that our ESS licensed internal code (LIC) and our z/OS system software supported this enhancement.

Our large volumes are SMS managed and were initialized with larger VTOCs, as follows:

```
//ICKDSF      EXEC PGM=ICKDSF
//SYSPRINT   DD SYSOUT=*
//SYSABEND DD SYSOUT=*
//SYSIN           DD *
  INIT UNITADDRESS(6D00) DEVICETYPE(3390) PURGE NORECLAIM NOCHECK SG -
               NOVERIFY VOLID(LVS001) VTOC(2,0,120) INDEX(1,0,15)
```

We exploit dynamic Parallel Access Volume (PAV) and on average have a 3:1 ratio (3alias' to 1 base). For our large volumes we defined 12 aliases per base in the ESS SPECIALIST.

We use DFSMShsm to manage space and availability for the data on these volumes, and on all our DASD.

Applications in the zSeries Integration Test environment are exploiting these larger volumes. The applications include: HFS, zFS, DB2, CICS®, IMS, JES, HSM ML1, SVC dumps as well as stand-alone dumps (SAD).

Testing greater than 16 CPU Support

With the combination of z/OS V1R6, z990 servers, and the recommended APARs listed below, customers can now define a single z/OS LPAR image with up to 32 CPs. This function provides the customer more flexibility in choosing the way they want to grow:

- Horizontally with Parallel Sysplex, or
- Vertically using the greater than 16 CP support.

This function is released in two phases:

1. The general availability of z/OS V1R6 in combination with the z990 servers, support up to 24 processors.
2. Later in 2005, this function will be extended to support up to 32 processors.

We installed the following APARs before starting our test:

- OA08993
- OA05907
- OA07200
- OA07857
- OA09340
- OA09688

Our testing occurred in two phases:

1. **Phase 1:** One LPAR, dedicated CPs.

   On a z990 server, we defined only one z/OS LPAR, with dedicated CPs. On this image, we ran a high stress level of our IMS, CICS, DB2, MQ, OMVS and WebSphere workloads with a constant number of transactions. We started with 16 CPs online, and then varied CPs online in groups of 8, up to 32 total CPs, while maintaining the same level of transactions. We observed the CPU utilization value and found that it scaled as expected.
2. **Phase 2:** Two LPARs, shared CPs

For this phase we defined two z/OS LPARs, each with 32 shared CPs. On one LPAR we ran the high stress IMS, CICS, DB2, MQ, OMVS and WebSphere workloads. On the other LPAR we ran low priority workloads (batch and OMVS). The initial weights for the two LPARs were set differently according to the workloads (one higher and one lower).

On the high stress LPAR, we did a staging run where we gradually increased the number of transactions that the workloads were running. We started at low levels and slowly increased them until the LPAR was using more than 80% of the total CPU resource. This was done in order to see how WLM and Intelligent Resource Manager (IRD) would manage processor resources. When the high stress LPAR reached 80% CPU utilization, we observed that processors were taken away from the low priority LPAR and that the weights of both LPARs partitions were adjusted accordingly. The number of processors on the high stress LPAR remained at 32 as expected (the maximum allowed).

Here are examples of the RMF™ Monitor III screens that show the number of processors:

```
HARDCOPY     RMF V1R5   CPC Capacity                  Line 1
 Command ===>
0Samples: 120     System: J80   Date: 03/11/05  Time: 12.12.00  Range: 120
0Partition:   J80        2084 Model 332
 CPC Capacity:    1365   Weight % of Max: ****       4h MSU Average:   163
 Image Capacity:  1365   WLM Capping %:   ****       4h MSU Maximum:   234
0Partition  --- MSU ---  Cap  Proc    Logical Util %   - Physical Util % -
              Def   Act  Def   Num    Effect   Total   LPAR  Effect  Total
0*CP                                                    0.9    25.5   26.5
 J80            0   330  NO   32.0      23.8    24.1    0.3    23.8   24.1
 Z1             0    24  NO   32.0       1.7     1.8    0.0     1.7    1.8
 PHYSICAL                                               0.6            0.6
```

CPU Utilization reached 80% at J80:

```
Time gap from 03/11/05 12.27.00 to 03/11/05 12.27.40.
Samples: 60      System: J80   Date: 03/11/05  Time: 12.26.00  Range: 60
Partition:   J80        2084 Model 332
CPC Capacity:    1365   Weight % of Max: ****       4h MSU Average:   192
Image Capacity:  1365   WLM Capping %:   ****       4h MSU Maximum:  1009
Partition  --- MSU ---  Cap  Proc    Logical Util %   - Physical Util % -
             Def   Act  Def   Num    Effect   Total   LPAR  Effect  Total
*CP                                                     0.8    94.5   95.3
J80            0  1139  NO   31.0      85.5    86.1    0.5    82.9   83.4
Z1             0   159  NO   23.0      16.2    16.2    0.0    11.6   11.7
PHYSICAL                                                0.3            0.3
```

On/Off Capacity On Demand Testing

As part of IBM's On Demand strategy we tested On/Off Capacity On Demand with the following scenarios:

- z800 Concurrent upgrade testing
- z890 Capacity On Demand testing

z800 Concurrent upgrade testing: We converted our 2066 processor from a model 004 to a model A02. This model conversion was disruptive as you can not concurrently downgrade a z800 processor. At the time of this test we only had one LPAR (J80) on our z800. With all our standard workloads running we concurrently upgraded from a model A02 to a model 002, then to a model 003 and finally back to a model 004. We observed no disruption to our workloads. We did observe an expected decrease in CP utilization while at model types A02, 002, and 003. See Appendix B, "Some of our RMF reports," on page 451 for our RMF screen shots.

z890 Capacity on Demand Testing: With all our normal workloads running, we concurrently downgraded our 2086 processor from a model 370 to a model 360. At the time of this test we had two LPARs on our 2086(JG0,JH0). Each LPAR had two general purpose processors and one zAAP processor configured. This downgrade decreased our MSU value from 158 to 91. This drop in MSU capacity only affected our general purpose processors, not our zAAP processors. We ran our 2086 as a model 360 for about two months until we concurrently upgraded our 2086 back to a model 370. During the duration of this test we had no disruptions or problems related to the concurrent downgrade or upgrade.

Our Parallel Sysplex software configuration

We run the z/OS operating system along with the following software products:

- CICS Transaction Server (CICS TS) V2R3
- IMS V8.1 (and its associated IRLM)
- DB2 UDB for z/OS and OS/390 V7 (and its associated IRLM)
- WebSphere for z/OS V5.1.0
- WebSphere MQ for z/OS V5.3.1
- WebSphere Business Integration Message Broker V5.0

We also run z/OS.e in one partition on our z890 server. z/OS.e supports next-generation e-business workloads; it does not support traditional workloads, such as CICS and IMS. However, z/OS.e uses the same code base as z/OS and invokes an operating environment that is identical to z/OS in all aspects of service, management, reporting, and zSeries functionality. See *z/OS.e Overview*, GA22-7869, for more information.

Note that we currently only run IBM software in our sysplex.

A word about dynamic enablement: As you will see when you read *z/OS and z/OS.e Planning for Installation*, z/OS is made up of base elements and optional features. Certain elements and features of z/OS support something called *dynamic enablement*. When placing your order, if you indicate you want to use one or more of these, IBM ships you a tailored IFAPRDxx parmlib member with those elements or features enabled. See *z/OS and z/OS.e Planning for Installation* and *z/OS MVS Product Management* for more information about dynamic enablement.

A note about IBM License Manager

In z/OS V1R1, IBM introduced a new base element called IBM License Manager (ILM). IBM has since decided not to deliver the IBM License Manager tool for zSeries. Therefore, when you run z/OS on a z800, z900, or z990 server, you must ensure that the ILMMODE parameter in IEASYS*xx* is set to `ILMMODE=NONE`.

Overview of our software configuration

Figure 2 on page 15 shows a high-level view of our sysplex software configuration.

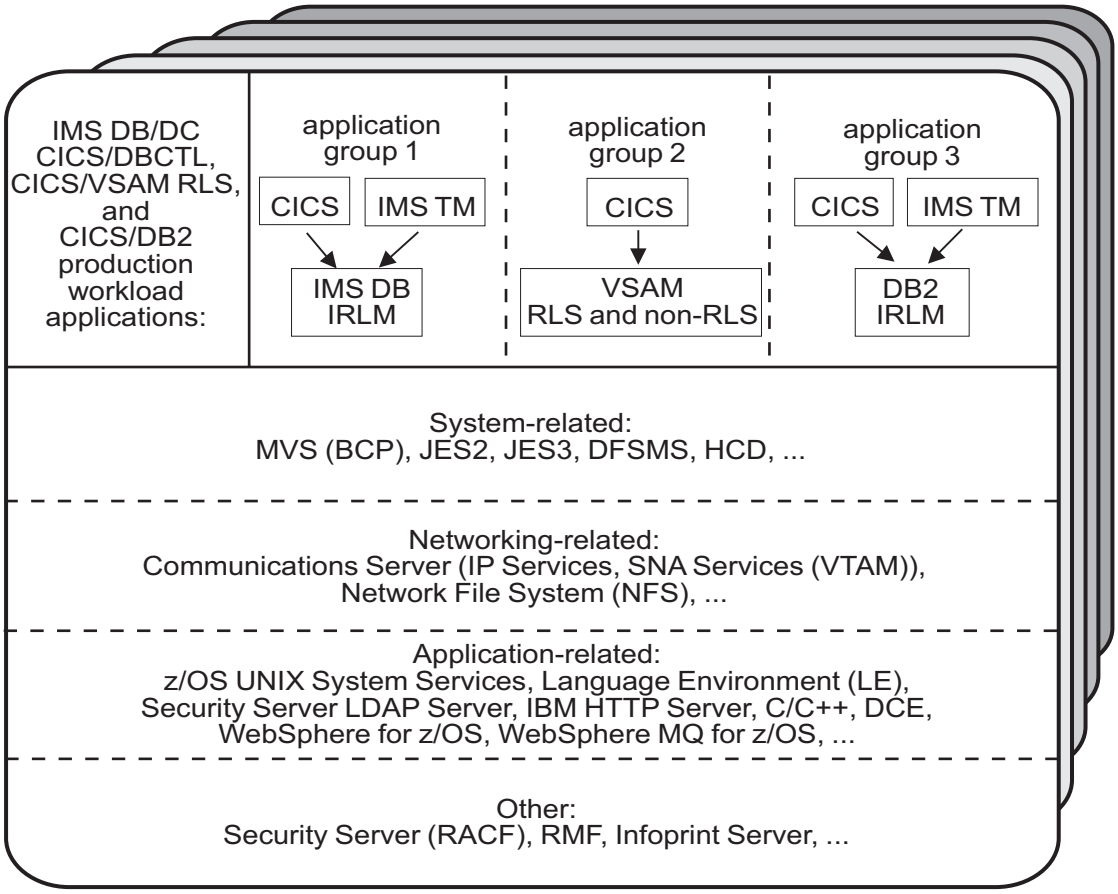


Figure 2. Our sysplex software configuration

We run three separate application groups in one sysplex and each application group spans multiple systems in the sysplex. Table 7 provides an overview of the types of transaction management, data management, and serialization management that each application group uses.

Table 7. Our production OLTP application groups

Application groups	Transaction management	Data management	Serialization management
Group 1	• CICS • IMS TM	IMS DB	IRLM
Group 2	• CICS	VSAM	VSAM record-level sharing (RLS)
Group 3	• CICS • IMS TM	DB2	IRLM

Our December 1995 edition describes in detail how a transaction is processed in the sysplex using application group 3 as an example. In the example, the transaction writes to both IMS and DB2 databases and is still valid for illustrative purposes, even though our application group 3 is no longer set up that way. For more information about the workloads that we currently run in each of our application groups, see “Database product OLTP workloads” on page 24.

About our naming conventions

We designed the naming convention for our CICS regions so that the names relate to the application groups and system names that the regions belong to. This is important because:

- Relating a CICS region name to its application groups means we can use wildcards to retrieve information about, or perform other tasks in relation to, a particular application group.
- Relating CICS region names to their respective z/OS system names means that subsystem job names also relate to the system names, which makes operations easier. This also makes using automatic restart management easier for us — we can direct where we want a restart to occur, and we know how to recover when the failed system is back online.

Our CICS regions have names of the form CICS*grsi* where:

- *g* represents the application group, and can be either 1, 2, or 3
- *r* represents the CICS region type, and can be either A for AORs, F for FORs, T for TORs, or W for WORs (Web server regions)
- *s* represents the system name, and can be 0 for system Z0, 8 for J80, 9 for J90, and A for JA0 through G for JG0
- *i* represents the instance of the region and can be A, B, or C (we have 3 AORs in each application group on each system)

For example, the CICS region named CICS2A0A would be the first group 2 AOR on system Z0.

Our IMS subsystem jobnames also correspond to their z/OS system name. They take the form IMS*s* where *s* represents the system name, as explained above for the CICS regions.

Our networking configuration

For a detailed description of our networking configuration, see Chapter 11, “About our networking and application enablement environment,” on page 119.

Our VTAM configuration

Figure 3 on page 17 illustrates our current VTAM® configuration.

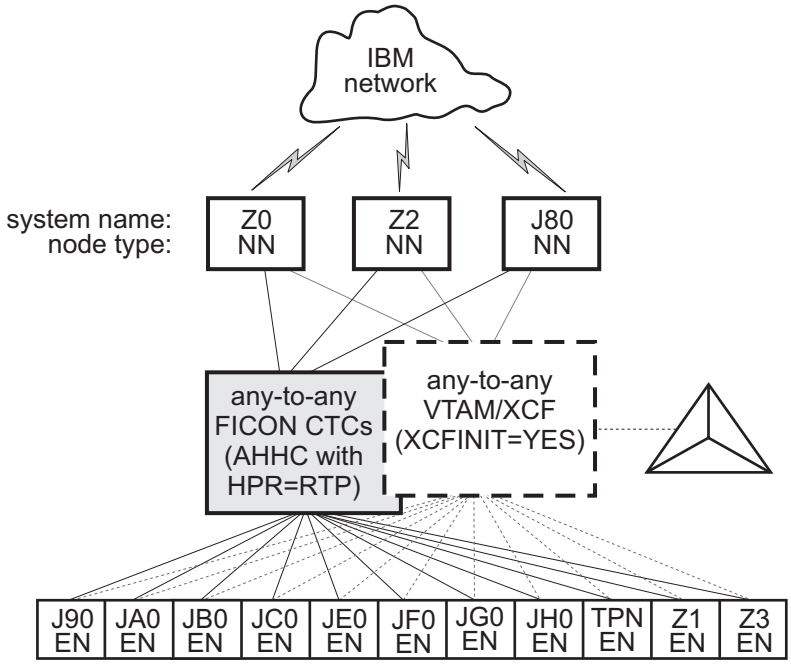


Figure 3. Our VTAM configuration

TPNS runs on our system TPN and routes CICS logons to any of the other systems in the sysplex (except JH0, which runs z/OS.e and does not support CICS).

Our VTAM configuration is a pure any-to-any AHHC. Systems Z0, Z2, and J80 are the network nodes (NNs) and the remaining systems are end nodes (ENs).

We also have any-to-any communication using XCF signalling, where XCF can use either CTCs, coupling facility structures, or both. This is called dynamic definition of VTAM-to-VTAM connections.

We are configured to use both AHHC and XCF signalling for test purposes.

Our security configuration

Our security configuration consists of the following:

- "Our Integrated Cryptographic Service Facility (ICSF) configuration"
- "RACF Security Server mixed case password support" on page 18

Our Integrated Cryptographic Service Facility (ICSF) configuration

z/OS Integrated Cryptographic Service Facility (ICSF) is a software element of z/OS that works with the hardware cryptographic features and the Security Server (RACF) to provide secure, high-speed cryptographic services in the z/OS environment. ICSF provides the application programming interfaces by which applications request the cryptographic services. The cryptographic feature is secure, high-speed hardware that performs the actual cryptographic functions.

The available cryptographic hardware features are dependent on the server.

In our sysplex, we are currently running ICSF, FMID HCR7730, on top of z/OS V1R7. Because we have many types of servers in our environment, we run with various cryptographic hardware features. Following is a list of cryptographic hardware features we currently have:

- z9:
  - Crypto Express2 Accelerator (CEX2A)
  - Crypto Express2 Coprocessor (CEX2C)
- Z990:
  - PCI Cryptographic Accelerator (PCICA)
  - PCI X Cryptographic Coprocessor (PCIXCC)
  - Crypto Express2 Coprocessor (CEX2C)
- Z890:
  - Crypto Express2 Coprocessor (CEX2C)
- Z900:
  - Cryptographic Coprocessor Feature (CCF)
  - PCI Cryptographic Accelerator (PCICA)

Since our goal is to run a customer-like environment, we have various products running customer-like scenarios using SSL. SSL will in turn use ICSF and any of the Cryptographic Features that we have, as needed. The products that use SSL in our environment are z/OS WebSphere Application Server, FTP, HTTP, and CICS. We also have an ICSF specific workload that runs 16 hours a day, 7 days a week and exercises the cryptographic services available through the ICSF API.

RACF Security Server mixed case password support

With the release of V1R7, RACF Security Server now supports mixed case passwords. The maximum length of the password remains at eight(8) characters. To turn on mixed case support, a MVS security administrator would enter the following command:

```
SETROPTS PASSWORD(MIXED)
```

to turn it off, the command is

```
SETROPTS PASSWORD(NOMIXED)
```

You should only turn this on if you really need this support and you are sure that all of your applications support mixed case passwords. If for some reason you have to turn mixed case support off, all passwords that were created during the time period that support was on will have to be reset.

After implementing MIXEDCASE, if a password is SET (through ADDUSER) without any lower-case characters, then RACF will not require exact case matching. If the user then changes their password to one without any lower-case characters, RACF still won't enforce exact case matching.

Once a user changes their password to include lower-case characters, RACF will enforce case matching.

Currently, the following CS/390 clients and servers now support mixed case passwords.

FTP
TN3270

POP
USS Telnet
TSO

Our workloads

We run a variety of workloads in our pseudo-production environment. Our workloads are similar to those that our customers use. In processing these workloads, we perform many of the same tasks as customer system programmers. Our goal, like yours, is to have our workloads up 24 hours a day, 7 days a week (24 x 7). We have workloads that exercise the sysplex, networking, and application enablement characteristics of our configuration.

Table 8 summarizes the workloads we run during our prime shift and off shift. We describe each workload in more detail below.

Table 8. Summary of our workloads

Shift	Base system workloads	Application enablement workloads	Networking workloads	Database product workloads
Prime shift	• Automatic tape switching • Batch pipes • JES2/JES3 printer simulators	• Enterprise Identity Mapping (EIM) • IBM HTTP Server • LDAP Server • z/OS UNIX Shelltest (rlogin/telnet) • z/OS UNIX Shelltest (TSO) • WebSphere Application Server for z/OS • WebSphere MQ • Websphere Business Integration Message Broker • MQ batch stress for shared queues • MQ-CICS bridge workload • MQ connection testing • MQ/DB2 bookstore application	• AutoWEB • FTP workloads • MMFACTS for NFS • NFSWL • Silk Test NFS video stream • TCP/IP CICS sockets • TN3270	• CICS DBCTL • CICS/DB2 • CICS/QMF online queries • CICS/RLS batch • CICS/RLS online • CICS/NRLS batch • CICS/NRLS online • DB2 Connect™ • DB2 online reorganization • DB2/RRS stored procedure • IMS AJS • IMS/DB2 • IMS full function • IMS SMQ fast path • QMF™ batch queries
Off shift	• Random batch • Automatic tape switching • JES2/JES3 printer simulators	• Enterprise Identity Mapping (EIM) • IBM HTTP Server • LDAP Server • z/OS UNIX Shelltest (rlogin/telnet) • z/OS UNIX Shelltest (TSO) • WebSphere Application Server for z/OS • WebSphere MQ • Websphere Business Integration Message Broker	• FTP workloads • Silk Test NFS video stream • MMFACTS for NFS	• CICS /DBCTL • CICS/DB2 • CICS/RLS batch • CICS RLS online • CICS/NRLS batch • CICS/NRLS online • DB2 DDF • DB2 utility • IMS/DB2 • IMS utility • MQ/DB2 bookstore application • QMF online queries

Base system workloads

We run the following z/OS base (MVS) workloads:

BatchPipes®: This is a multi-system batch workload using BatchPipes. It drives high CP utilization of the coupling facility.

Automatic tape switching: We run 2 batch workloads to exploit automatic tape switching and the ATS STAR tape sharing function. These workloads use the Virtual Tape Server and DFSMSrmm™, as described in our December 1998 edition, and consist of DSSCOPY jobs and DSSDUMP jobs. The DSSCOPY jobs copy particular data sets to tape, while the DSSDUMP jobs copy an entire DASD volume to tape.

Both workloads are set up to run under Tivoli Workload Scheduler (TWS, formerly called OPC) so that 3 to 5 job streams with hundreds of jobs are all running at the same time to all systems in the sysplex. With WLM-managed initiators, there are no system affinities, so any job can run on any system. In this way we truly exploit the capabilities of automatic tape switching.

Tivoli Workload Scheduler (TWS) EXIT 51 tip:

Due to changes in JES2 for z/OS V1R7, TWS has made a new EXIT called EXIT51. TWS will only support TWS 8.1 or higher for z/OS V1R7 users. If you have z/OS V1R7 and use TWS 8.1 or higher you will need to:

- compile and linkedit your usual JES2/TWS EXITS
- compile and linkedit the new EXIT51.

EQQXIT51 is provided in the SEQQSAMP Lib. You will also need to add the following to both your JES2 PARM and existing OPCAXIT7 statement:

```
LOAD(TWSXIT51)
EXIT(51) ROUTINES=TWSENT51,STATUS=ENABLED
```

Once EXIT51 was installed and enabled we found no problems with our normal use of TWS 8.1.

JES2/JES3 printer simulators: This workload uses the sample functional subsystem (FSS) and the FSS application (FSA) functions for JES2 and JES3 output processing.

Random batch: This workload is a collection of MVS test cases that invoke many of the functions (both old and new) provided by MVS.

Application enablement workloads

We run the following application enablement workloads:

Enterprise Identity Mapping (EIM)

This workload exercises the z/OS EIM client and z/OS EIM domain controller. It consists of a shell script running on a z/OS image that simulates a user running EIM transactions.

IBM HTTP Server

These workloads are driven from AIX/RISC workstations. They run against various HTTP server environments, including the following:

- HTTP scalable server
- HTTP standalone server
- Sysplex distributor routing to various HTTP servers

These workloads access the following:
- DB2 through net.data
- MVS data sets
- FastCGI programs
- Counters
- Static html pages
- Protected pages
- SSL transactions

LDAP Server
This workload consists of a script running on a Windows NT® workstation that simulates multiple users running a transaction that drives several different **ldapsearch** commands against the LDAP server on z/OS.

z/OS UNIX Shelltest (rlogin/telnet)
In this workload, users log in remotely from an RS/6000® workstation to the z/OS shell using either rlogin or telnet and then issue commands.

z/OS UNIX Shelltest (TSO)
In this workload, simulated users driven by the Teleprocessing Network Simulator (TPNS) logon to TSO/E and invoke the z/OS UNIX shell and issue various commands. The users perform tasks that simulate real z/OS UNIX users daily jobs, for example:
- Moving data between the HFS and MVS data sets.
- Compiling C programs.
- Running shell programs.

WebSphere Application Server for z/OS
We run a number of different Web application workloads in our test environment on z/OS. Generally, each workload drives HTTP requests to Web applications that consist of any combination of static content (such as HTML documents and images files), Java™ Servlets, JSP pages, and Enterprise JavaBeans™ (EJB) components. These Web applications use various connectors to access data in our DB2, CICS, or IMS subsystems.

Our Web application workloads currently include the following:
- J2EE applications (including persistent (CMP and BMP) and stateless session EJB components) that:
  - Access DB2 using JDBC
  - Access CICS using the CICS Common Client Interface (CCI)
  - Access IMS using the IMS Connector for Java CCI
- Non-J2EE applications (only static resources, Servlets, and JSP pages) that:
  - Access DB2 using JDBC
  - Access CICS using CICS CTG
  - Access IMS using IMS Connect
- Other variations of the above applications, including those that:
  - Access secure HTTPS connections using SSL
  - Perform basic mode authentication
  - Use HTTP session data
  - Use connection pooling

WebSphere MQ workloads
Our WebSphere MQ environment includes one WebSphere MQ for z/OS V5.3.1 queue manager on each system in the sysplex. We have two queue sharing groups: one with three queue managers and another with seven queue managers.

Our workloads test the following WebSphere MQ features:
- CICS Bridge
- Distributed queueing with APPC, SSL, and TCP/IP channels
- Large messages
- Shared queues
- Clustering
- Transaction coordination with RRS

We use the following methods to drive our workloads (not all workloads use each method):
- Batch jobs
- Web applications driven by WebSphere Studio Workload Simulator
- TPNS TSO users running Java programs via z/OS UNIX shell scripts

The batch-driven workloads that use WebSphere MQ for z/OS include the following:

MQ batch stress for non-shared queues: This workload runs on one system and stresses WebSphere MQ for z/OS by issuing MQI calls. These calls include a variety of commands affecting local queues.

MQ batch stress for shared queues: This workload runs on one system and stresses WebSphere MQ for z/OS by issuing MQI calls. These calls include a variety of commands affecting shared queues. Workload parameters control the number of each type of call.

Communications testing: This workload tests our communications channels by kicking off an application that sends messages to a remote queue manager. A trigger monitor program running on the remote system kicks off a separate application that sends the same message back to the originating system. The remote queue manager resides on a mainframe Linux system running WebSphere MQ V5.3.1.

We also run several Web applications to test WebSphere MQ for z/OS. Currently all our applications use the WebSphere Application Server V5.1.

DQM and DQMssl: These workloads test the communication between z/OS queue managers as well as z/OS and Linux queue managers using SSL TCPIP channels and non-SSL APPC channels. The application puts messages on remote queues and waits for replies on its local queues.

MQCICS: This workload uses the MQ CICS bridge to run a transaction that updates a DB2 parts table. The CICS bridge request and reply queues are local queues that have persistent messages. We also have a non-Web version of MQCICS that uses shared cluster queues with persistent messages. We defined a separate coupling facility structure for this application.

MQLarge: This workload tests various large message sizes by creating temporary dynamic queues and putting large messages on those queues. Message sizes vary from 1MB to 100MB starting in increments of 10MB. The script running the application randomly chooses a message size and passes this to the mqLarge program. mqLarge then dynamically defines a queue using model queues that have their maxmsgl set to accommodate the message.

Websphere Business Integration Message Broker

Our Websphere Business Integration Message Broker environment consists of four message brokers: three on test systems, and one on a production system. All are

running at WBIMB 5.0.1 FixPack 04. We use the following methods to drive our workloads (not all workloads use each method):

- Web applications driven by WebSphere Studio Workload Simulator
- Batch jobs
- TPNS TSO users running Java programs via z/OS UNIX shell scripts

The Web applications consist of html pages, java servlets, and WBIMB message flows to process the messages. These Java-based workloads have recently been converted to use Websphere Application Server 5.1 instead of the IBM HTTP Server with the WebSphere V4.0 plugin.

Retail_IMS: This workload tests message manipulation by taking a message, extracting certain fields from it, and adding an IMS header.

Retail_Info: This workload tests inserting and deleting fields from a message into a simple DB2 table.

Retail_Wh: This workload tests inserting and deleting an entire message (using a data warehouse node) into a LOB DB2 table.

We have two batch-driven workloads that use WBIMB:

Sniffer: This workload tests basic MQ and WBIMB functionality using persistent and non-persistent messages. It is based on SupportPac™ IP13: Sniff test and Performance on z/OS. (See http://www-306.ibm.com/software/integration/support/supportpacs/category.html#cat1)

Football: This workload tests basic WBIMB publish/subscribe functionality. Using the Subscribe portion of the workload, a subscription is registered with the broker. The Publish portion publishes messages to the broker, which then routes them to the matching subscribers. Like the Sniffer workload, this workload is based on SupportPac IP13.

We have one TPNS workload that uses WBIMB:

Retail_TPNS: This workload is another version of Retail_IMS, but rather than being driven by WebSphere Studio Workload Simulator, it is driven by TNPS via z/OS UNIX shell scripts.

Networking workloads

We run the following networking workloads:

FTP workloads:

- **FTPHFS/DB2:** This client/server workload simulates SQL/DB2 queries via an FTP client.
- **FTPHFS(Linux):** This workload simulates users logging onto a Linux client through telnet or FTP and simulates workloads between the z/OS servers and the LINUX client.
- **FTP TPNS:** This workload uses TPNS to simulate FTP client connections to the z/OS server.
- **FTPWL:** This client/server workload automates Linux clients performing FTP file transfers across Token Ring and Ethernet networks. This workload also exercises the z/OS Domain Name System (DNS). Files that are transferred reside in both

z/OS HFS and MVS non-VSAM data sets. Future enhancements to this workload will exploit the z/OS workload manager DNS.

MMFACTS for NFS: This client/server workload is designed to simulate the delivery of multimedia data streams, such as video, across the network. It moves large volumes of randomly-generated data in a continuous, real-time stream from the server (in our case, z/OS) to the client. Data files can range in size from 4 MB to 2 Gigabytes. A variety of options allow for variations in such things as frame size and required delivery rates.

NFSWL: This client/server workload consists of shell scripts that run on our AIX clients. The shell script implements reads, writes, and deletes on an NFS mounted file system. We mount both HFS and zFS file systems that reside on z/OS. This workload is managed by a front end Web interface.

AutoWEB: This client/server workload is designed to simulate a user working from a Web Browser. It uses the following HTML meta-statement to automate the loading of a new page after the refresh timer expires:

```
<meta http-equiv='Refresh' content='10; url=file:///filename.ext'>
```

This workload can drive any file server, such as LAN Server or NFS. It also can drive a Web Server by changing the URL from `url=file:///filename.ext` to `url=http://host/filename.ext`.

Silk Test NFS video stream: This client/server workload is very similar to that of MMFACTS except that it sends actual video streams across the network instead of simulating them.

TCP/IP CICS sockets: This TPNS workload exercises TCP/IP CICS sockets to simulate real transactions.

TN3270: This workload uses TPNS to simulate TN3270 clients which logon to TSO using generic resources. This workload exploits Sysplex Distributor.

Database product workloads

Database product OLTP workloads

Our sysplex OLTP workloads are our mission critical, primary production workloads. Each of our 3 application groups runs different OLTP workloads using CICS or IMS as the transaction manager:

- Application group 1—IMS data sharing, including IMS shared message queue
- Application group 2—VSAM record level sharing (RLS) and non-RLS
- Application group 3—DB2 data sharing (four different OLTP workloads, as well as several batch workloads).

Note that our OLTP workloads, which are COBOL, FORTRAN, PL1, or C/C++ programs, are Language Environment® enabled (that is, they invoke Language Environment support).

IMS data sharing workloads: In application group one, we run three IMS data sharing workloads:

- CICS/DBCTL
- IMS SMQ Fast Path
- IMS SMQ full function
- IMS automated job submission (AJS)

Highlights of our IMS data sharing workloads include:
- Full function, Fast Path, and mixed mode transactions
- Use of virtual storage option (VSO), shared sequential dependent (SDEP) databases, generic resources, and High Availability Large Databases (HALDB)
- Integrity checking on INSERT calls using SDEP journaling
- A batch message processing (BMP) application to do integrity checking on REPLACE calls
- A set of automatically-submitted BMP jobs to exercise the High-Speed Sequential Processing (HSSP) function of Fast Path and the reorg and SDEP scan and delete utilities. This workload continuously submits jobs at specific intervals to run concurrently with the online system. We enhanced this workload based on recent customer experiences to more closely resemble a real-world environment.

VSAM/RLS data sharing workload: In application group 2, we run one OLTP VSAM/RLS data sharing workload. This workload runs transactions that simulate a banking application (ATM and teller transactions). The workload also runs transactions that are similar to the IMS data sharing workload that runs in application group 1, except that these transactions use VSAM files.

VSAM/NRLS workload: Also in application group 2, we added two new workloads. One uses transactions similar to our VSAM/RLS workload but accessing VSAM non-RLS files. The other is a very I/O-intensive workload that simulates a financial brokerage application.

DB2 data sharing workloads: In application group 3, we run four different DB2 data sharing OLTP workloads. These workloads are also similar to the IMS data sharing workload running in application group 1.

In the first of the DB2 workloads, we execute 8 different types of transactions in a CICS/DB2 environment. This workload uses databases with simple and partitioned table spaces.

In the second of our DB2 workloads, we use the same CICS regions and the same DB2 data sharing members. However, we use different transactions and different databases. The table space layout is also different for the databases used by the second DB2 workload—it has partitioned table spaces, segmented table spaces, simple table spaces, and partitioned indexes.

Our third workload is a derivative of the second, but incorporates large objects (LOBs), triggers, user defined functions (UDFs), identity columns, and global temporary tables.

The fourth workload uses IMS/TM executing 12 different transaction types accessing DB2 tables with LOBs. It also excercises UDFs, stored procedures and global temporary tables.

Database product batch workloads

We run various batch workloads in our environment, some of which we will describe here. They include:
- IMS Utility
- RLS batch (read-only) and TVS batch
- DB2 batch workloads

We run our batch workloads under TWS control and use WLM-managed initiators. Our implementation of WLM batch management is described in our December 1997 edition.

DB2 batch workloads: Our DB2 batch workloads include:
- DB2 Online reorganization
- DB2/RRS stored procedure
- QMF batch queries
- DB2 utilities
- DB2 DDF

Our DB2 batch workload has close to 2000 jobs that are scheduled using TWS, so that the jobs run in a certain sequence based on their inter-job dependencies.

WebSphere MQ / DB2 bookstore application

Our multi-platform bookstore application lets users order books or maintain inventory. The user interface runs on AIX, and we have data in DB2 databases on AIX and z/OS systems. We use WebSphere MQ for z/OS to bridge the platforms and MQ clustering to give the application access to any queue manager in the cluster. See our December 2001 edition for details on how we set up this application.

Chapter 2. Migrating to and using z/OS

This chapter describes our experiences with migrating to new releases of the z/OS operating system.

Overview

The following sections describe our most recent migration activities:

- "Migrating to z/OS V1R7"
- "Migrating to z/OS V1R6" on page 33
- "Migrating to z/OS.e V1R6" on page 35

We primarily discuss our sysplex-related base operating system experiences. This includes the enablement of significant new functions and, if applicable, performance aspects. Detailed test experiences with major new functions beyond migration appear in subsequent chapters.

We discuss our networking and application-enablement environment and test experiences in Part 2, "Networking and application enablement," on page 113.

You can read about our migration experiences with earlier releases of z/OS and OS/390 in previous editions of our test report, available on our Web site:

For migration experiences with...	See...
z/OS V1R4	our December 2003 edition
z/OS V1R3	our December 2002 edition
z/OS V1R1 and V1R2	our December 2001 edition

Migrating to z/OS V1R7

This section describes our migration experiences with z/OS V1R7.

z/OS V1R7 base migration experiences

In this section we described our experiences with our base migration to z/OS V1R7, without having implemented any new functions. It includes our high level migration process along with other migration activities and considerations.

Our high-level migration process for z/OS V1R7

The following is an overview of our z/OS V1R7 migration process.

Before we began: We reviewed the migration information in *z/OS and z/OS.e Planning for Installation*, GA22-7504 and *z/OS Migration*.

Table 9 on page 28 shows the high-level process we followed to migrate the members of our sysplex from z/OS V1R5 to z/OS V1R6.

Table 9. Our high-level migration process for z/OS V1R7

Stage	Description
Updating parmlib for z/OS V1R7	We created SYS1.PETR17.PARMLIB to contain all the parmlib members that changed for z/OS V1R7 and we used our LOAD*xx* member for migrating our systems one at the time. (See “Using concatenated parmlib” on page 35 for more about our use of concatenated parmlib and see our December 1997 edition for an example of how we use LOAD*xx* to migrate individual systems.)
Applying coexistence service	We applied the necessary coexistence service (also known as compatibility or toleration PTFs) to position our systems for the migration. See the coexistence service requirements in *z/OS and z/OS.e Planning for Installation* and make sure you install the fixes for any APARs that relate to your configuration before you migrate.
IPLing our first z/OS V1R7 image	We brought up z/OS V1R7 on our Z2 test system and ran it there for a couple of weeks.
Updating the RACF templates	To test the RACF dynamic template enhancement, we IPLed the first z/OS V1R7 image without first running the IRRMIN00 utility with PARM=UPDATE. As expected, the following message appeared: `ICH579E RACF TEMPLATES ON DATABASE ARE DOWNLEVEL` RACF initialization still completed successfully. We then ran IRRMIN00 with PARM=UPDATE to dynamically update the templates on all six RACF data sets without the need for an IPL. (See *z/OS Security Server RACF System Programmer's Guide*, SA22-7681 for details about RACF templates.)
IPLing additional z/OS V1R7 images	We continued to bring up additional z/OS V1R7 images across our sysplex, as follows: • We brought up z/OS V1R7 on our on JC0 production system and ran with it for a couple of months. • Next we migrated one test system, Z1, and ran for a couple of weeks. • Next, we migrated an additional production system, J80, and ran with it for a couple of days. • At this point, we took all of the V1R7 images back down to V1R6. This is part of our increased focus on migration testing and fallback. We ran for a full day and experienced no fallback issues. • Next we migrated an additional test system, Z3, and two more productions systems, JF0 and TPN, and ran for a week. • Next we migrated four additional production systems, JA0, JB0, JE0, and JH0, and ran for a couple of weeks. • We then migrated the remaining production system, Z0, to V1R7.

Due to special testing that needed to be done with images on V1R7, the migration for our Sysplex took longer that it would normally take. This time we had 2 images on V1R7 for a couple of months before we migrated the rest of the Sysplex.

More about our migration activities for z/OS V1R7

This section highlights additional details about some of our migration activities.

Running with mixed product levels: During our migration, we successfully ran our sysplex with mixed product levels, including the following:

- z/OS V1R6 and z/OS V1R7
- z/OS V1R6 and z/OS.e V1R7
- z/OS V1R6 JES2 and z/OS V1R7 JES2
- z/OS V1R6 JES3 and z/OS V1R7 JES3.

Using concatenated parmlib: We continue to use concatenated parmlib support to add or update parmlib members for z/OS V1R7. Appendix A, "Some of our parmlib members," on page 449 summarizes the additions and changes we made by parmlib member. Also see our Web site for examples of some of our parmlib members.

This is a good use of concatenated parmlib because it isolates all of the parmlib changes for z/OS V1R7 in one place and makes it easier to migrate multiple systems. Rather than change many parmlib members each time we migrate another system to V1R7, we just add the PARMLIB statements at the appropriate places in SYS0.IPLPARM(LOAD*xx*) to allow that system to use SYS1.PETR17.PARMLIB.

Recompiling REXX EXECs for automation: We recompiled our SA OS/390 REXX EXECs when we migrated to z/OS V1R7. We discuss the need to recompile these REXX EXECs in our our December 1997 edition.

Migrating JES2 large spool datasets: ES2 for z/OS V1R7 supports spool datasets larger than 65K track, if you are in a MAS that has no pre-z/OS V1R7 members.

We implemented this support in our sysplex, using the .

After we had completely migrated our entire MAS for z/OS V1R7, and were confident that we would not fall back to a pre-z/OS V1R7 level on any member of the MAS, we enabled JES2 large dataset support with the *$T SPOOLDEF,LARGEDS=ALLOWED* command. Once this command was completed, a COLD START would have been necessary to fall back to a pre-V1R7 JES2.

We then chose a large (32K Cylinder) volume, and allocated a large spool dataset with 491,220 tracks. We used the DSNTYPE=LARGE keyword in our JCL.

```
//SPOOL    EXEC  PGM=IEFBR14
//SYSPRINT DD SYSOUT=*
//*
//SP1200 DD DISP=(,KEEP),SPACE=(TRK,(491220),,CONTIG),
//    DCB=(DSORG=PSU),DSNTYPE=LARGE,
//    DSN=SYS1.HASPACE,UNIT=3390,VOL=SER=SPOLJ5
```

Then we adjusted our TGSPACE=MAX= value to ensure we could add additional TGs (Track Groups), again using the *$T SPOOLDEF* command. In our MAS, we have three tracks per TG, so we needed to ensure we could add 163,740 TGs.

Once the dataset was allocated we formatted and started the spool dataset with the *$S SPL(SPOLJ5),FORMAT* command.

The following example shows what this looks like in SDSF:

Note: The number of TGs for SPOLJ5 shows at 163T, where the T represents Thousands.

```
SDSF SPOOL DISPLAY  J80    23%  ACT 379915 FRE 292216  LINE 1-12 (12)
COMMAND INPUT ===>                                        SCROLL ===> PAGE
NP   VOLUME Status   TGPct TGNum TGUse Command  SAff  Ext LoTrk    HiTrk    Trk
     SPOLJ5   ACTIVE      12 163T  19940          ANY    01 00000001 00077ED4
     SPOLJ8   ACTIVE      39 50025 19822          ANY    07 00000001 00024A3B
     SPOLJM  ACTIVE      28 16615  4747           ANY    0B 00000001 0000C2B5
     SPOLJW ACTIVE      29 16615  4830           ANY    0C 00000001 0000C2B5
     SPOLJ0   ACTIVE      28 16615  4739          ANY    05 00000001 0000C2B5
     SPOLJ1   ACTIVE      29 16615  4869          ANY    08 00000001 0000C2B5
     SPOLJ2   ACTIVE      28 16615  4789          ANY    03 00000001 0000C2B5
     SPOLJ3   ACTIVE      28 16615  4783          ANY    09 00000001 0000C2B5
     SPOLJ4   ACTIVE      28 16615  4777          ANY    04 00000001 0000C2B5
     SPOLJ6   ACTIVE      28 16615  4748          ANY    0D 00000001 0000C2B5
     SPOLJ7   ACTIVE      29 16615  4831          ANY    0A 00000001 0000C2B5
     SPOLJ9   ACTIVE      29 16615  4824          ANY    06 00000001 0000C2B5
```

Migrating to z/OS.e V1R7

This section describes our migration experiences with z/OS.e V1R7.

z/OS.e V1R7 base migration experiences

This section describes our experiences with migrating one system image (JH0) from z/OS.e V1R6 to z/OS.e V1R7. Here we only cover our experiences with our base migration to z/OS.e V1R6, including our high-level migration process and other migration activities and considerations.

Our high-level migration process for z/OS.e V1R7

The following is an overview of our z/OS.e V1R7 migration process.

Before we began: We reviewed the information in *z/OS and z/OS.e Planning for Installation*, GA22-7504, which covers both z/OS V1R7 and z/OS.e V1R7.

Important notice about cloning and software licensing

As discussed in *z/OS and z/OS.e Planning for Installation*, you might find that sharing system libraries or cloning an already-installed z/OS or z/OS.e system is faster and easier than installing z/OS or z/OS.e with an IBM installation package such as ServerPac. Most Parallel Sysplex customers are already aware of the concept of cloning and the benefits it provides.

However, prior to sharing or cloning z/OS or z/OS.e, **you must have a license for each z/OS and z/OS.e operating system that you run.** If you don't have the appropriate license or licenses, you must contact IBM. Any sharing or cloning of z/OS or z/OS.e without the appropriate licenses is not an authorized use of such programs. On a z800 server, if you want to run both z/OS and z/OS.e, z/OS requires the appropriate license for the machine on which it runs and z/OS.e requires a license for the number of engines on which it runs.

For more information about z/OS.e licensing, see *z800 Software Pricing Configuration Technical Paper* at www.ibm.com/servers/eserver/zseries/library/techpapers/pdf/gm130121.pdf.

Table 10 on page 31 shows the high-level process we followed to migrate our z/OS.e V1R6 system to z/OS.e V1R7.

Table 10. Our high-level migration process for z/OS.e V1R7

Stage	Description
Obtaining licenses for z/OS.e	You need a license for the appropriate number of engines on the z800 or z890 server on which you intend to run z/OS.e (and, you would also need a license to run z/OS on the z800 or z890, if you intend to install it there). We use an internal process to do this; however, you must use the official process stated in *z800 Software Pricing Configuration Technical Paper*.
Updating the z800 or z890 LPAR name	z/OS.e must run in LPAR mode and the LPAR name must be of the form `ZOSE`*xxxx*, where *xxxx* is up to 4 user-specified alphanumeric characters. The name of the LPAR in which we run z/OS.e is `ZOSEJH0`. (We used HCD to set this when we first installed z/OS.e V1R3.)
Updating parmlib for z/OS.e V1R7	z/OS.e requires the `LICENSE=Z/OSE` statement in the IEASYS*xx* parmlib member. We used the same SYS1.PETR17.PARMLIB data set that we created for z/OS V1R7. We then have separate IEASYS*xx* and IFAPRD*xx* members in SYS1.PARMLIB that we tailored specifically for z/OS.e. See “Updating system data sets for z/OS.e” on page 32 for details.
Updating our LOAD*xx* member	During our initial installation of z/OS.e V1R3, we updated the entry for our system JH0 in our LOAD*xx* member in SYS0.IPLPARM to point to our new IEASYS02 parmlib member and to reflect the new LPAR name. Therefore, we did not need to change it for V1R7.
Updating our IEASYMPT member	During our initial installation of z/OS.e V1R3, we updated the entry for our system JH0 in our IEASYMPT member in SYS1.PETR13.PARMLIB to point to our new IFAPRD*xx* parmlib member and to reflect the new LPAR name. Therefore, when we created our new SYS1.PETR17.PARMLIB, we carried the change along for V1R7.
IPLing the z/OS.e V1R7 image	We brought up z/OS.e V1R7 on our JH0 production system.

More about our migration activities for z/OS.e V1R7

This section highlights additional details about some of our migration activities.

About our z890 LPAR environment: z/OS.e must run in LPAR mode on a zSeries 800 or 890 mainframe server; it cannot run in basic mode. In addition, the name of the LPAR in which z/OS.e runs must be of the form `ZOSE`*xxxx*, where *xxxx* is up to four user-specified alphanumeric characters. The name of our z/OS.e z890 LPAR is ZOSEJH0.

Note: You can only run z/OS.e in a partition named ZOSE*xxxx*. You cannot IPL a z/OS system in a partition named ZOSE*xxxx*.

We currently run z/OS.e (JH0) as our only LPAR in a z890 server.

Note: Don't let the fact that z/OS.e only runs on a z800 or z890 server confuse you. These are fully functional zSeries servers and, in addition to z/OS.e, theyt supports all of the same zSeries operating systems as a z900 or z990 server.

Updating system data sets for z/OS.e: We continue to use concatenated parmlib support to add or update parmlib members for z/OS.e V1R7. We use the same SYS1.PETR17.PARMLIB data set as we do for our z/OS V1R7 systems.

Below are examples of our parmlib customizations to accommodate z/OS.e V1R7. Appendix A, "Some of our parmlib members," on page 449 summarizes the changes we made by parmlib member.

Example: We have a separate IEASYS*xx* member, IEASYS02, which specifies the `LICENSE=Z/OSE` statement that z/OS.e requires.

The entry for our z/OS.e system (JH0) in our LOAD*xx* member in SYS0.IPLPARM points to our IEASYS02 parmlib member and specifies the name of our z/OS.e LPAR, as follows:

```
:
HWNAME   z800name
LPARNAME  ZOSEJH0
PARMLIB  SYS1.PETR17.PARMLIB
SYSPARM   02
:
```

Example: We have a separate IFAPRD*xx* member, IFAPRD02, which specifies the product ID value `5655-G52` for z/OS.e. There is no change to the product name value for z/OS.e (the product name value remains `Z/OS`).

Below is an example of one of the entries from our IFAPRD02 member:

```
:
PRODUCT OWNER('IBM CORP')
        NAME(Z/OS)
        ID( 5655-G52 )
        VERSION(*) RELEASE(*) MOD(*)
        FEATURENAME(Z/OS)
        STATE(ENABLED)
:
```

We also have an entry for our system JH0 in our IEASYMPT member in SYS1.PETR17.PARMLIB to point to our new IFAPRD02 parmlib member and to reflect the z/OS.e LPAR name, as follows:

```
:
SYSDEF HWNAME(z800name)
       LPARNAME( ZOSEJH0 )
       SYSNAME(JH0)
       SYSCLONE(JH)
:
       SYMDEF(&PROD= '02' )
:
```

Using current z/OS.e levels of JES2 and LE: As required, we are using the level of JES2 and Language Environment (LE) that comes with z/OS.e V1R7. z/OS.e does not permit the use of a lower level JES2 (or JES3) or LE.

Updating the ARM policy: You must ensure that your automation policies, such as ARM, do not try to use a z/OS.e image to start products that z/OS.e does not

support. For example, do not identify a z/OS.e image as a restart target in a Parallel Sysplex that contains a mix of z/OS.e and z/OS images where the z/OS images run IMS, CICS, or DB2 with a requirement for CICS. CICS, IMS, or DB2 that uses CICS cannot restart on a z/OS.e image, but must restart on a z/OS image. If, for example, a CICS region attempts to start on z/OS.e, the region will start but the applications will fail with a U4093 abend.

Back when we installed z/OS.e V1R3, we removed our z/OS.e image, JH0, as a restart target for the unsupported subsystems mentioned above.

Removing z/OS.e from participation in MNPS: In our environment, CICS is the only exploiter of multiple node persistent sessions (MNPS) support. Because CICS cannot run on z/OS.e, there is no reason for the VTAM on z/OS.e to connect to the MNPS structure, ISTMNPS. We removed our z/OS.e image from participating in MNPS by coding the `STRMNPS=NONE` statement in our VTAM start member, ATCSTR*xx*, in SYS1.VTAMLST.

Removing z/OS.e from participation in TSO generic resource groups: Since TSO on z/OS.e only allows a maximum of eight concurrent sessions, we removed our z/OS.e image from participating in TSO generic resource groups. You can do this by coding the `GNAME=NONE` parameter—either in a separate TSOKEY*xx* member in parmlib or on the START command that starts the terminal control address space (TCAS).

In our case, we use a single TSOKEY*xx* member that has a symbolic value for the GNAME parameter. We then set that symbol to `NONE` for our JH0 image in our IEASYMPT member.

Other experiences with z/OS.e V1R7

Our testing of z/OS.e V1R7 included the following workloads or scenarios:

- z/OS UNIX System Services
- DB2 UDB
- IBM HTTP Server in scalable server mode
- WebSphere Application Server for z/OS
- CICS Transaction Gateway (CTG) to access CICS regions running in z/OS images on the same CPC and other CPCs
- DB2 access from Linux guests under z/VM on the same CPC
- our Bookstore application transactions

Migrating to z/OS V1R6

This section describes our migration experiences with z/OS V1R6.

z/OS V1R6 base migration experiences

In this section we only describe our experiences with our base migration to z/OS V1R6, without having implemented any new functions. It includes our high-level migration process along with other migration activities and considerations.

Our high-level migration process for z/OS V1R6

The following is an overview of our z/OS V1R6 migration process.

Before we began: We reviewed the migration information in *z/OS and z/OS.e Planning for Installation*, GA22-7504 and *z/OS Migration*.

Table 11 shows the high-level process we followed to migrate the members of our sysplex from z/OS V1R5 to z/OS V1R6.

Table 11. Our high-level migration process for z/OS V1R6

Stage	Description
Updating parmlib for z/OS V1R6	We created SYS1.PETR16.PARMLIB to contain all the parmlib members that changed for z/OS V1R6 and we used our LOAD*xx* member for migrating our systems one at a time. (See “Using concatenated parmlib” on page 35 for more about our use of concatenated parmlib and see our December 1997 edition for an example of how we use LOAD*xx* to migrate individual systems.)
Applying coexistence service	We applied the necessary coexistence service (also known as compatibility or toleration PTFs) to position our systems for the migration. See the coexistence service requirements in *z/OS and z/OS.e Planning for Installation* and make sure you install the fixes for any APARs that relate to your configuration before you migrate.
IPLing our first z/OS V1R6 image	We brought up z/OS V1R6 on our Z1 test system and ran it there for about one week.
Updating the RACF templates	To test the RACF dynamic template enhancement, we IPLed the first z/OS V1R6 image without first running the IRRMIN00 utility with PARM=UPDATE. As expected, the following message appeared: `ICH579E RACF TEMPLATES ON DATABASE ARE DOWNLEVEL` RACF initialization still completed successfully. We then ran IRRMIN00 with PARM=UPDATE to dynamically update the templates on all six RACF data sets without the need for an IPL. (See *z/OS Security Server RACF System Programmer's Guide*, SA22-7681 for details about RACF templates.)
IPLing additional z/OS V1R6 images	We continued to bring up additional z/OS V1R6 images across our sysplex, as follows: • We brought up z/OS V1R6 on our Z2 and Z3 test systems and ran for a couple of days. • Next, we migrated one production system, JF0, and ran for about a week. • Next, we migrated an additional test system, Z1, and two production systems, JG0 and JH0, and ran for another week. • At this point, we took all of the V1R6 images back down to V1R5. This is part of our increased focus on migration testing and fallback. We ran for a full day and experienced no fallback issues. • Next, we migrated an additional test system, Z0, and three production systems, TPN, JB0, and JC0, and ran for a couple of days. • Next, we migrated two more production systems, JA0 and JE0, and ran for about a week. • We then migrated the remaining two systems, J80 and J90.

The total time for our migration was approximately a month.

More about our migration activities for z/OS V1R6

This section highlights additional details about some of our migration activities.

Running with mixed product levels: During our migration, we successfully ran our sysplex with mixed product levels, including the following:

- z/OS V1R5 and z/OS V1R6
- z/OS V1R5 and z/OS.e V1R6
- z/OS V1R5 JES2 and z/OS V1R6 JES2
- z/OS V1R5 JES3 and z/OS V1R6 JES3

Using concatenated parmlib: We continue to use concatenated parmlib support to add or update parmlib members for z/OS V1R6. Appendix A, "Some of our parmlib members," on page 449 summarizes the additions and changes we made by parmlib member. Also see our Web site for examples of some of our parmlib members.

This is a good use of concatenated parmlib because it isolates all of the parmlib changes for z/OS V1R6 in one place and makes it easier to migrate multiple systems. Rather than change many parmlib members each time we migrate another system to V1R6, we just add the PARMLIB statements at the appropriate places in SYS0.IPLPARM(LOAD*xx*) to allow that system to use SYS1.PETR16.PARMLIB.

Recompiling REXX EXECs for automation: We recompiled our SA OS/390 REXX EXECs when we migrated to z/OS V1R6. We discuss the need to recompile these REXX EXECs in our our December 1997 edition.

Defining greater than 16 CPs per z/OS image

Beginning with z/OS V1.6, you can now define up to 24 processors in a single z/OS image. Note that the limit of 24 processors is the total of general purpose processors and zAAPs. We defined greater than 16 processors for several of the partitions on our z990 server, up to 22 general purpose processors plus 2 zAAPs. Making this change is done, as usual, from the hardware management console (HMC) by updating the CP panel on the image profiles. Enhancements have been made to several z/OS elements (WLM, etc.) in z/OS V1.6 to support this new limit. IBM intends to support up to 32 processors in a single z/OS image in 2005. See "Testing greater than 16 CPU Support" on page 12 for more information.

Migrating to z/OS.e V1R6

This section describes our migration experiences with z/OS.e V1R6.

z/OS.e V1R6 base migration experiences

This section describes our experiences with migrating one system image (JH0) from z/OS.e V1R5 to z/OS.e V1R6. Here we only cover our experiences with our base migration to z/OS.e V1R6, including our high-level migration process and other migration activities and considerations.

Our high-level migration process for z/OS.e V1R6

The following is an overview of our z/OS.e V1R6 migration process.

Before we began: We reviewed the information in *z/OS and z/OS.e Planning for Installation*, GA22-7504, which covers both z/OS V1R6 and z/OS.e V1R6.

Important notice about cloning and software licensing

As discussed in *z/OS and z/OS.e Planning for Installation*, you might find that sharing system libraries or cloning an already-installed z/OS or z/OS.e system is faster and easier than installing z/OS or z/OS.e with an IBM installation package such as ServerPac. Most Parallel Sysplex customers are already aware of the concept of cloning and the benefits it provides.

However, prior to sharing or cloning z/OS or z/OS.e, **you must have a license for each z/OS and z/OS.e operating system that you run.** If you don't have the appropriate license or licenses, you must contact IBM. Any sharing or cloning of z/OS or z/OS.e without the appropriate licenses is not an authorized use of such programs. On a z800 server, if you want to run both z/OS and z/OS.e, z/OS requires the appropriate license for the machine on which it runs and z/OS.e requires a license for the number of engines on which it runs.

For more information about z/OS.e licensing, see *z800 Software Pricing Configuration Technical Paper* at www.ibm.com/servers/eserver/zseries/library/techpapers/pdf/gm130121.pdf.

Table 12 shows the high-level process we followed to migrate our z/OS.e V1R5 system to z/OS.e V1R6.

Table 12. Our high-level migration process for z/OS.e V1R6

Stage	Description
Obtaining licenses for z/OS.e	You need a license for the appropriate number of engines on the z800 or z890 server on which you intend to run z/OS.e (and, you would also need a license to run z/OS on the z800 or z890, if you intend to install it there). We use an internal process to do this; however, you must use the official process stated in *z800 Software Pricing Configuration Technical Paper*.
Updating the z800 or z890 LPAR name	z/OS.e must run in LPAR mode and the LPAR name must be of the form `ZOSE`*xxxx*, where *xxxx* is up to 4 user-specified alphanumeric characters. The name of the LPAR in which we run z/OS.e is `ZOSEJH0`. (We used HCD to set this when we first installed z/OS.e V1R3.)
Updating parmlib for z/OS.e V1R6	z/OS.e requires the `LICENSE=Z/OSE` statement in the IEASYS*xx* parmlib member. We used the same SYS1.PETR16.PARMLIB data set that we created for z/OS V1R6. We then have separate IEASYS*xx* and IFAPRD*xx* members in SYS1.PARMLIB that we tailored specifically for z/OS.e. See "Updating system data sets for z/OS.e" on page 37 for details.
Updating our LOAD*xx* member	During our initial installation of z/OS.e V1R3, we updated the entry for our system JH0 in our LOAD*xx* member in SYS0.IPLPARM to point to our new IEASYS02 parmlib member and to reflect the new LPAR name. Therefore, we did not need to change it for V1R6.

Table 12. Our high-level migration process for z/OS.e V1R6 (continued)

Stage	Description
Updating our IEASYMPT member	During our initial installation of z/OS.e V1R3, we updated the entry for our system JH0 in our IEASYMPT member in SYS1.PETR13.PARMLIB to point to our new IFAPRD*xx* parmlib member and to reflect the new LPAR name. Therefore, when we created our new SYS1.PETR16.PARMLIB, we carried the change along for V1R6.
IPLing the z/OS.e V1R6 image	We brought up z/OS.e V1R6 on our JH0 production system.

More about our migration activities for z/OS.e V1R6

This section highlights additional details about some of our migration activities.

About our z890 LPAR environment: z/OS.e must run in LPAR mode on a zSeries 800 or 890 mainframe server; it cannot run in basic mode. In addition, the name of the LPAR in which z/OS.e runs must be of the form `ZOSE`*xxxx*, where *xxxx* is up to four user-specified alphanumeric characters. The name of our z/OS.e z890 LPAR is ZOSEJH0.

Note: You can only run z/OS.e in a partition named ZOSE*xxxx*. You cannot IPL a z/OS system in a partition named ZOSE*xxxx*.

We currently run z/OS.e (JH0) in a mixed LPAR environment alongside LPARs running z/OS (JG0) on the same z890 server.

Note: Don't let the fact that z/OS.e only runs on a z800 or z890 server confuse you. These are fully functional zSeries servers and, in addition to z/OS.e, theyt supports all of the same zSeries operating systems as a z900 or z990 server.

Updating system data sets for z/OS.e: We continue to use concatenated parmlib support to add or update parmlib members for z/OS.e V1R6. We use the same SYS1.PETR16.PARMLIB data set as we do for our z/OS V1R6 systems.

Below are examples of our parmlib customizations to accommodate z/OS.e V1R6. Appendix A, "Some of our parmlib members," on page 449 summarizes the changes we made by parmlib member.

Example: We have a separate IEASYS*xx* member, IEASYS02, which specifies the `LICENSE=Z/OSE` statement that z/OS.e requires.

The entry for our z/OS.e system (JH0) in our LOAD*xx* member in SYS0.IPLPARM points to our IEASYS02 parmlib member and specifies the name of our z/OS.e LPAR, as follows:

```
⋮
HWNAME   z800name
LPARNAME ZOSEJH0
PARMLIB  SYS1.PETR16.PARMLIB
```

```
SYSPARM   02
:
```

Example: We have a separate IFAPRD*xx* member, IFAPRD02, which specifies the product ID value 5655-G52 for z/OS.e. There is no change to the product name value for z/OS.e (the product name value remains Z/OS).

Below is an example of one of the entries from our IFAPRD02 member:

```
:
PRODUCT OWNER('IBM CORP')
        NAME(Z/OS)
        ID( 5655-G52 )
        VERSION(*) RELEASE(*) MOD(*)
        FEATURENAME(Z/OS)
        STATE(ENABLED)
:
```

We also have an entry for our system JH0 in our IEASYMPT member in SYS1.PETR16.PARMLIB to point to our new IFAPRD02 parmlib member and to reflect the z/OS.e LPAR name, as follows:

```
:
SYSDEF HWNAME(z800name)
       LPARNAME( ZOSEJH0 )
       SYSNAME(JH0)
       SYSCLONE(JH)
:
       SYMDEF(&PROD= '02' )
:
```

Using current z/OS.e levels of JES2 and LE: As required, we are using the level of JES2 and Language Environment (LE) that comes with z/OS.e V1R6. z/OS.e does not permit the use of a lower level JES2 (or JES3) or LE.

Updating the ARM policy: You must ensure that your automation policies, such as ARM, do not try to use a z/OS.e image to start products that z/OS.e does not support. For example, do not identify a z/OS.e image as a restart target in a Parallel Sysplex that contains a mix of z/OS.e and z/OS images where the z/OS images run IMS, CICS, or DB2 with a requirement for CICS. CICS, IMS, or DB2 that uses CICS cannot restart on a z/OS.e image, but must restart on a z/OS image. If, for example, a CICS region attempts to start on z/OS.e, the region will start but the applications will fail with a U4093 abend.

Back when we installed z/OS.e V1R3, we removed our z/OS.e image, JH0, as a restart target for the unsupported subsystems mentioned above.

Removing z/OS.e from participation in MNPS: In our environment, CICS is the only exploiter of multiple node persistent sessions (MNPS) support. Because CICS cannot run on z/OS.e, there is no reason for the VTAM on z/OS.e to connect to the MNPS structure, ISTMNPS. We removed our z/OS.e image from participating in MNPS by coding the STRMNPS=NONE statement in our VTAM start member, ATCSTR*xx*, in SYS1.VTAMLST.

Removing z/OS.e from participation in TSO generic resource groups: Since TSO on z/OS.e only allows a maximum of eight concurrent sessions, we removed our z/OS.e image from participating in TSO generic resource groups. You can do this by coding the GNAME=NONE parameter—either in a separate TSOKEY*xx* member in parmlib or on the START command that starts the terminal control address space (TCAS).

In our case, we use a single TSOKEY*xx* member that has a symbolic value for the GNAME parameter. We then set that symbol to `NONE` for our JH0 image in our IEASYMPT member.

Other experiences with z/OS.e V1R6

Our testing of z/OS.e V1R6 included the following workloads or scenarios:

- z/OS UNIX System Services
- DB2 UDB
- IBM HTTP Server in scalable server mode
- WebSphere Application Server for z/OS
- CICS Transaction Gateway (CTG) to access CICS regions running in z/OS images on the same CPC and other CPCs
- DB2 access from Linux guests under z/VM on the same CPC
- our Bookstore application transactions

Migrating z/OS Images and a Coupling Facility to the z9

We migrated the following images from two other CPCs to the z9 server:

- Our J80 and Z3 z/OS images that were running on our z990 server
- Our JF0 and Z1 z/OS images that were running on our z900 server
- Our CF2 coupling facility that was running on our z990 server

We added the following zVM and Linux images to the z9 server:

- zVM images for Linux Distr01,Petlvs and Petlvs2
- Linux images Distr02 and Ticltst

Figure 4 summarizes the LPs that we migrated to the z9 server.

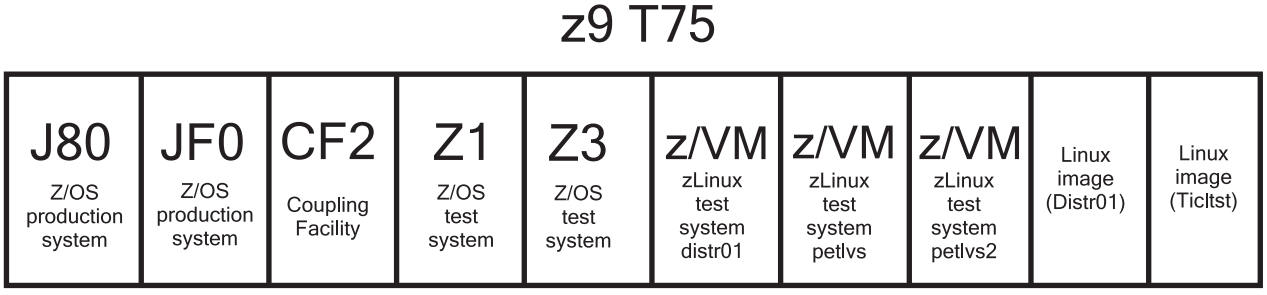


Figure 4. Summary of LPs that we migrated to the z9 server

Some of the features that differentiate our new z9 from our z990 are:

MIDAWS: z9 introduces a new type of channel program called a Modified Indirect Data Addressing Word (MIDAWS) for both Escon and Ficon. MIDAWS gives extended format VSAM data sets a considerable performance boost. The environment to most benefit from this support is one in which there is a great amount of extended format DFSMS data set activity. This includes DB2 database manager, CICS with extended format VSAM, and any environment that extensively uses extended format sequential data.

Managing ICF, IFL, and zAAPs independently: PUs defined as Internal Coupling Facility (ICF) processors, Integrated Facility for Linux (IFL) processors, or System

z9 Application Assist Processors (zAAPs) are now managed separately. In the past, ICF processors, IFL processors, and zAAPs were grouped together for allocation within and across the LPARs. The separate management of PU types enhances and simplifies capacity planning and management of the configured LPARs and their associated processor resources.

Improved LPAR weight management of CPs and zAAPs: For LPARs that have both CPs and zAAPs configured, a new zAAP weight specification is provided to allow a new unique LPAR weight specification for shared zAAPs to be defined. The existing LPAR shared processor weight specification is now applied only to the CPs configured to the LPAR. In the past, the existing shared processor weight specification was applied to both the shared CPs and to shared zAAPs configured to the LPAR. The ability to specify a separate LPAR weight for shared zAAPs helps to enhance and simplify capacity planning and management of the configured LPARs and their associated processor resources.

Multiple Subchannel Sets: Multiple Subchannel Set support enables constraint relief for subchannels. Two subchannel sets per LCSS will be implemented enabling a total of 63K subchannels in set-0 (was available with z990) and adding 64K-1 subchannels in set-1 with this function for z9.Subchannels for parallel devices will not be allowed in subchannel set-1, and initially only z/OS will support multiple subchannel sets with only Shark PAV devices in the second set.

z/OS performance

The performance of our z/OS systems is an important issue for us, just as it is for you. If we are to be customer-like, we must pay attention to meeting the goals in our service level agreements.

The following describes what we do in each phase of our testing, and what we plan to periodically report to you in our test reports:

- Monitor our performance in terms of our service level agreements

  Our goal for our sysplex workloads continues to be 90% CP utilization across the systems in the sysplex, with WLM goals such as 80% of CICS transactions completed in less than 0.6 seconds on those images where CICS runs. We fill in the remaining 10% with batch work and various additional types of users, such as z/OS UNIX users (such as WebSphere for z/OS), TSO users, and workstation clients.

  Note: This is not formal performance testing for purposes of publishing performance statistics for z/OS. It is a way for us to establish and report on reasonable goals for response times and transaction rates for the various types of workloads we run, just as a customer would do to create a service level agreement (SLA).
- Identify performance problems in our environment, find solutions to those problems, and report the information to you.
- Provide you with periodic performance snapshots of our environment, in the form of RMF reports, to provide pertinent information such as how many transactions we process per second and what our response times are for various workloads. You can find those reports in Appendix B, “Some of our RMF reports,” on page 451.

Chapter 3. Using zSeries Application Assist Processors (zAAPs)

As promised, we've updated our most recent testing of zAAP since the June 2004 report.

IBM @server zSeries 890 (z890) and zSeries 990 (z990) servers make available a new, optional feature—the zSeries Application Assist Processor (zAAP)—which provides a strategic z/OS Java execution environment for customers who desire the powerful integration advantages and traditional qualities of service of the zSeries platform.

A zAAP is similar in concept to a System Assist Processor (SAP). Unlike CPs, ICFs, and IFLs, zAAPs can do nothing on their own; they cannot perform an IPL and cannot run an operating system. zAAPs must operate along with general purpose CPs within logical partitions running z/OS; however, they are designed to operate asynchronously with the general purpose CPs to execute Java programming under control of the IBM Java Virtual Machine (JVM).

This chapter describes what we did to configure and to prepare to exercise the zAAP feature on our z990 server.

Prerequisites for zAPP

The following are prerequisites for zAAP and execution of the JVM processing cycles:

- the IBM Software Developer's Kit (SDK) for z/OS
- z/OS 1.6 (or z/OS.e 1.6)
- Java 2 Technology Edition V1.4.1 with PTF for APAR PQ86689
- and the Processor Resource/Systems Manager™ ((PR/SM™) must be enabled).

Subsystems and applications using SDK 1.4 that exploit zAAPs

The following subsystems and applications using SDK 1.4 exploit zAAPs:

- WebSphere Application Server 5.1
- CICS/TS 2.3
- DB2 V7, DB2 V8 (we tested with both)
- IMS V7, IMS V8, and IMS V9 (we tested with IMS V8)
- Websphere MQ 5.3.1
- Websphere Business Integration Message Broker 5.0

Setting up zAAP

First we executed the recommended zAAP Projection Tool for Java 2 Technology Edition SDK 1.3.1 against the available Java workload we had at the early stage of our testing. This provided us a baseline or a starting point for defining the minimum number of zAAP processors we would require on our z990 and z890 processors. Please reference the following for more details pertaining to the Projection Tool:

- "Installation of the zAAP Projection Tool Instrumented SDK in WebSphere for z/OS Version 5" available at:

  `http://www-1.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100431`

- z/OS Performance: Capacity Planning Considerations for zAAP Processors available at:

  `http://www-1.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP100417`

As mentioned in the intro we recommend that you contact your hardware support for the latest hardware and software requirements. We licensed 1 CP on our z890 and 2 CPs on our z990 as zAAPs.

Configuring zAAPs

We configured two zAAPs on all our z/OS images on our z990 server and we configured one zAAP on our z890 server. When you configure the z/OS logical partitions, you simply specify how many logical zAAPs you want to configure for each partition, just as you do the number of standard CPs. When you IPL the system, z/OS determines how many zAAPs are configured and manages an additional dispatcher queue for zAAP-eligible work.

We did the following to configure the zAAPs:

1. Updated the image profiles for the Z2 and Z3 partitions to define two zAAPs to each partition.

   Example: Figure 5 shows an example of the image profile for our Z2 image with two zAAPs defined.

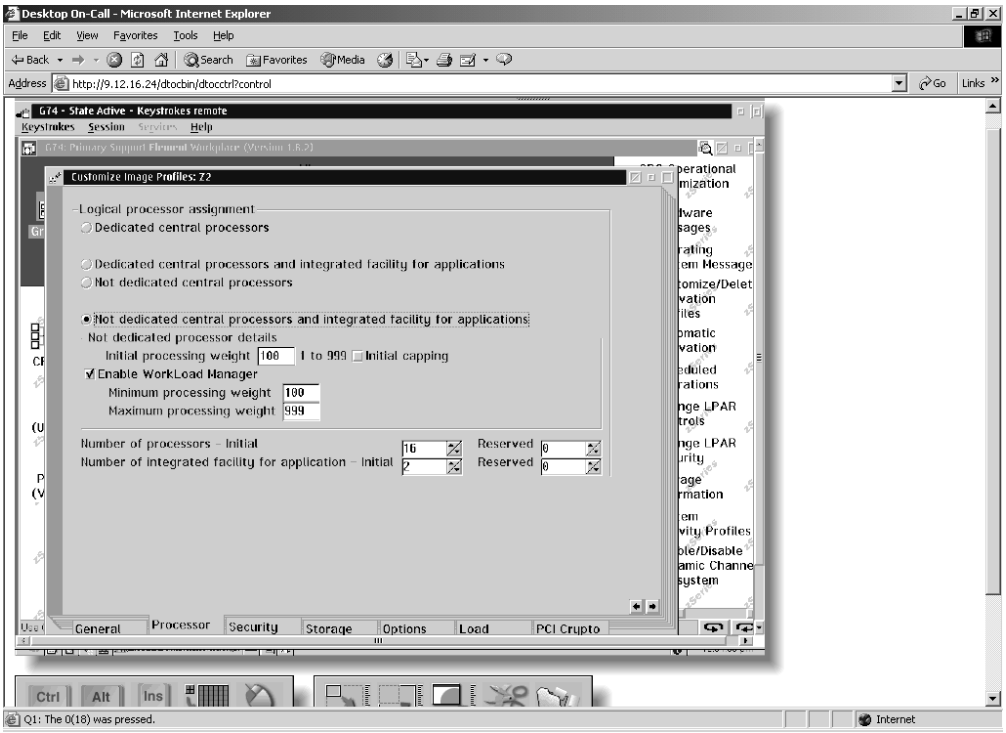


Figure 5. Example of the image profile for our Z2 image with two zAAPs defined.

2. Updated parmlib member IEAOPT*xx* for the z/OS partitions to specify the following options:

IFACROSSOVER=YES
zAAP-eligible work may execute on zAAPs or it can “cross over” and execute on standard processors.

IFAHONORPRIORITY=YES
Standard processors execute both Java and non-Java work in order of dispatching priority.

---

3. Deactivated and reactivated the z/OS partitions to bring the zAAPs online.

   You can use the D M=CPU command to display the status of the zAAPs. The zAAPs appear as assist processors in the response to the D M=CPU command.

   Example: The following is an example of the response to the D M=CPU command on system Z2:

```
IEE174I 15.34.28 DISPLAY M
PROCESSOR STATUS
ID  CPU                 SERIAL
00  +                   02B52A2084
01  +                   02B52A2084
02  +                   02B52A2084
03  +                   02B52A2084
04  +A                  02B52A2084
05  +A                  02B52A2084

CPC ND = 002084.D32.IBM.00.00000001B52A
CPC SI = 2084.325.IBM.00.000000000001B52A
CPC ID = 00
CPC NAME = G74
LP NAME = Z2         LP ID =  2
CSS ID  = 0
MIF ID  = 2
```

   Example: The following is an example of the response to the D M=CPU command on system Z3:

```
IEE174I 15.38.30 DISPLAY M
PROCESSOR STATUS
ID  CPU                 SERIAL
00  +                   24B52A2084
01  +                   24B52A2084
02  +                   24B52A2084
03  +                   24B52A2084
04  +A                  24B52A2084
05  +A                  24B52A2084

CPC ND = 002084.D32.IBM.00.00000001B52A
CPC SI = 2084.325.IBM.00.000000000001B52A
CPC ID = 00
CPC NAME = G74
LP NAME = Z3         LP ID = 24
CSS ID  = 2
MIF ID  = 4
```

Monitoring zAAP utilization

There is support in RMF (supplied by APAR OA05731) to provide information about zAAP utilization. This information is useful to determine if and when you need to add additional zAAP capacity.

SMF is another source of information. SMF type 72 records contain information about zAAP utilization. There are also new fields in SMF type 30 records to indicate

the amount of time spent on zAAP work as well as the amount of time spent executing zAAP-eligible work on standard processors for both crossover and honor priority execution modes.

Here is an example of our RMF Monitor III displaying the use of the zAAPs on our z990 processor highlighted in **bold**:

```
                        RMF V1R5   CPC Capacity                  Line 1 o
Command ===>                                                  Scroll ===>
Switched to option set WLMPOL01 on JA0.
Samples: 120     System: JA0   Date: 09/14/04  Time: 11.09.00  Range: 120

Partition:   JA0        2084 Model 325
CPC Capacity:    1114   Weight % of Max: 10.0       4h MSU Average:   175
Image Capacity:  1069   WLM Capping %:   ****       4h MSU Maximum:   205

Partition  --- MSU ---  Cap  Proc    Logical Util %   - Physical Util % -
             Def   Act  Def   Num    Effect   Total   LPAR  Effect  Total

*CP                                                    2.1    46.9   49.0
EBTELNX        0     1  NO    2.0       1.3     1.3   0.0     0.1    0.1
JA0            0   191  NO    7.0      60.3    61.2   0.3    16.9   17.1
JC0            0   158  NO    7.0      49.8    50.6   0.2    13.9   14.2
JE0            0   137  NO    8.0      37.9    38.6   0.2    12.1   12.3
Z2             0    27  NO    7.0       8.5     8.7   0.1     2.4    2.4
Z3             0    17  NO    4.0       9.3     9.5   0.0     1.5    1.5
PHYSICAL                                               1.3            1.3

*ICF                                                   1.2    60.6   61.8
CF2                         3.0      98.9    98.9   0.0    42.4   42.4
JA0                    NO   2.0      46.7    46.9   0.1    13.3   13.4
JC0                    NO   2.0       0.0     0.0   0.0     0.0    0.0
JE0                    NO   2.0       0.0     0.0   0.0     0.0    0.0
PETVM                  NO   2.0      15.0    15.6   0.2     4.3    4.4
Z2                     NO   2.0       2.0     2.1   0.0     0.6    0.6
Z3                     NO   2.0       0.1     0.1   0.0     0.0    0.0
PHYSICAL                                               1.0            1.0
```

Preparing our workloads to exercise the zAAP feature

Initially, we selected several of our current MQ Web workloads and rewrote them as base Java applications (non-Web) to exercise the zAAP feature. We also installed WebSphere Business Integration Message Broker 5.0 for zAAP testing. This product itself uses Java and will increase the utilization of the zAAP feature in addition to the workloads. .

In the near future, we plan to use the following MQ-based workloads (which run via TPNS scripts and TSO users) to test the zAAP feature:

- MQLARGE — This workload currently runs primarily on system JG0. Its purpose is to create temporary MQ queues and put large messages on them. We added a compute module to increase the application's CPU usage, as MQ itself does not consume much CPU resource.
- MQCICS — This workload runs on system JB0 and puts a request message on a CICS bridge queue to run a DB2 transaction.
- MQDQM — This is a communications test workload that puts and gets messages between a local MQ queue manager and a remote system's queue manager.
- MQDQLSSL — This workload is similar to the MQDQM workload but uses SSL channels to test security.

- RetailTPNS — This workload simulates a retail type of application and uses WebSphere MQ Integrator to put messages on a queue for the broker to process. We run a TPNS version in Java that will use the zAAP feature.

Other workloads we support are:

- DB2— In the past, Integration Test had implemented the NST (Native Stress Test) Version 6 workload for DB2, which is a TPNS driven, CICS based workload comprised of COBOL programs, stored procedures and user defined functions (UDFs). For z/OS 1.6 with the introduction of eServer™ zSeries Application Assist Processor, several of the stored procedures originally written in COBOL were converted to Java, and a new Workload Manager (WLM) address space to run the Java stored procedures was defined.
- IMS— The IMS Java workload is based on the IMS Java Dealership IVP application, which is documented in the ″IMS Java User's Guide″ (SC27-1296-00). The environment is IMS V8 running SDK 1.4.2. This application consists of one database and one transaction (with multiple methods). We modified the IMS V8 Dealership IVP application by:
  - Creating MFS screen formats so the transactions can be set up as an OLTP workload
  - Coded TPNS scripts to drive different dealership application methods.

We are currently running the following methods: FindACar, ListModels and ShowModelDetails.

We executed our zAAP testing with different configurations.The majority of our testing was completed with our zAAPs configured online. We also performed extensive testing with the zAAP processors configuring them online and offline with Java workload running.

Chapter 4. Migrating to CICS TS Version 3 Release 1

In this section, we describe our experiences with migrating to CICS Transaction Server Version 3 Release 1 (CICS TS 3.1). CICS TS 3.1 contains the following:

- HBDD110 CICS Application Migration Aid
- HCI6400 CICS - Base
- HCP3100 CICSPLEX System Manager - Base
- H0B5110 CICS REXX Runtime
- H0B7110 CICS REXX Runtime Development
- H0Z2110 CICS REXX Runtime Common
- JCI640D CICS - JAVA/IIOP
- JCI6401 CICS - COBOL language parts
- JCI6402 CICS - PL/1 language parts
- JCI6403 CICS - 'C' language parts
- JCP3102 CICS/Plex System Manager - SAS components

Applicable documentation: During the migration to CICS TS 3.1, we used the following publications:

- *Program Directory for CICS Transaction Server for z/OS, GI10-2586* located at:
  `http://publibz.boulder.ibm.com/epubs/pdf/i1025860.pdf`
- *CICS Transaction Server for z/OS Migration Guide, GC34-6425* located at:
  `http://publibfp.boulder.ibm.com/epubs/pdf/dfhe5b02.pdf`
- *CICS Transaction Server for z/OS Installation Guide, GC34-6426* located at:
  `http://publibfp.boulder.ibm.com/epubs/pdf/dfhe5b02.pdf`
- *CICS Transaction Server for z/OS Messages and Codes, GC34-6442* located at:
  `http://publibfp.boulder.ibm.com/epubs/pdf/dfhe5b02.pdf`
- *CICS Transaction Server for z/OS Operations and Utilities Guide, SC34-6431* located at:
  `http://publibfp.boulder.ibm.com/epubs/pdf/dfhe5b02.pdf`
- *CICS Transaction Server for z/OS CICSPlexSM Messages and Codes, GC34-6471* located at:
  `http://publibz.boulder.ibm.com/epubs/pdf/eyua1b01.pdf`

Overview of migrating to CICS TS 3.1

As always, our goal with this migration was to follow the path of a typical customer. We migrated slowly across the sysplex, and within the workloads on the sysplex. This created a thorough mixture of releases on a system as well as across the CICSPlex. We did this to uncover as many compatibility and operational problems as possible. After we tested the migration steps on our test CICSPlex, we were ready to migrate our production CICSPlex.

As we mentioned in our last report, we've added another workload to our CICSPlex. In addition to the original data-sharing workloads (IMS, VSAM-RLS, DB2), we now have a fourth workload, used primarily to test new z/OS Cryptographic hardware, ICSF, and Java. We call this our application group-C workload, which exploits the CICS-ICSF attach facility and the CICS-Java interface.

Figure 6 shows our CICS TS 3.1 and CPSM 3.1 latest configuration:

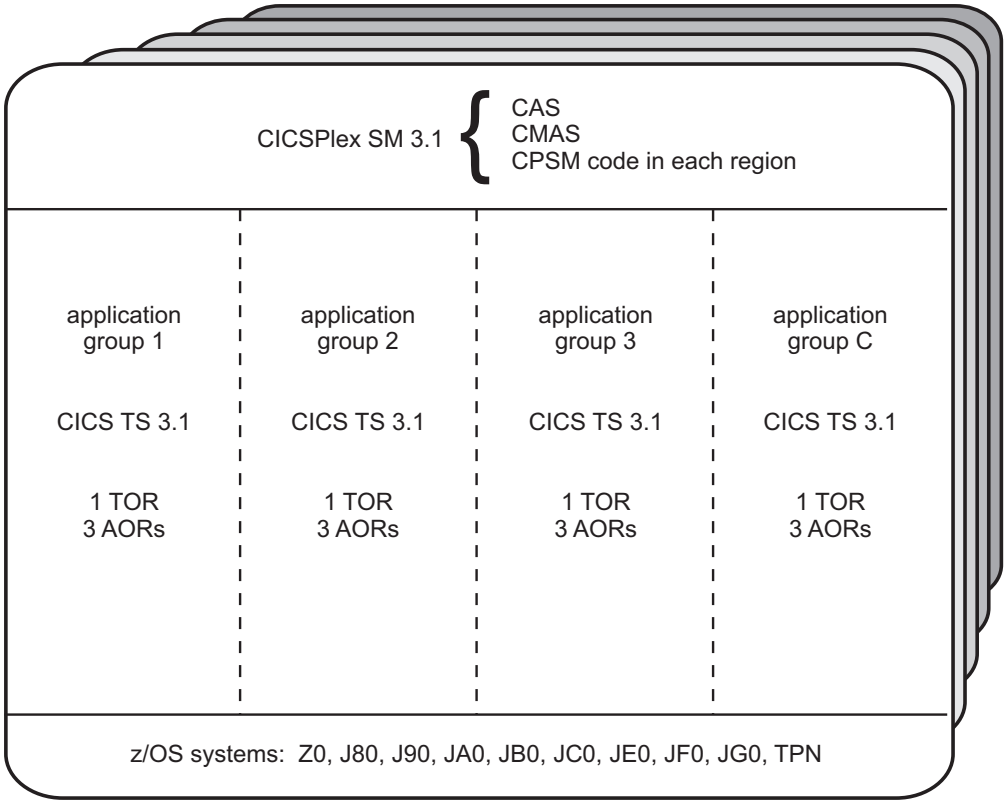


Figure 6. Our CICS TS 3.1 and CPSM 3.1 configuration

When all of our systems are up and running we have a total of 10 CASs/CMASs monitoring 120+ CICS regions (MASs). We stopped the migration when we were about half-way across the sysplex. At this point we had CTS23 CMASs communicating with CTS31 CMASs. Under the CTS31 CMASs, we had a mixture of CTS23 and CTS31 MASs. We did this to test the compatibility of the different releases working together and to further expose the CICSPlex to the z/OS testing already in progress. About three weeks later, we completed this migration.

Performing the migration to CICS TS 3.1

This section describes how we migrated to CICS TS 3.1.

Preparing for migration

Before we began the actual migration process, we did some preparatory work in the following areas:

Backing up our data: Even though we created new files and data sets, as a precaution, we first took backups of all of the CSDs and data repositories.

Alias's: We defined new aliases for CTS31.

Loading the CTS31 product libraries: We set up and ran the SMPE jobs to load the CTS31 product libraries. We then ran a copy job to bring the build libraries over to our production systems.

Allocating supporting PDS's: We created copies of all our supporting libraries (JCL, SYSIN, TABLEs, and so on). We reviewed these and updated accordingly with all the necessary CTS31 changes.

Customizing the CICS region data sets: We customized the jobs in *hlq*.SDFHINST(DFHDEFDS) and *hlq*.SEYUINST(EYUDEFDS) to define all of the region data sets and submitted them a number of times. Depending on your environment, you might need to alter the default file sizes. We increased the file sizes for the DFHGCD, DFHINTRA and DFHTEMP data sets.

Reviewing and reassembling tables: We reviewed and reassembled any tables we had modified. We stopped using a ″customized″ SRT, since all of our customizations are now included in the default SRT.

Updating SYS1.PARMLIB and APF-authorizing program libraries: In SYS1.PARMLIB, we updated LINK list and LPA list. We APF-authorized the following program libraries:

- *hlq*.SDFHAUTH
- *hlq*.SDFHLINK
- *hlq*.SDFJAUTH
- *hlq*.SEYUAUTH
- *hlq*.SEYULINK

In PROCLIB, we reviewed and updated all our procs for the CTS31 changes.

Migrating CICSPlex SM

If you are migrating to CICSPlex SM for the first time, CPSM consists of the following parts on each system:

- CAS (coordinating address space)
- CMAS (CICS-managed address space)
- CPSM code running in each CICS region (MAS), which communicates with the CMAS, sometimes referred to as the ″agent″ code. On any specific z/OS system, all three parts of CPSM must be at the same release level. As long as all CPSM components on any single z/OS system are at the same level, you can run mixed levels of CPSM on different systems within a sysplex.

Note: Remember, DFHIRP must be at the highest level of the code.

Migrating the CASs

We reviewed the steps documented in *CICS Transaction Server for z/OS Migration Guide* to migrate the CASs.

Steps for migrating the CASs

We did the following to migrate the CASs:

1. Defined a new BBIPARM parameter repository data set for CPSM 3.1 We reviewed the JCL in the EYUDEFDS member, customized the JCL statements that allocate the CAS parameter library (EYUIPARM) data set, and then submitted it. The BBIPARM DD name contains the cross-system definitions for CPSM.

   Note: CASs running at different levels cannot share the same BBIPARM data set.

2. Updated our TSO signon procedures to point to the new data sets for the new release of CPSM 3.1

3. Reviewed the JCL in the EYUCAS member for any changes to the CAS startup procedure.

   Because there were no changes, we simply made a copy of our old procedure and updated the data set names to use our new high-level qualifiers. (The EYUCAS member resides in the *hlq*.SEYUINST library.)

4. Started the CAS

5. Defined the CAS and updated the parameter repository (BBIPARM), as follows:
   a. From the TSO EUI address space (CPSM), selected option 1 to invoke the PLEXMGR view
   b. Invoked the CASDEF view, which put us into the browse mode
   c. Entered the EDIT command to change to edit mode
   d. Entered the C action command to select our CAS, which took us to the **Change CAS System Definition** panel
   e. Made the appropriate changes to our environment

   Note: When the CAS first comes up, it takes a default group name of EYUGR310. We changed our XCF group name to EYUGP310 for our production CASs, (EYUGT310 for test). Remember, as in any migration, CASs running at different release levels cannot communicate with each other.

Migrating the CMASs

Steps for migrating the CMASs

We did the following to migrate the CMASs:

1. Defined a new CSD

2. Updated the CSD with CPSM 3.1 level resource definitions and the CICS startup group list.

   We did this by running the DFHCSDUP utility with the UPGRADE command, as discussed in *CICS Operations and Utilities Guide*.

3. Updated the CICS system initialization table (SIT) overrides as follows:
   - changed GRPLIST parameter to point to the new CPSM 3.1 group list (EYU310L0)

4. Reviewed our CICS resource definition tables, which we updated earlier

5. Converted the CPSM data repository to the CPSM 3.1 level by running the EYU9XDUT utility, as discussed in *CICS Transaction Server for z/OS Installation Guide*

6. Reviewed the JCL in the EYUCMAS member for any changes to the CMAS startup procedure.

   Because there were no changes, we simply made a copy of our old procedure and updated the data set names to use our new high-level qualifiers.

7. Updated the MAS JCL to point to the new CPSM data sets, in order to identify the new CMAS code to the MAS regions.

Our CMASs were then ready to start.

Migrating the MASs

Steps for migrating the MASs

We reviewed the steps documented in CICS Transaction Server for z/OS Migration Guide to migrate the MASs. Many of the steps are similar to the steps we followed to migrate the CASs and CMASs.

We did the following to migrate the MASs:

1. Defined a new CSD and copied our application groups from the old CSD

2. Upgraded the CSD using ″UPGRADE USING(EYU964G1)″ for CPSM 3.1. We also removed groups for previous releases of CPSM from the group list

3. Reviewed our CICS resource definition tables, which were updated earlier

4. Copied the JCL for our MAS startup procedure and changed the library names to use our new high-level qualifiers;

   Reviewed the LE libraries we had in RPL concatenation.

5. Before release CTS23, JVM profiles were stored in a PDS member. In CICS TS 2.3 and later, they are stored in an HFS directory pointed to by the JVMPROFILEDIR system initialization parameter. If you are migrating from a release prior to CTS23, you will need to make the appropriate JAVA changes.

   Note: We keep our JVM profiles outside the HFS shipped with CTS31, so that they would not be overridden with a CTS31 HFS at maintenance time.

Our MASs were then ready to start.

Migrating the Web User Interface (WUI)

As stated in the *CICS Transaction Server for z/OS Migration Guide*, both the Web User Interface and the CMAS it connects to must be at the highest level of CICSPlex SM within the CICSplex. This means that both must be at the same level as the maintenance point CMAS.

Since the CICS system that acts as the Web User Interface is just another MAS, use the same steps above for migrating a MAS:

1. Migrate the MAS that acts as the Web User Interface.
2. Update the CSD with the Web User Interface group (EYU310G1).
3. Migrate the contents of the Web User Interface server repository (EYUWREP) as documented in the *CICS Transaction Server for z/OS Migration Guide*.

Experiences with migrating to CICS TS 3.1

With the exception of the usual typos and unrelated sysplex issues, this migration went very well. As we did during the last migration, we stopped and compared CPSM views, across the different releases of CPSM. We did NOT find any discrepancies or problems. In fact, we did NOT find any problems during this migration.

Chapter 5. Migrating to DB2 Version 8

This chapter addresses the processes and experiences encountered during the migration of the Integration Test production 12 way DB2 data sharing group DB1G from DB2 Version 7 to Version 8 (composed of members DBA1, DBB1, DBC1, DBD1, DBE1, DBF1, DBG1, DBH1, DBI1, DBZ1, DB81, and DB91).

We used the *DB2 Installation Guide* for our migration. Whenever we reference a **Migration Step** in **bold** in this chapter, we are referencing the same migration steps that are in the *DB2 Installation Guide*.

Migration considerations

Before you migrate to DB2 Version 8, note the following points:

- Migrations to DB2 Version 8 are only supported from subsystems currently running DB2 Version 7; unpredictable results can occur if a migration is attempted from another release of DB2.
- **Migration Step 24** is an optional step that is used to verify the DB2 Version 8 subsystem after it is in compatibility mode. For this step, only the following selected Version 7 IVP jobs can be executed:
  1. Version 7 phase 2 IVP applications
     a. DSNTEJ2A - All steps except the first two
     b. DSNTEJ2C - Only step PH02CS04, statement RUN PROGRAM(DSN8BC3) PLAN(DSN8BH61), is to be executed
     c. DSNTEJ2D - Only step PH02DS03, statement RUN PROGRAM(DSN8BD3) PLAN(DSN8BD61), is to be executed
     d. DSNTEJ2E - Only step PH02ES04, statement RUN PROGRAM(DSN8BE3) PLAN(DSN8BE61), is to be executed
     e. DSNTEJ2F - Only step PH02FS03, statement RUN PROGRAM(DSN8BF3) PLAN(DSN8BF61), is to be executed
     f. DSNTEJ2P - Execute step PH02PS05
  2. Version 7 phase 3 IVP applications
     a. ISPF-CAF applications, with the exception of DSNTEJ3C and DSNTEJ3P.

  If you want to run these IVPs as part of the verification of DB2 Version 8 compatibility mode, they must first be run under Version 7 in their entirety before you start the Version 8 migration process and must remain available for use after you complete the migration to Version 8 compatibility mode.
- Before you begin the migration process to DB2 Version 8, verify that if you are using CFCC levels 7 or 8, they are at the proper service levels - 1.06 and 1.03, respectively; to avoid the possibility of data corruption. Our three CFs are all running higher levels of service, as shown below:

```
CF1: CFCC RELEASE 14.00, SERVICE LEVEL 00.14
CF2: CFCC RELEASE 14.00, SERVICE LEVEL 00.14
CF3: CFCC RELEASE 13.00, SERVICE LEVEL 04.08
```

  Other than these requirements, no other CFCC service level requirements exist.
- Examining ″Migration Considerations″ of the *DB2 Installation Guide*, the following items are of particular interest:
  – Global temporary tables require a 16K buffer pool.

  - Declared temporary tables require at least one table space to have a page size of 8K or greater in the temporary database.
  - Support for DB2-established data spaces for cached dynamic statements is removed; you can no longer specify parameters EDMDSPAC and EDMDSMAX during migration.
  - Consider increasing IDBACK and CTHREAD subsystem parameters -- utilities might now require additional threads.
  - Support for DB2-established stored procedure address spaces is removed (that is you can no longer specify NO WLM ENVIRONMENT when creating or altering a stored procedure); existing stored procedures can continue to run in a DB2-established stored procedure address space, but you should migrate such procedures to a WLM environment as soon as possible.
  - A default DSNHDECP module (found in SDSNLOAD) is no longer shipped with DB2. DSNTIJUZ must be used to create a customized DSNHDECP, which is then placed in SDSNLOAD and SDSNEXIT.
- During the migration of the first member of a data sharing group to DB2 Version 8, other members of the data sharing group can be active, although they can experience delays or time-outs when accessing catalog objects as these objects might be locked because of the migration process. Upon completion of the migration process for all data sharing group members, you must update TSO and CAF logon procedures to reference the DB2 Version 8 libraries exclusively.

Premigration activities

Before migrating to DB2 Version 8, application of the fallback SPE to all members of the Version 7 data sharing group is necessary.

Also, ensure that the size of the work file database is sufficiently large enough to support the sorting of indexes when migration job DSNTIJTC is run.

After making a backup of the current logon procedure in use, we updated the procedure to reflect the following DB2 Version 8 concatenations before invoking the DB2 installation CLIST:

- DB2.DB2810.SDSNSPFM was concatenated to ISPMLIB.
- DB2.DB2810.SDSNSPFP was concatenated to ISPPLIB.
- DB2.DB2810.SDSNSPFS was concatenated to ISPSLIB.
- DB2.DB2810.SDSNSPFT was **not** concatenated to ISPTLIB, as DB2 online help was not installed.

In some instances it might be necessary to issue the following RACF command for the SDSNLOAD library:

```
ralter program * addmem('hlq.SDSNLOAD'/******/NOPADCHK)
```

This might prevent error messages like the following:

```
CEE3518S The module DSNAOCLI was not found in an authorized library.
CSV042I REQUESTED MODULE DSNAOCLI NOT ACCESSED. THE MODULE IS NOT PROGRAM CONTROLLED.
```

For our setup, we issued the RACF command on behalf of LDAP.

After we logged on with the updated logon procedure, we invoked the installation CLIST DSNTINST from the ISPF Command Shell by entering the following command:

```
ex 'db2.db2810.sdsnclst(dsntinst)' from ISPF option 6.
```

We filled in the first panel DSNTIPA1 as shown in Figure 7:

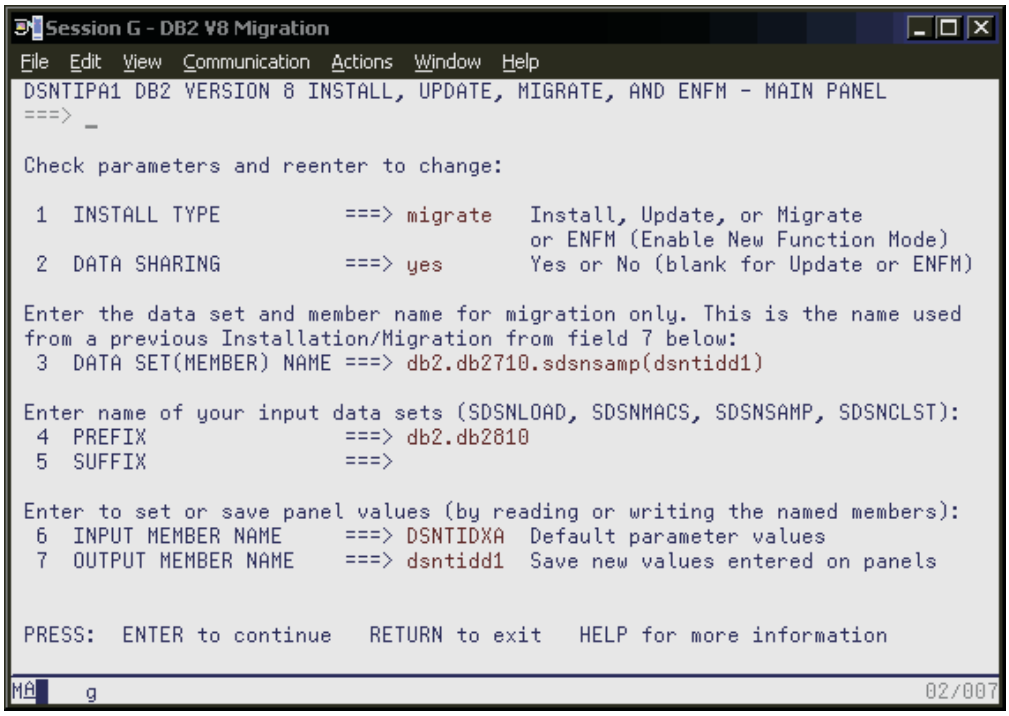


Figure 7. DSNTIPA1

When we pressed enter, the pop-up screen DSNTIPP2 appeared as shown in Figure 8 on page 56:

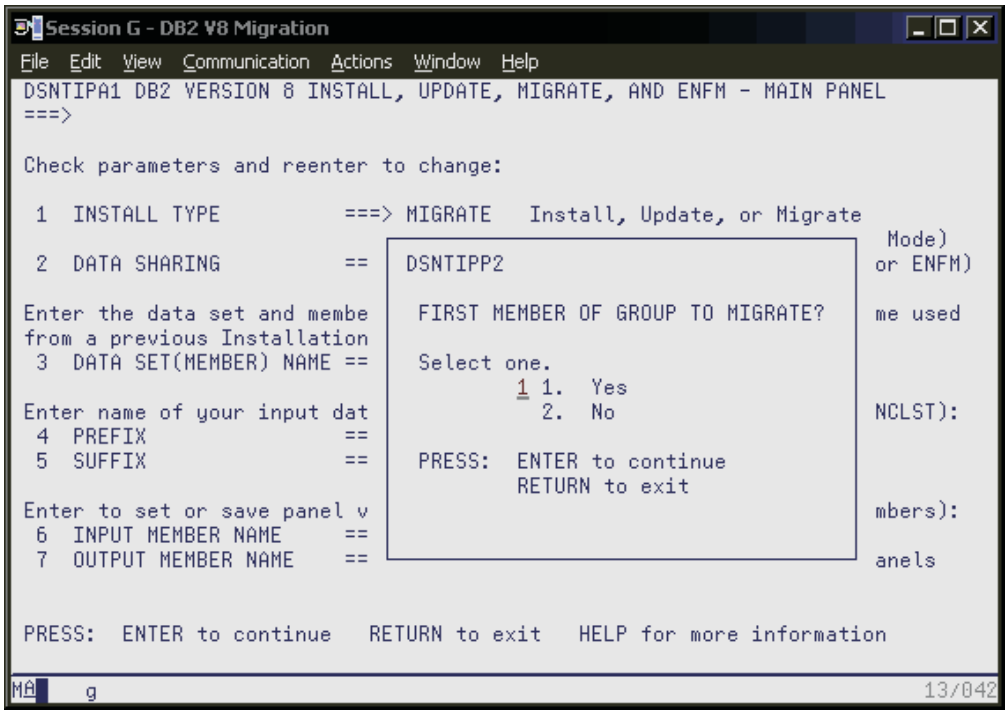


Figure 8. DSNTIPP2

We entered '1' to reflect that this was the first member of the data sharing group to be migrated to DB2 Version 8. From this point, we scrolled through the panels and accepted the existing values; upon completion, we placed the tailored CLISTs in DB2.DB2810.DBD1.SDSNSAMP and DB2.DB2810.NEW.SDSNTEMP, as shown in Figure 9 on page 57.

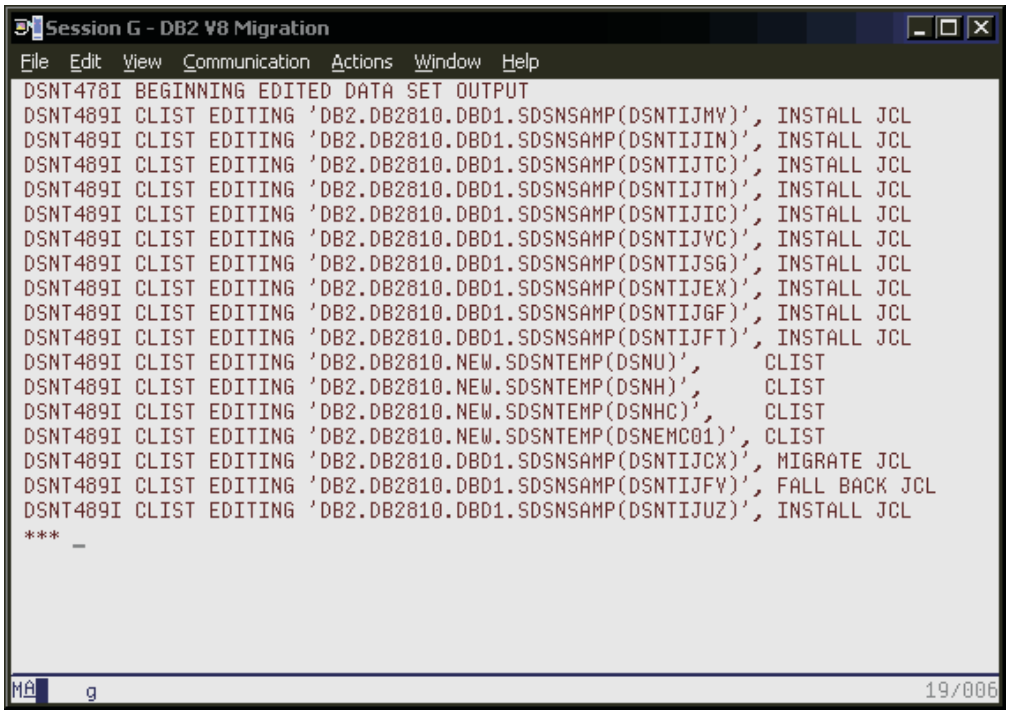


Figure 9. Tailored CLISTs placed in DB2.DB2810.DBD1.SDSNSAMP and DB2.DB2810.NEW.SDSNTEMP

Migrating the first member to compatibility mode

After we reviewed the topics outlined in **Migration Step 1**, we made the following observations:

- Ensured that the IVP jobs and sample database objects for DB2 Version 7 are still available for use. Failure to do so will prevent verifying that a successful migration to DB2 Version 8 compatibility mode has been made.
- Ensured that no utilities are running before migrating to DB2 Version 8. When the migration to Version 8 compatibility mode has been completed, any outstanding utilities that were started under Version 7 cannot be restarted or terminated under Version 8.
- EBCDIC and ASCII CCSID values must be nonzero. Note that this issue was addressed by several DB2 Version 7 PTFs (such as UQ74294), so ensure that the maintenance level for DB2 Version 7 is current before migrating to DB2 Version 8.

Migration Step 2 concerns the optional step of executing DSN1CHKR to verify the integrity of the DB2 directory and catalog table spaces that contain links or hashes. Before executing, we had to stop the following table spaces (through option `7, DB2 Commands` of the `DB2I Primary Option Menu`):

```
DSNDB06.SYSDBASE
DSNDB06.SYSDBAUT
DSNDB06.SYSGROUP
DSNDB06.SYSPLAN
DSNDB06.SYSVIEWS
DSNDB01.DBD01
```

DSN1CHKR was then executed without incident. The table spaces were restarted which had been stopped.

DB2 recommends running DSN1COPY with the CHECK option on all of the catalog and directory table spaces. To accomplish this, we created a job called CKDIRCAT and ran the job with DB2 down. No problems occurred and we brought DB2 back up.

Next, we ran the CHECK index utility against all catalog and directory indexes (we created a job called CKIDRCAT). Again, no major problems occurred (we received a RC = 4).

Finally, to ensure that there were no STOGROUPs defined with both specific and nonspecific volume ids, we ran the following query:

```
SELECT * FROM SYSIBM.SYSVOLUMES V1
  WHERE VOLID <> '*' AND
  EXISTS (SELECT * FROM SYSIBM.SYSVOLUMES V2
            WHERE V1.SGNAME = V2.SGNAME AND V2.VOLID='*');
```

The query did not return any rows.

Migration Step 3 is an optional step to determine which plans and packages are to be rendered not valid as a result of migrating to DB2 Version 8. To accomplish this, we ran the following queries:

```
SELECT DISTINCT DNAME
  FROM SYSIBM.SYSPLANDEP
  WHERE BNAME IN('DSNVVX01','DSNVTH01') AND
        BCREATOR = 'SYSIBM' AND
        BTYPE IN ('I','T')
  ORDER BY DNAME;


SELECT DISTINCT COLLID, NAME, VERSION
  FROM SYSIBM.SYSPACKDEP, SYSIBM.SYSPACKAGE
  WHERE BNAME IN('DSNVVX01','DSNVTH01')
    AND LOCATION = ' '
    AND BQUALIFIER = 'SYSIBM'
    AND BTYPE IN ('I','T')
    AND COLLID = DCOLLID
    AND NAME = DNAME
    AND CONTOKEN = DCONTOKEN
  ORDER BY COLLID, NAME, VERSION;
```

The first query did not produce any rows, while the second generated the results shown in Figure 10 on page 59.

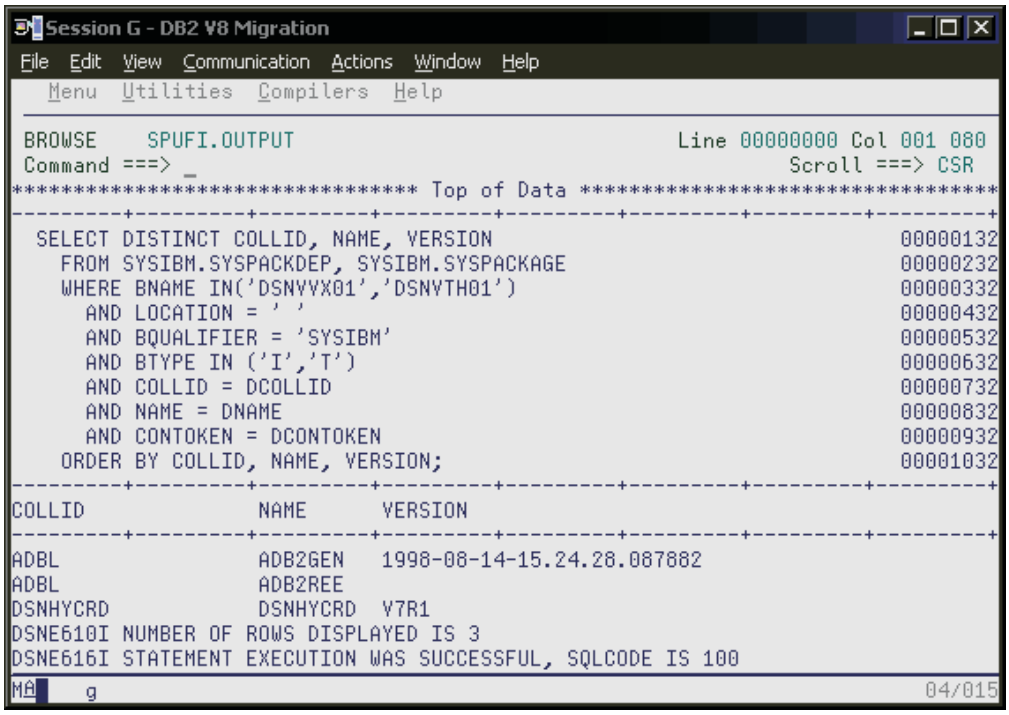


Figure 10. Output from query to find packages that will be invalidated when migrating to DB2 Version 8

Migration Step 4 is another optional step to check for consistency between catalog tables through running the queries contained in DB2.DB2810.SDSNSAMP(DSNTESQ). There are a total of 65 queries contained in this data set. We used the data set as input to SPUFI, it ran with no inconsistencies.

Migration Step 5 addresses performing an image copy of the catalog and directory in case of fallback. The *DB2 Installation Guide* recommends using the Version 7 job DSNTIJIC, however, this job has the following shortcomings:

- Does not place the catalog and directory table spaces in utility status to prevent updates while the image copies are being taken.
- Does not quiesce the catalog and directory spaces to provide a consistent point of recovery (the catalogs are referentially linked).

Using the groundwork laid in DSNTIJIC and before performing the image copies, we added steps to place all catalog and directory spaces in utility status and to quiesce them. In addition, we redirected the image copies to DASD generation data groups (GDGs) rather than to tape. Finally, we added a step to the job to restart the catalog and directory tables spaces read/write after the image copies. The job called IDIRCAT7 and was successfully executed.

In preparation for the post-migration image copy of the catalog and directory, we made similar modifications to the Version 8 job DSNTIJIC. The job was called IDIRCAT8 and included image copy steps for the new catalog table spaces **DSNDB06.SYSALTER** and **DSNDB06.SYSEBCDC**.

Migration Step 6 addresses the following steps necessary to connect DB2 to TSO:

- **Making DB2 load modules available to TSO and batch users** - SDSNEXIT and SDSNLOAD were added to linklist.

- **Making DB2 CLISTs available to TSO and batch users: DSNTIJVC** - Our logon proc QMFPROC must again be updated to add DB2.DB2810.NEW.SDSNCLST to the SYSPROC concatenation. We had to do this **after** we ran the installation job DSNTIJVC (the job that merges tailored CLISTs from prefix.NEW.SDSNTEMP with unchanged CLISTs from prefix.SDSNCLST and places the resulting set of CLISTs in the newly created data set prefix.NEW.SDSNCLST). Since we currently use fixed-block CLIST libraries (use the SYSPROC concatenation in logon proc QMFPROC), we had to modify DSNTIJVC as follows:
  - Changed the SYSIN DD to DUMMY.
  - Changed the allocation of prefix.SDSNCLST to match the data control block (DCB) attributes of our other CLIST libraries; this was accomplished by replacing the DCB attributes for DSNTIVB.SYSUT2 with **DCB=*.SYSUT1**.

  After DSNTIJVC successfully ran, we update logon proc QMFPROC to add DB2.DB2810.NEW.SDSNCLST to the SYSPROC concatenation.
- **Making panels, messages, and load modules available to ISPF and TSO** - We previously added SDSNSPFP, SDSNSPFM, and SDSNSPFS to the ISPF concatenations. In addition, we updated the logon proc QMFPROC to reflect the concatenation of the DB2 English DB2I panels as follows:
  - DB2.DB2810.SDSNPFPE concatenated to ISPPLIB.

Because IMS and CICS connections to DB2 had previously been established, we skipped **Migration Step 7** and **Migration Step 8**.

Migration Step 9 instructed us to stop all DB2 V7 activity or else fallback procedures can fail. Before stopping data sharing group DB1G, we insured that there were no incomplete utilities (**@DBD1 DISPLAY UTILITY(*)**), and that no databases were in restrict or advisory status (**@DBD1 DISPLAY DATABASE(*) SPACE(*) RESTRICT** and **@DBD1 DISPLAY DATABASE(*) SPACE(*) ADVISORY**, respectively); brought down all members of DB1G.

We skipped optional **Migration Step 10 (Back Up your DB2 Version 7 volumes)** and performed **Migration Step 11**, which defines DB2 initialization parameters through DSNTIJUZ. After modifying this job by removing the SMP/E step, we submitted it and it ran successfully.

As subsystem security had already been established, we skipped **Migration Step 12**.

Migration Step 13 defines DB2 V8 to MVS. We examined job DSNTIJMV to see which modifications to the MVS environment were required; they were implemented accordingly. DSNTIJMV performs the following actions:

- Updates IEFSSNxx, APF, and linklist members, which were deemed not necessary as they had been performed previously.
- Step RENAME renames the current DB2 procedures in proclib. We skipped this step, however. The DB2 startup procs for DBD1 are renamed manually (see below).
- Step DSNTIPM adds catalogued procedures to proclib; however rather than directing the output of this step to SYS1.PROCLIB, we directed it to a newly created data set, DB2.DB2810.PROCLIB.

We renamed the startup procs for DBD1 that reside in PET.PROCLIB (as per the RENAME step of DSNTIJMV). Next, we copied the new V8 startup procs for DBD1 from DB2.DB2810.PROCLIB.

For **Migration Step 14**, we successfully ran job DSNTIJIN to define system data sets.

For **Migration Step 15**, we ran the last two steps of job DSNTIJEX to assemble and link edit the access control authorization exit DSNXSXAC and user exit routine DSNACICX (invoked by stored procedure DSNACICS). We skipped the first and second steps that are used to assemble and link edit the signon (DSN3@SGN) and identify (DSN3@ATH) exits because they were not previously implemented.

Because we had previously IPLed the system to pick the V8 early code, we skipped **Migration Step 16**.

For **Migration Step 17**, the DBD1 member of data sharing group DB1G was started successfully. As shown in Figure 11, the level of the data sharing group is now 810 and in compatibility mode (**MODE(C)**). The DB2 level of DBD1 reflects that it is now running DB2 Version 8 code. The DISPLAY GROUP command shows the data sharing group is in compatibility mode and one member is running DB2 Version 8.

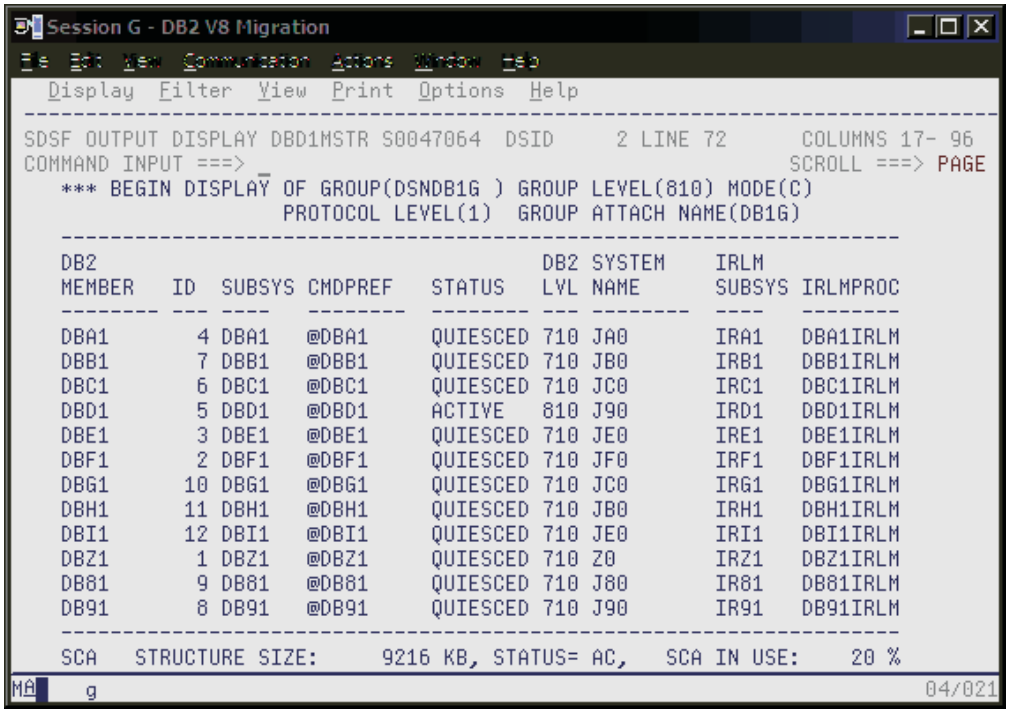


Figure 11. DISPLAY GROUP command

Up on deck next is CATMAINT, as outlined in **Migration Step 18**. We submitted and ran DSNTIJTC successfully. The job periodically issued message DSNU777I in SYSPRINT to indicate migration progress, as shown in Figure 12 on page 62:

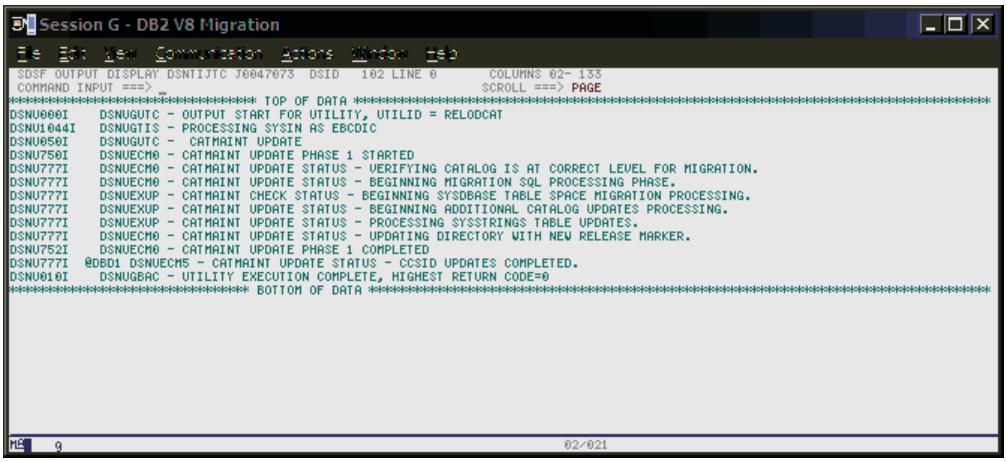


Figure 12. Message DSNU777I displays CATMAINT progress

Migration Step 19 is an optional step to ensure that there are no problems with the catalog and directory after running DSNTIJTC. We used the following steps:

- Ran DSNTIJCX to ensure the integrity of the catalog indexes. The first step produced a return code of 4 as a result of no indexes being found for table space DSNDB06.SYSALTER (these objects will be created during the enabling of New Function Mode). The remaining steps produced a return code of zero.
- Ran DSN1CHKR as in **Migration Step 2** to ensure there were no broken links and that it ran successfully.
- Examined the queries in SDSNSAMP member DSNTESQ for discrepancies; none found.
- Ran DSN1COPY with the CHECK option on the catalog and directory table spaces. The job completed with a return code of 4, the result of step SYSDBASE, which produced the following report:

```
DSN1999I START OF DSN1COPY FOR JOB CKDIRCAT STEP1   SYSDBASE
DSN1989I DSN1COPY IS PROCESSED WITH THE FOLLOWING OPTIONS:
         CHECK/NO PRINT/4K/NO IMAGECOPY/NON-SEGMENT/NUMPARTS=0/NO OBIDXLAT/NO VALUE/NO RESET/     /   /   /
         DSSIZE=   /PIECESIZ=    /
DSN1998I INPUT  DSNAME = DSNDB1G.DSNDBC.DSNDB06.SYSDBASE.I0001.A001  , VSAM
DSN1997I OUTPUT DSNAME = NULLFILE                                     , SEQ
DSN1991I UNCLUSTERED DATA DETECTED.  RID: '0000006D03'X   TABLE: SYSTABLESPACE INDEX KEY: WRKDBD1  DSN32K01
DSN1991I UNCLUSTERED DATA DETECTED.  RID: '0000006D02'X   TABLE: SYSTABLESPACE INDEX KEY: TMPDBD1  TEMPTS01
DSN1994I DSN1COPY COMPLETED SUCCESSFULLY,  00001250 PAGES PROCESSED
```

We submitted a reorg of DSNDB06.SYSDBASE to recluster the data; using DSN1COPY again with the CHECK option against DSNDB06.SYSDBASE then produced a return code of zero.

Before DB2 Version 8, if DBINFO was used to define external functions or procedures, the routine body must be recompiled and rebound to correctly reference ASCII or Unicode CCSID fields in DBINFO. **Migration Step 20** deals with this. The following query can be executed to identify those routines that might need to be recompiled and rebound because they reference ASCII or Unicode CCSID fields in DBINFO:

```
SELECT SCHEMA,NAME FROM SYSIBM.SYSROUTINES WHERE DBINFO='Y';
```

We had no such routines defined on our system.

Because we disabled change data capture on multiple DB2 catalog tables as a result of migrating to Version 8 compatibility mode, we performed **Migration Step 21** to re-enable change data capture on the appropriate catalog tables by issuing the following command:

```
ALTER TABLE SYSIBM.SYSTABLES DATA CAPTURE CHANGES;
```

We received an SQL code of -4700, which basically states that the query could not be executed because the data sharing group was not in New Function Mode. We postponed this step until after all members of the data sharing group were migrated to compatibility mode (see “Migrating to new function mode” on page 70).

We performed **Migration Step 22**, DSNTIJTM, assemble, link-edit, bind, and invoke DSNTIAD, and the job ran successfully.

We ran job DSNTIJSG according to the instructions specified in **Migration Step 23**. It completed successfully (RC=4). Note that when this job is executed, SPUFI can only be invoked from members of the data sharing group that have been migrated to V8 - those remaining on V7 will receive resource unavailable messages until they have migrated to V8, as shown in Figure 13:

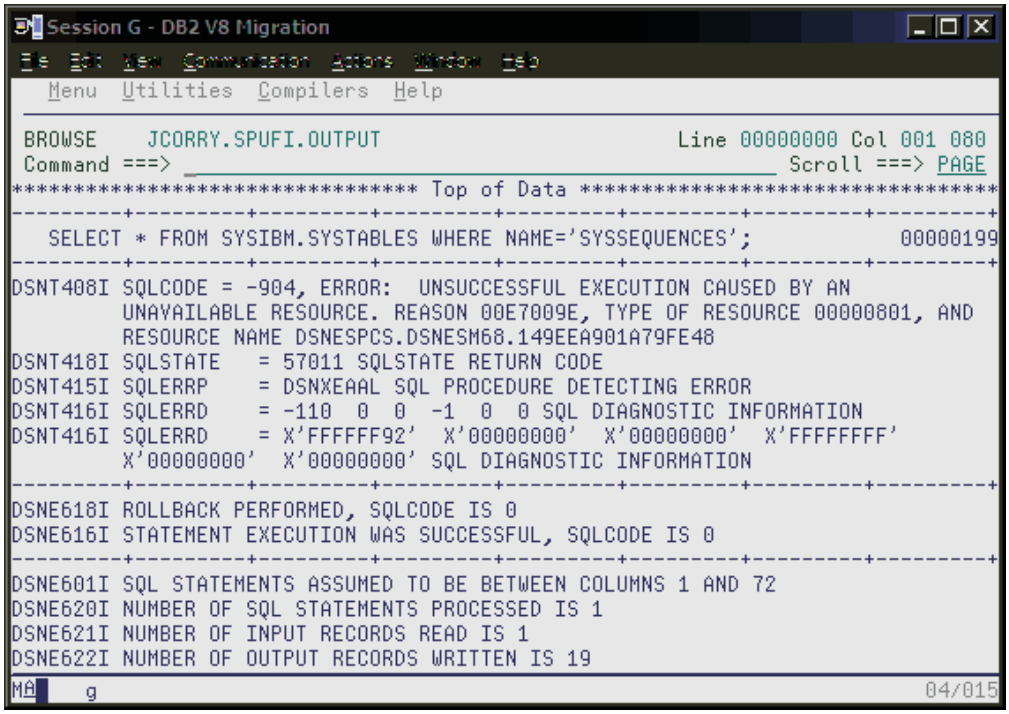


Figure 13. SPUFI is not available for use on DB2 Version 7 members after the execution of DSNTIJSG

Migration Step 24 describes how DSNTIJRX is used to optionally bind the packages for DB2 REXX language support. We did not perform this step because we do not have this feature available.

Because some views might have been marked with view regeneration errors during the migration to Version 8 compatibility mode, we performed **Migration Step 25** and identified the views with the following query:

```
SELECT CREATOR,NAME FROM SYSIBM.SYSTABLES
WHERE TYPE='V' AND STATUS='R' AND TABLESTATUS='V';
```

For those views found to have view regeneration errors, we issued the following command:

```
ALTER VIEW view_name REGENERATE;
```

In **Migration Step 26** we took another image copy of the directory and catalog after they were successfully migrated to V8, and submitted job IDIRCAT8; recall that this job is located in DB2.JOBS and is a modified version of DSNTIJIC (see **Migration Step 5** for details). Execution of IDIRCAT8 completed successfully.

Optional **Migration Step 27** verifies the DB2 Version 8 subsystem that is now in Compatibility Mode. For this step, only the following Version 7 IVP jobs can be submitted:

1. Version 7 Phase 2 IVP Applications
   a. DSNTEJ2A - All steps except the first two
   b. DSNTEJ2C - Only step PH02CS04, statement RUN PROGRAM(DSN8BC3) PLAN(DSN8BH61) is to be executed
   c. DSNTEJ2D - Only step PH02DS03, statement RUN PROGRAM(DSN8BD3) PLAN(DSN8BD61) is to be executed
   d. DSNTEJ2E - Only step PH02ES04, statement RUN PROGRAM(DSN8BE3) PLAN(DSN8BE61) is to be executed
   e. DSNTEJ2F - Only step PH02FS03, statement RUN PROGRAM(DSN8BF3) PLAN(DSN8BF61) is to be executed
   f. DSNTEJ2P - Execute step PH02PS05.
2. Version 7 Phase 3 IVP Applications
   a. ISPF-CAF applications, with the exception of DSNTEJ3C and DSNTEJ3P. Note that you must temporarily place the Version 7 SDSNSPFP panel library ahead of the Version 8 SDSNSPFP panel library in the ISPPLIB concatenation. This permits the plans that were migrated from Version 7 to be used.

Of the IVP jobs listed, we only issued the first, DSNTEJ2A, under Version 7. It is therefore the only IVP that we could use in Version 8 Compatibility Mode. For the record, if it is desired to execute the remaining IVPs as part of the verification of DB2 Version 8 Compatibility Mode, they must first be executed under Version 7 in their entirety before starting the Version 8 migration process and remain available for use after the migration to Version 8 Compatibility mode has been completed.

Before executing DSNTEJ2A, we performed the following actions:

- We updated JOBLIB statements to reflect the DB2 Version 8 load library.
- We edited proc DSN8EAE1 (used by the employee sample table) and copied it from the Version 7 exit library to the Version 8 exit library.

When we completed these tasks, we ran DSNTEJ2A and it produced a return code of 4 as the result of placing tables DSN8D71U.NEWDEPT and DSN8D71U.NEWPHONE in COPY PENDING status. This was as expected.

Finally, optional **Migration Step 28** deals with enabling WLM stored procedures by either executing the installation CLIST in MIGRATE mode or by editing and executing DSNTIJUZ. Additional information on enabling stored procedures is available in the *DB2 Installation Guide* under topic 2.6.24, ″Enabling stored procedures after installation″. Since we had already enabled WLM stored procedures under DB2 Version 7, this step was skipped.

DB2 V7 and V8 coexistence issues

We allowed the data sharing group to run in coexistence mode for several days while we tested various workloads and products for coexistence issues.

It is recommended that a data sharing group remain in coexistence mode for as brief a time period as necessary.

During this period we did not experience any problems.

Migrating the remaining members to compatibility mode

The next member to migrate in the data sharing group to DB2 Version 8 compatibility mode was DBG1. For us, this was a fairly simple process, which entailed the following steps:

1. Executing the installation CLIST.
2. Executing the resultant DSNTIJUZ job.
3. Replacing the Version 7 startup procs for the member being upgraded with their Version 8 equivalents. This is performed by executing DSNTIJMV step DSNTIPM.
4. Starting the member.

So, beginning with the installation CLIST, we ran DSNTINST from the ISPF Command Shell (ISPF option 6) by entering the following command:

```
ex 'db2.db2810.sdsnclst(dsntinst)'
```

We filled in the first panel as shown:

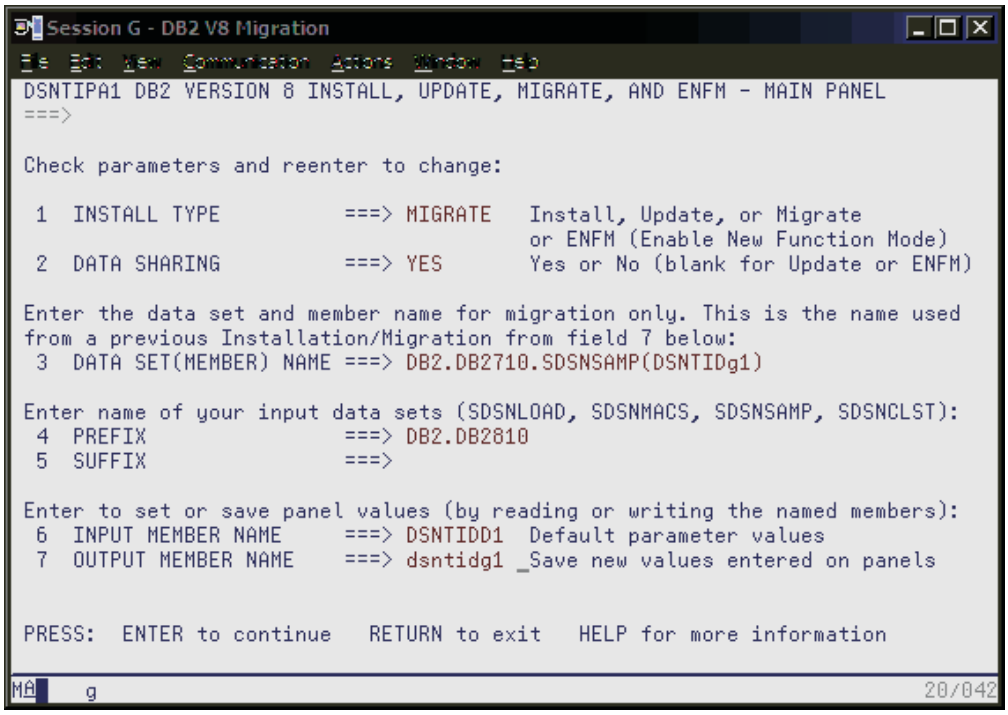


Figure 14. Executing DSNTINST in preparation for migrating the next member of the data sharing group

Pressing enter, we obtained the following pop-up screen:

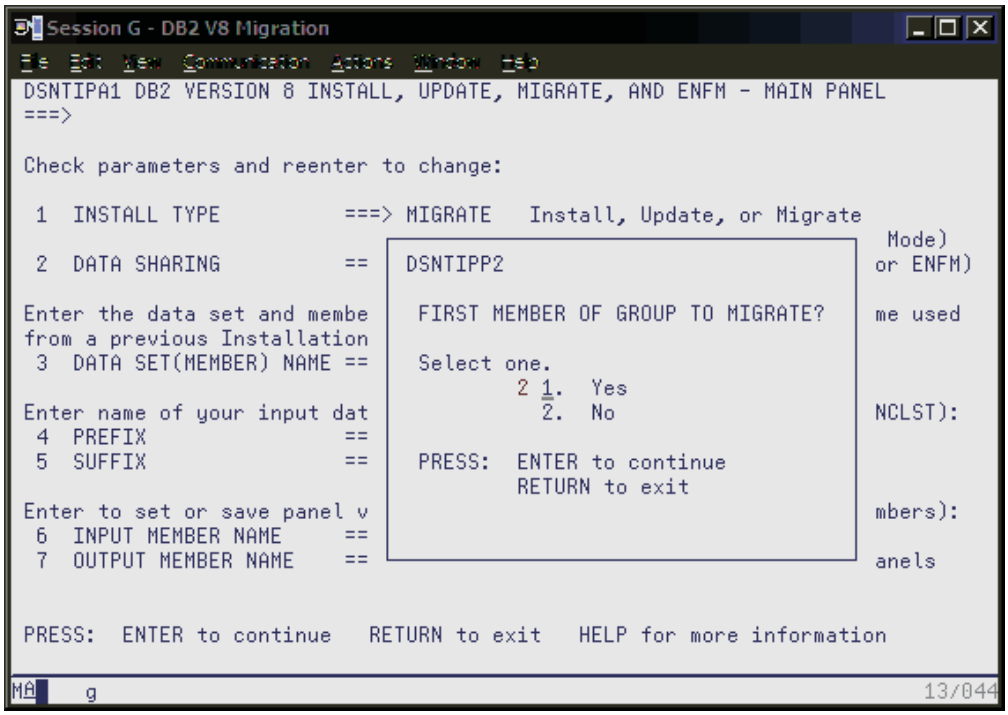


Figure 15. DSNTIPP2 pop-up screen

From this point, we scrolled the panels and accepted the existing values with the exception of the name of the sample library on panel DSNTIPT. We maintain a

separate sample library for each member of the data sharing group, so this field was updated accordingly to reflect DBG1, as shown in Figure 16.

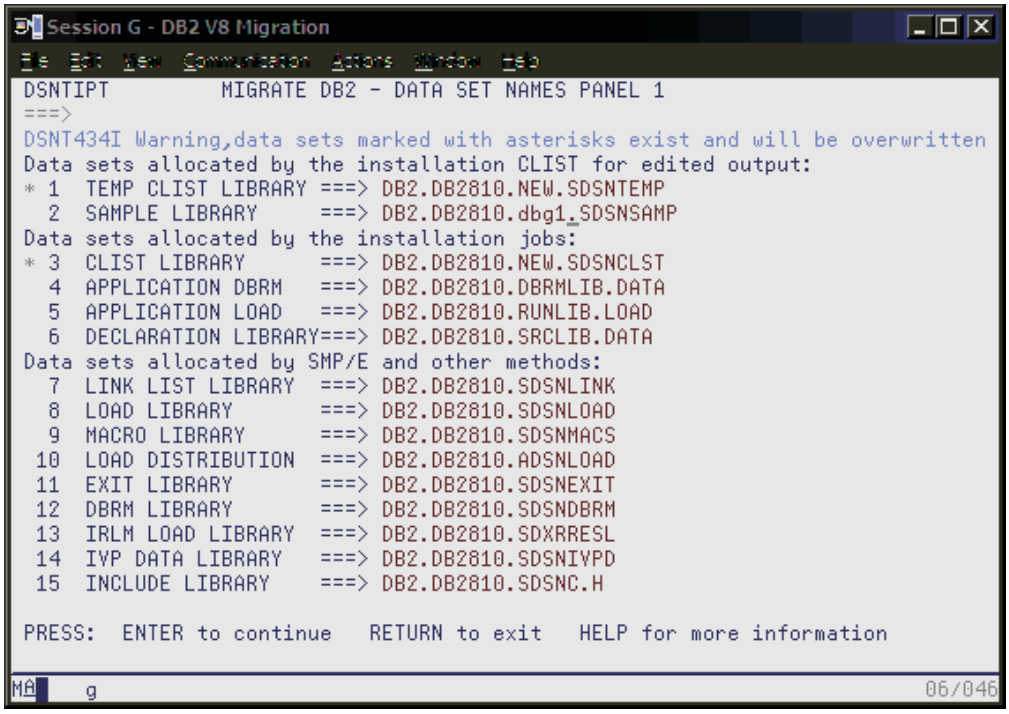


Figure 16. DSNTIPT - Data Set Names Panel 1

We placed the tailored migration JCL in DB2.DB2810.DBG1.SDSNSAMP as can be seen in Figure 17 on page 68:

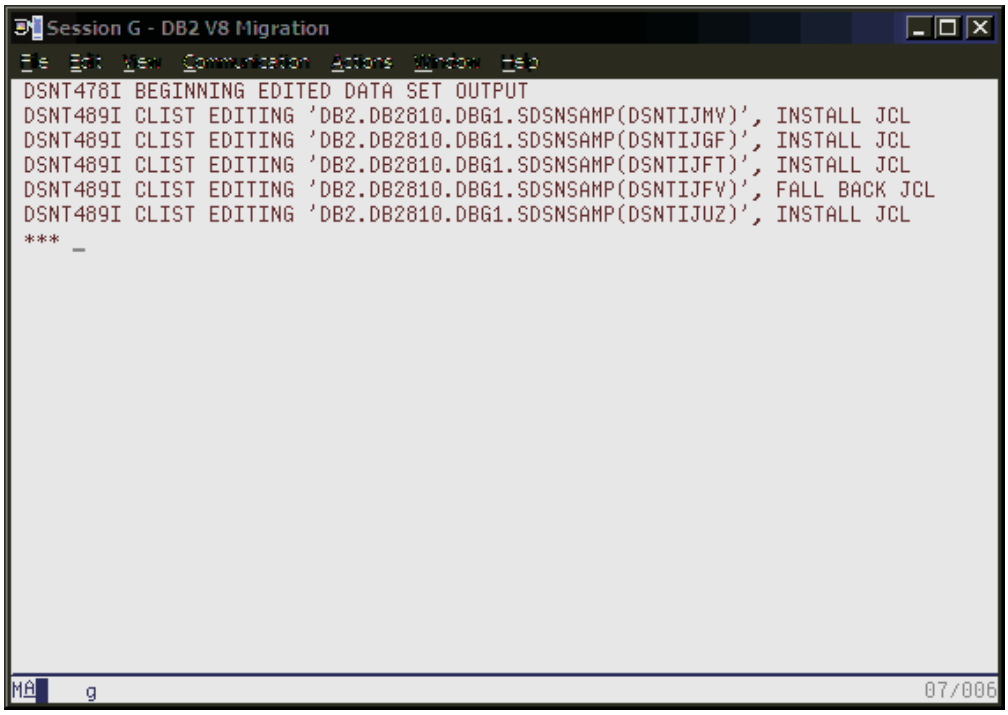


Figure 17. Tailored migration JCL placed in DB2.DB2810.DBG1.SDSNSAMP

Next, we removed the SMP/E step, brought DBG1 down, and ran DSNTIJUZ. DSNTIJUZ was submitted and ran successfully.

Next, we used steps RENAME and DSNTIPM of job DSNTIJMV to rename the existing Version 7 startup procedures for DBG1 and to add the new Version 8 startup procedures to proclib.

We then started DBG1 successfully in compatibility mode, as can be seen in Figure 18 on page 69:

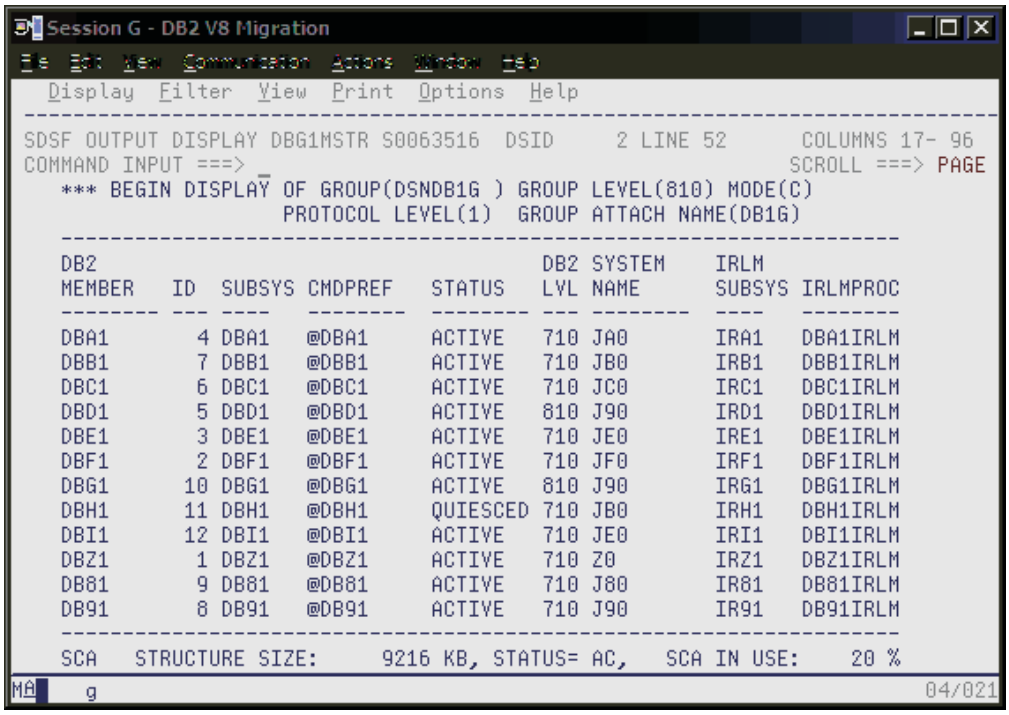


Figure 18. DBG1 started in compatibility mode

We followed the same process for the remaining ten members of the data sharing group, resulting in all members being in compatibility mode:

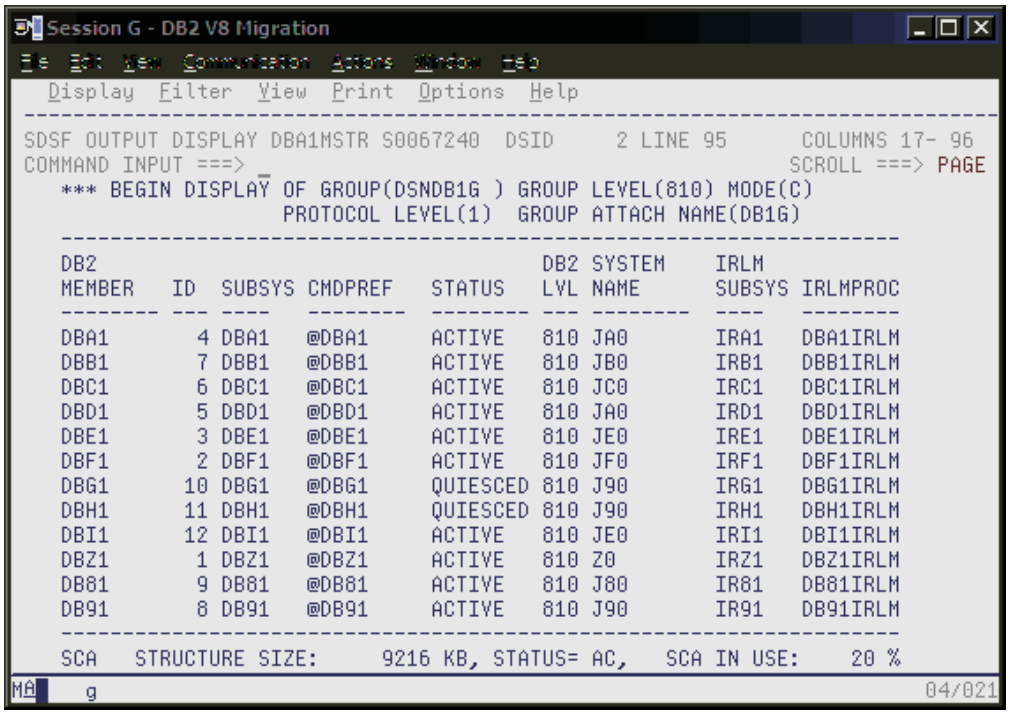


Figure 19. All members now in compatibility mode

Migrating to new function mode

After we migrated all members of the data sharing group to compatibility mode, we had to convert the DB2 catalog to exploit the new functions introduced by DB2 Version 8. The process is outlined below.

Preparing for new function mode

Before enabling-new-function mode, ensure that the following steps are taken.

- Ensure buffer pools BP8K0, BP16K0, BP32K exist, and in a data sharing environment that their corresponding group buffer pools have been defined (GBP8K0, GBP16K0, and GBP32K).
- An image copy of the catalog and directory must be taken before executing DSNTIJNE, which converts the DB2 catalog to Unicode for the first time.
- Increase the size of shadow data sets (panel DSNTIP01 of the installation CLIST) in order to support longer object names in the DB2 catalog; depending on their current size, you might have to increase the size of the catalog table space and index space as well.
- Run the installation CLIST using the ENFM option on panel DSNTIPA1.

After attending to the first three items, the installation CLIST was executed; panel DSNTIPA1 was completed as shown in Figure 20:

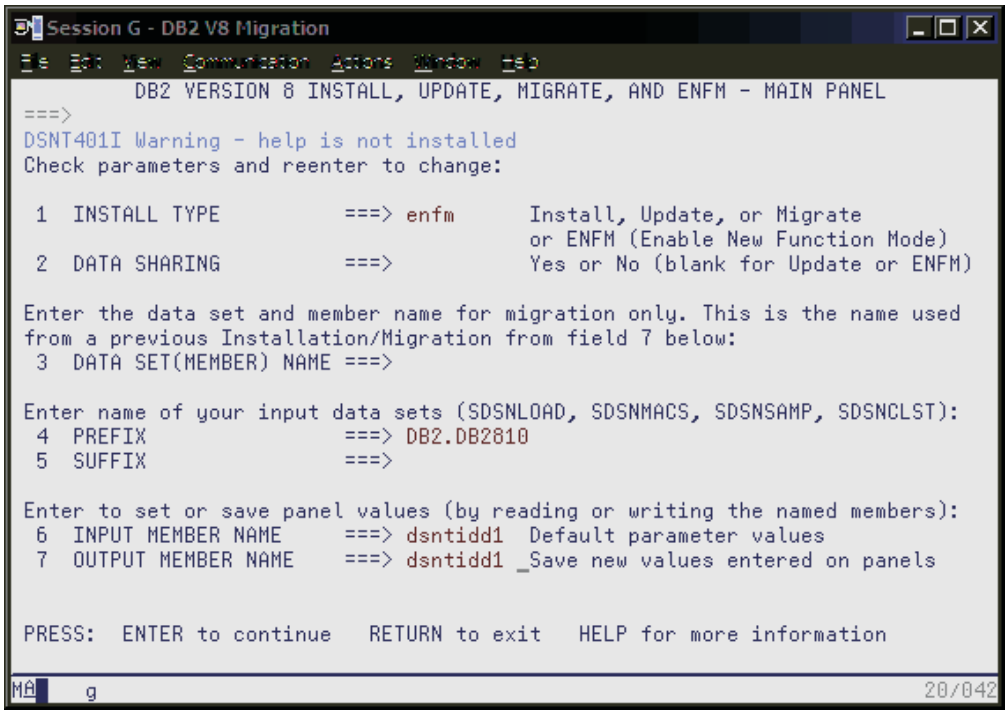


Figure 20. Executing DSNTINST in preparation for enabling-new-function-mode

Press enter twice to display panel DSNTIP00:

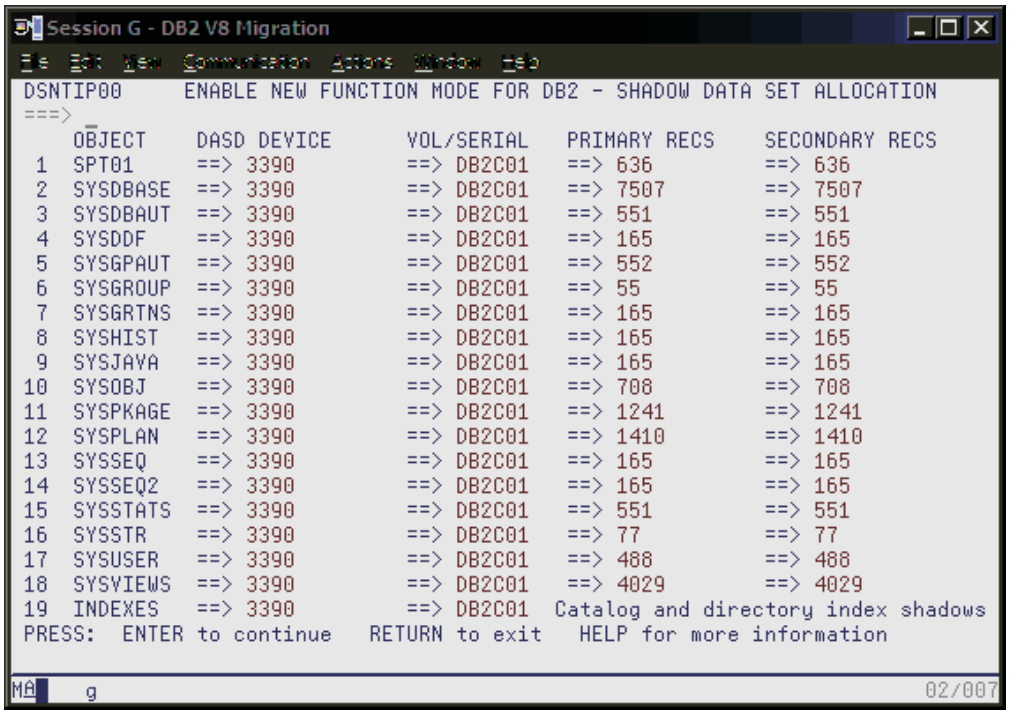


Figure 21. DSNTIP00 panel

We accepted calculated values and pressed enter to continue:

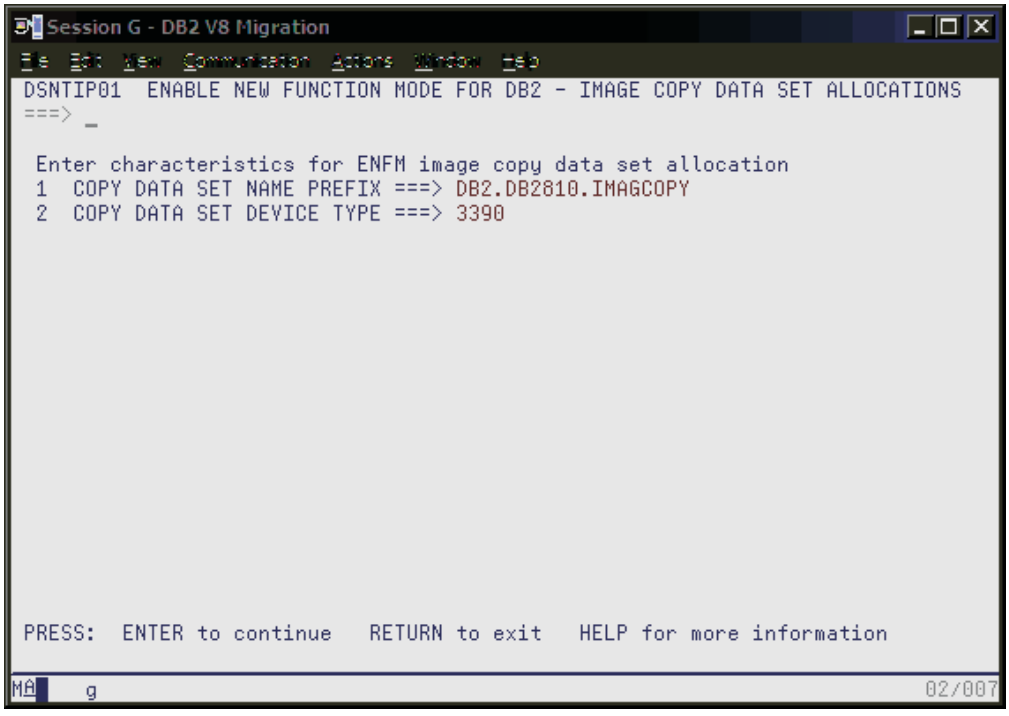


Figure 22. Image copy data set allocations on panel DSNTIP01

After updating the high-level-qualifier to be used for image copy data sets (`DB2.IC.DB1G`), we pressed enter and the following warning message appeared:

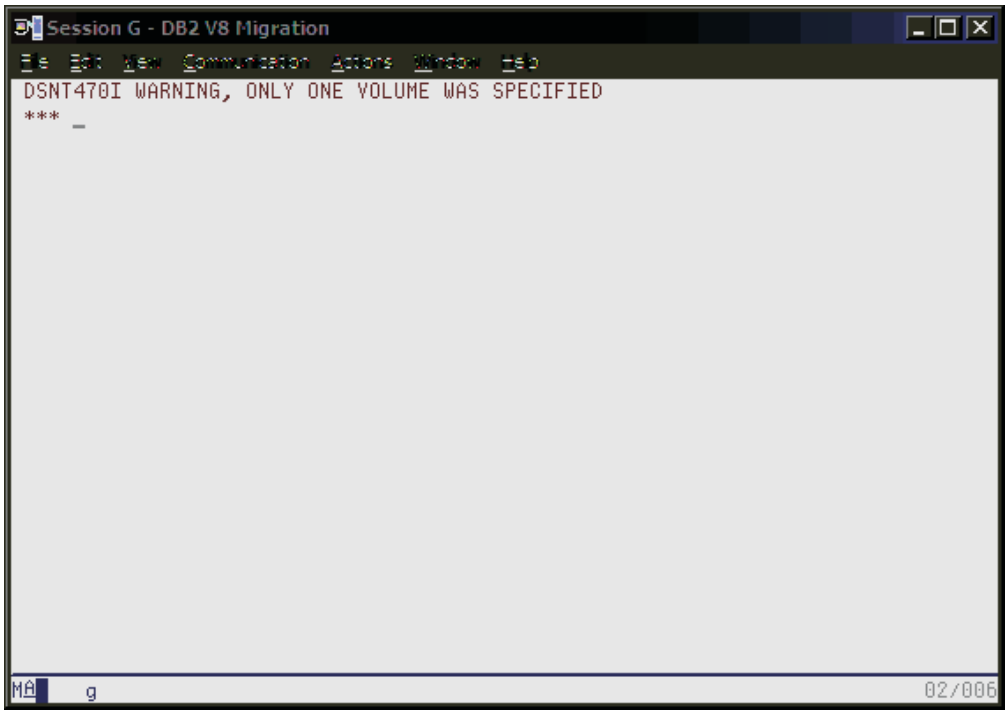


Figure 23. DSNT470I Warning message, only one volume was specified

After pressing enter, we obtained panel DSNTIP02:

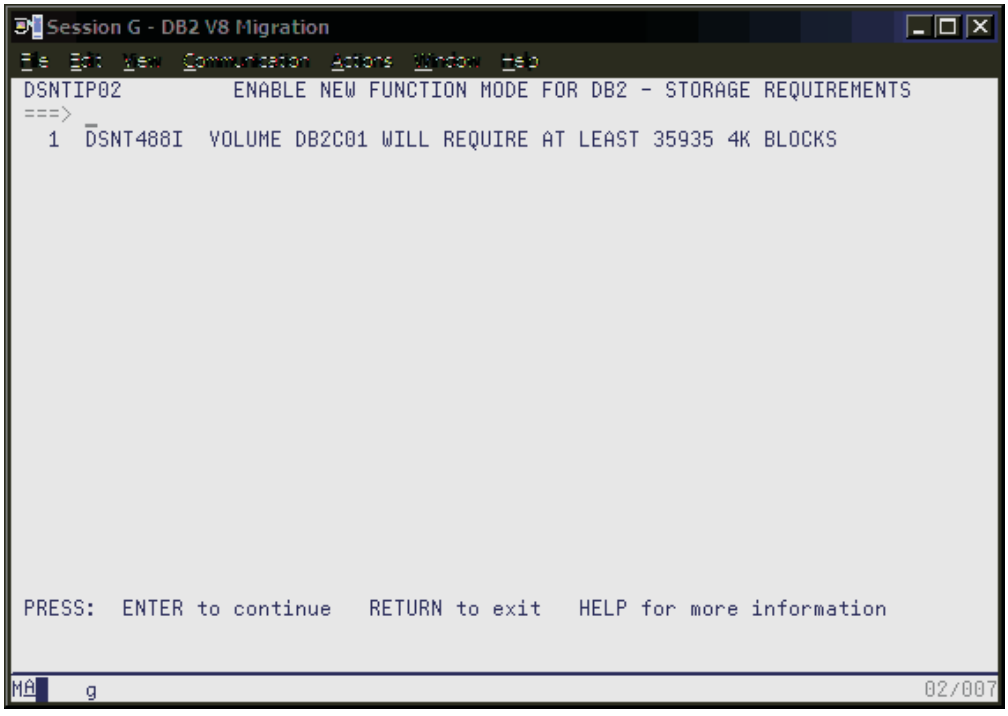


Figure 24. Message DSNT488I displayed on panel DSNTIP02

This was the last panel displayed. When we pressed enter, the generation of the enabling-new-function mode job along with the DB2 Version 8 sample jobs, occurred as shown in the following three screen images:

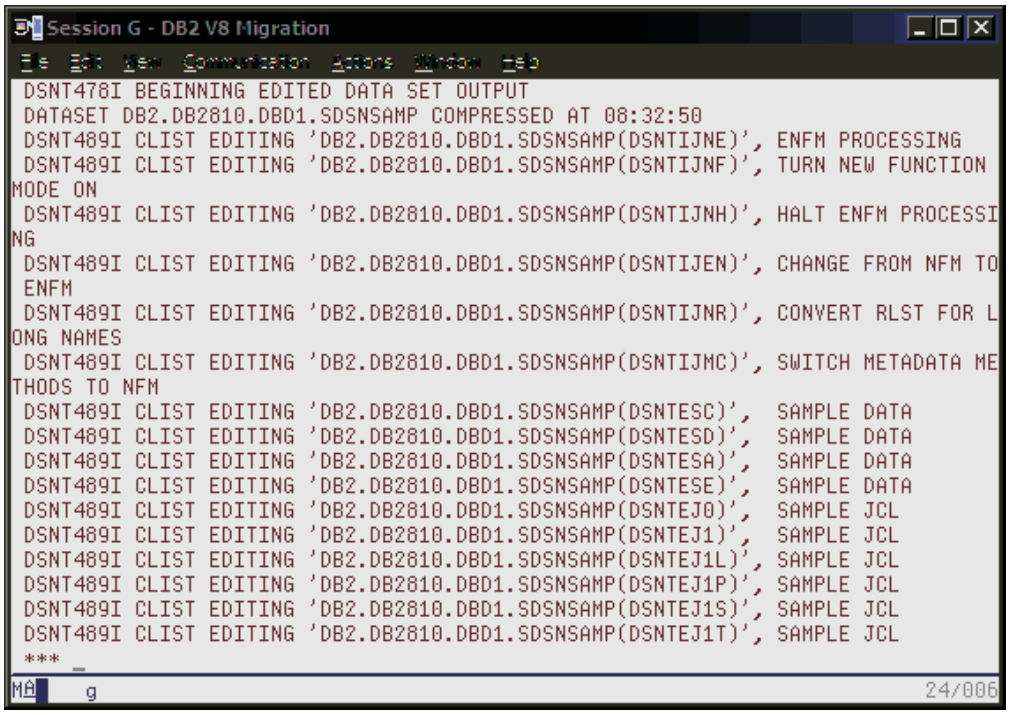


Figure 25. DSNT478I beginning data set output

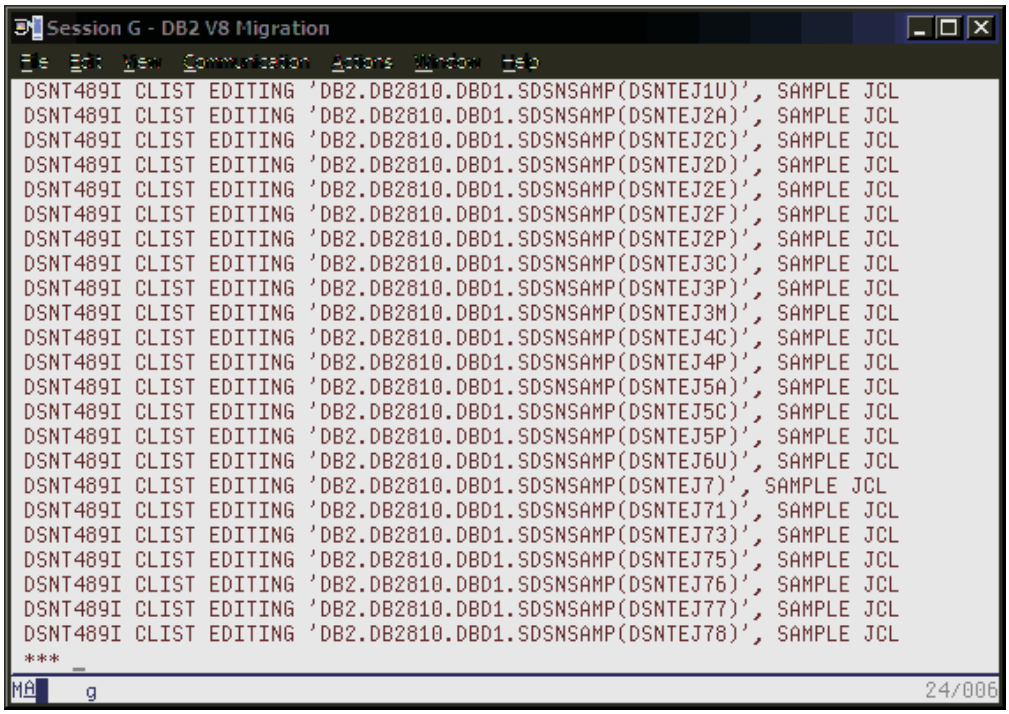


Figure 26. DSNT489I CLIST editing

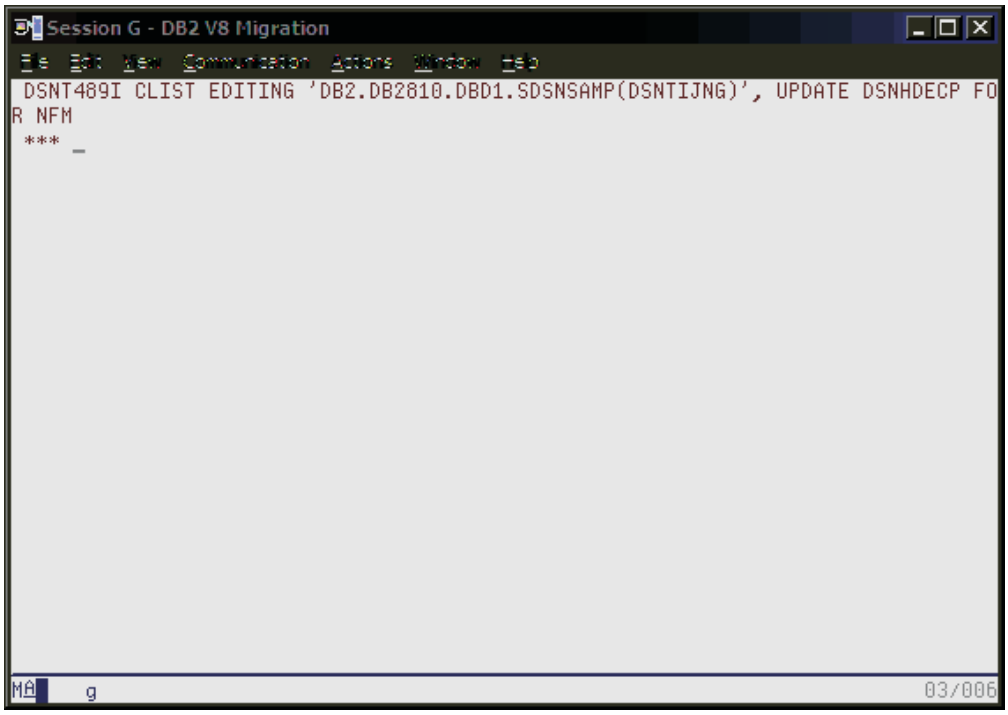


Figure 27. Screen showing completion of the preparation before enabling Version 8 new function mode

Enabling new function mode

Attention: Before proceeding, ensure that an image copy of the catalog and directory is taken.

The first step in enabling new function mode is to execute DSNTIJNE, which among other things converts the DB2 catalog to Unicode. The DISPLAY GROUP DETAIL command can be used during DSNTIJNE processing to determine how the enabling-new-function mode process is proceeding. It will display the names of the DB2 system table spaces and whether or not new function mode has been enabled yet, as shown in Table 13 on page 75:

Table 13. DB2 system table spaces and whether or not new function mode has been enabled yet.

Table Space	Enabled New Function Mode
SYSVIEWS	YES
SYSDBASE	YES
SYSDBAUT	YES
SYSDDF	NO
SYSGPAUT	NO
SYSGROUP	NO
SYSGRTNS	NO
SYSHIST	NO
SYSJAVA	NO
SYSOBJ	NO
SYSPKAGE	NO
SYSPLAN	NO
SYSSEQ	NO
SYSSEQ2	NO
SYSSTATS	NO
SYSSTR	NO
SYSUSER	NO
SPT01	NO

We submitted DSNTIJNE and then issued the DISPLAY GROUP DETAIL command throughout DSNTIJNE processing to view our progress. Note that the DISPLAY GROUP DETAIL output showed that we were now in enabling new function mode, as evidenced by `MODE(E)`.

Upon successful completion of DSNTIJNE, we took another image copy of the catalog and directory.

Next, we executed job DSNTIJNF, which is used to verify that the conversion of the DB2 catalog and directory. It completed successfully and produced a return code of zero. A DISPLAY GROUP DETAIL at this point reveals that we are now in new function mode (note `MODE(N)` in Figure 28 on page 76):

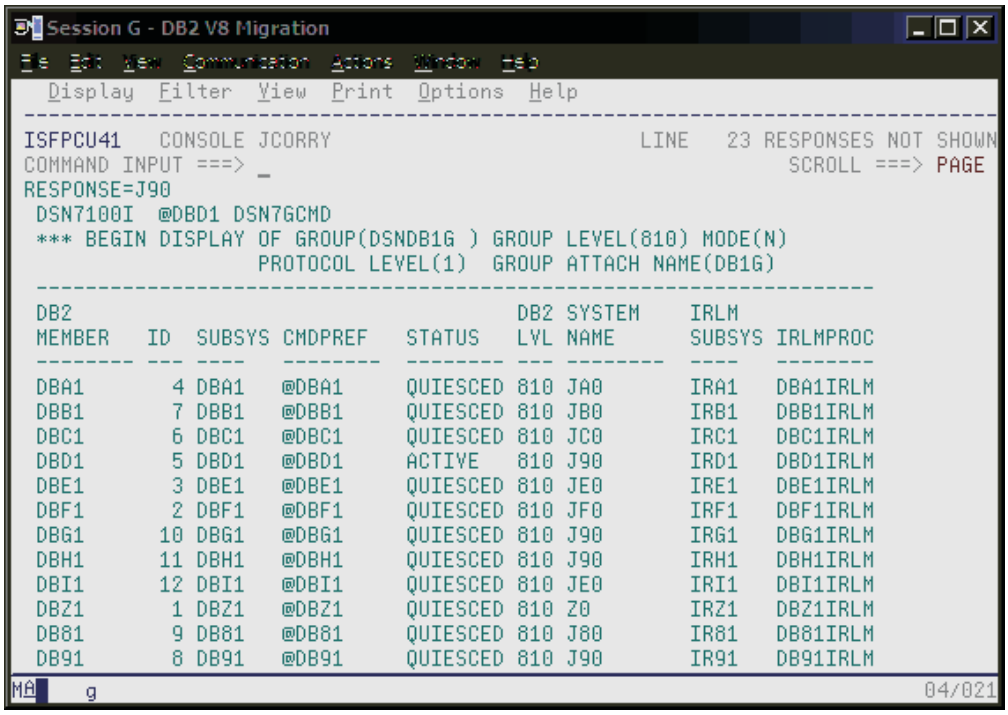


Figure 28. The DISPLAY GROUP command shows the data sharing group is now in new function mode

Running in new function mode

When we were in new function mode, we needed to run DSNTIJNG; it modifies DSNHDECP and allows new-function SQL statements introduced with Version 8 to be accepted by the DB2 precompiler by default. Note that in a data sharing environment where multiple DSNHDECP modules are in use, the jobs used to maintain the DSNHDECP modules must be updated to specify NEWFUN=YES. In our environment, only a single DSNHDECP module exists, therefore we ran DSNTIJNG successfully. (Note that we did not execute the last step, which deals with SMP/E.)

During the process of enabling-new-function mode, DATA CAPTURE was set to NONE on all of the DB2 catalog tables with the exception of SYSCOPY. Now that we are in new function mode, DATA CAPTURE must be re-enabled. This is a manual process and is performed by issuing the following ALTER command:

```
ALTER TABLE SYSIBM.SYSTABLES DATA CAPTURE CHANGES;
```

Also during enabling-new-function mode processing, two DB2 catalog tables that are not required by Version 8 were deleted. Once in new function mode, the corresponding VSAM data set for the index DSNKCX01 can be manually deleted.

An optional step can be executed once in new function mode that can be performed to convert SYSIBM.DSNRLST01, (the Resource Limit Specification Table, or RLST), to provide long name support for the authorization id (AUTHID), collection id (RLFCOLLN), and package id (RLFPKG) columns. Note that this step is only required if you would like to convert the Version 7 RLST or some other RLST (by

modifying the job) to support long names. We decided to enable long name support for the aforementioned columns of RLST and executed DSNTIJNR successfully.

Note that it is possible to create a larger BSDS once in new function mode, thereby providing support for up to 93 active log data sets and 10,000 archive log data sets per copy. Our BSDS was of a sufficient size for the time being, so we did not run the DSNJCNVB conversion utility as outlined in the *DB2 Installation Guide*.

Finally, once in new function mode, it is recommended to alter any frequently accessed buffer pools so that their pages are fixed in real storage, thereby avoiding the overhead involved for DB2 to fix and free pages each time an I/O operation is performed. For I/O intensive workloads, this processing time can amount to as much as 10%. To fix pages in storage, the PGFIX parameter of the ALTER BPOOL command is used as shown below:

```
ALTER BPOOL(buffer_pool_name) VPSIZE(virtual_page_size) PGFIX(YES)
```

Note that you should verify that sufficient real storage is available for fixing buffer pool pages before issuing the ALTER BPOOL command.

The following DSNDB06 indexes were placed in informational image copy status:

```
DSNDDX02
DSNDPX01
DSNDRX01
DSNDSX01
DSNDTX01
DSNDXX03
DSNPPH01
```

We image copied these indexes.

We also placed DSNRLST objects DSNRLS01 and DSNARL01 in advisory reorg status. Therefore, we reorganized table space DSNRLST.DSNRLS01.

Verifying the installation using the sample applications

Using the sample applications provided in DB2.DB2810.DBD1.SDSNSAMP, we performed verification of DBD1's migration to DB2 Version 8 as outlined below. Note that of the seven verification phases available, we ran only those phases and their associated jobs that applied to our specific environment.

Phase 0 is comprised of a single job, DSNTEJ0, that is used to free all objects that were created by running any of the seven verification phases. This permits the verification phases to be executed again in their entirety without the possibility of failure as a result of objects having been previously created.

Phases 1 through **3** are used to test the TSO and batch environments, including user-defined functions.

Phase 4 addresses IMS.

Phase 5 addresses CICS.

Phase 6 initializes sample tables and stored procedures for distributed processing.

Finally, **Phase 7** is used for the testing of DB2's Large Object feature (LOB) using sample tables, data, and programs.

We added the following JCLLIB statement after the JOB statement for all verification jobs that were executed:

```
//         JCLLIB ORDER=DB2.DB2810.PROCLIB
```

Recall that in **Migration Step 13** job DSNTIJMV was executed to add catalogued procedures to proclib; however, rather than directing the output of this step to SYS1.PROCLIB, it was directed to the newly created data set DB2.DB2810.PROCLIB. This library must be APF authorized (we dynamically added it to the APF authorization list before proceeding).

Beginning with **Phase 1**, which is used to create and load sample tables, we ran job DSNTEJ1. It produced the return codes as shown in Table 62 in the *DB2 Installation Guide*.

We prepared DSNTEP2 for DB2 Version 8 using job DSNTEJ1L, which produced a return code of zero. Job DSNTEJ1P was not executed as customization of DSNTEP2 was not required.

Job DSNTEJ1U installs DB2 Unicode support, but should only be run if the operating system is capable of supporting Version 7 Unicode. Referring to the program directory, Unicode support requires OS/390 Version 2 Release 9 or higher. Since our system is on z/OS Version 1 Release 6, we were able to execute DSNTEJ1U successfully.

Phase 2 tests the batch environment. Job DSNTEJ2A was executed to prepare assembler program DSNTIAUL. All steps produced the expected return codes.

Problems encountered:

When we ran job DSNTEJ2C next we ran into some problems. When we first ran this job, we received the following error:

```
IGYOS4003-E   INVALID OPTION PGMNAME(LONGUPPER) WAS FOUND AND DISCARDED
```

To correct this, we modified the parameters on the EXEC statement of steps PH02CS02 and PH02CS03 in job DSNTEJ2C. Originally, they were:

```
//PH02CS02 EXEC DSNHICOB,MEM=DSN8MCG,
//         COND=(4,LT),
//         PARM.PC=('HOST(IBMCOB)',APOST,APOSTSQL,SOURCE,
//         NOXREF,'SQL(DB2)','DEC(31)'),
//         PARM.COB=(NOSEQUENCE,QUOTE,RENT,'PGMNAME(LONGUPPER)'),
//         PARM.LKED='LIST,XREF,MAP,RENT'

.
.
.

//PH02CS03 EXEC DSNHICOB,MEM=DSN8BC3,
//         COND=(4,LT),
//         PARM.PC=('HOST(IBMCOB)',APOST,APOSTSQL,SOURCE,
//         NOXREF,'SQL(DB2)','DEC(31)'),
//         PARM.COB=(NOSEQUENCE,QUOTE,RENT,'PGMNAME(LONGUPPER)')
```

We updated them as shown below:

```
//PH02CS02 EXEC DSNHICOB,MEM=DSN8MCG,
//         COND=(4,LT),
//         PARM.PC=('HOST(IBMCOB)',APOST,APOSTSQL,SOURCE,
//         NOXREF,'SQL(DB2)','DEC(31)'),
//         PARM.COB=(NOSEQUENCE,APOST,RENT),
//         PARM.LKED='LIST,XREF,MAP,RENT'

.
.
.

//PH02CS03 EXEC DSNHICOB,MEM=DSN8BC3,
//         COND=(4,LT),
//         PARM.PC=('HOST(IBMCOB)',APOST,APOSTSQL,SOURCE,
//         NOXREF,'SQL(DB2)','DEC(31)'),
//         PARM.COB=(NOSEQUENCE,APOST,RENT)
```

Our modifications are highlighted above. Note that parameter PGMNAME(LONGUPPER) was removed altogether. After making these modifications, the job ran successfully and generated the expected return codes.

Because we do not use C, C++, or Fortran to access DB2, installation verification programs DSNTEJ2D, DSNTEJ2E and DSNTEJ2F were not executed.

We ran job DSNTEJ2P next to test PL/I program preparation procedures. It ran successfully.

Because we do not have access to C++ and did not complete the fields pertaining to C++ on the installation panel DSNTIPU, job DSNTEJ2U was not generated by the installation CLIST. This completed **Phase 2** of the installation verification procedures.

Phase 3 tests SPUFI, DRDA® access, dynamic SQL, and TSO connections to DB2 Version 8.

To test SPUFI, we used members DSNTESA, DSNTESC and DSNTESE of data set DB2.DB2810.DBD1.SDSNSAMP as input to SPUFI. We ran all these members successfully with the exception of DSNTESC, which failed on each of the insert statements . The DB2 Version 7 tables DSN8710.PLAN_TABLE, DSN8710.DSN_FUNCTION_TABLE, and DSN8710.DSN_STATEMNT_TABLE did not exist, causing the corresponding subselect to fail. When we commented out the insert statements, DSNTESC completed successfully.

We skipped running SPUFI at remote non-DB2 systems as none were available, and moved on to installation of the ISPF/CAF sample application. We removed the DSNHICOB parameter PGMNAME(LONGUPPER), and changed the QUOTE parameter to APOST before executing DSNTEJ3C. Next, we ran DSNTEJ3C successfully and generated the expected return codes. Finally, we ran DSNTEJ3P successfully and produced the designated return codes.

Chapter 6. Migrating to IMS Version 9

We migrated our IMS systems from IMS Version 8 Release 1 to IMS Version 9 Release 1. We completed the migration of our IMS systems in the following stages:

1. We migrated one of our IMS systems from IMS V8 to V9 on an IBM @server zSeries 990 server.
2. We migrated another IMS system to V9 on an IBM @server zSeries 800 server.
3. We migrated another IMS system to V9 on an IBM @serverzSeries 900 server
4. We migrated all remaining IMSs to Version 9 Release 1, except one, which needs to remain at Version 8 Release 1 for testing that is still in progress.

As soon as our IMS Version 8 Release 1 testing is completed, we will migrate the final IMS to Version 9 Release 1. We have been running with a mixed release IMSplex for approximately five months.

We used information from the following IMS V9.1 publications to perform the migration:

- IMS Version 9: Release Planning Guide, GC17-7831
- IMS Version 9: Installation Volume 1: Installation Verification , GC18-7822
- IMS Version 9: Installation Volume 2: System Definition and Tailoring, GC18-7823

We successfully performed the migration according to the instructions in the product publications. The following sections describe some of our experiences and observations.

Installing availability enhancements: IMS Version 9 provides two major enhancements for availability.

1. **z/OS Resource Manager Services:** IMS dynamically installs its Resource Manager cleanup routine; you do not need to install the DFSMRCL0 module as part of the IMS installation. Registration of the IMS Resource Manager cleanup routine with the operating system is done automatically during IMS startup.

   The Resource Manager is registered dynamically only for IMS Version 9 or later. If you use earlier IMS releases, or use both IMS Version 9 and earlier IMS releases, you must still install the DFSMRCL0 module as part of the IMS installation. The DFSMRCL0 module must be the highest version prior to IMS Version 9. When all IMSs (control region and batch regions) are IMS Version 9 or later, you can remove DFSMRCL0 from SYS1.LPALIB and remove the IEAVTRML CSECT of z/OS module IGC0001C. You must remove the name DFSMRCL0 from the IEAVTRML CSECT before you remove the module from SYS1.LPALIB. If the name is still in IEAVTRML but the module is not in SYS1.LPALIB, z/OS IPL will fail.

   Because we are running with both V8 and V9, we installed the V9 level of the DFSMRCL0 module. When we are running entirely on V9 we will uninstall the DFSMRCL0 module.
2. **DBRC Type-4 SVC Dynamic Install:** The Dynamic SVC (DFSUSVC0) utility dynamically updates the DBRC type-4 SVC module. Thus, you can apply maintenance to the DBRC type-4 SVC module without having to restart z/OS after each update. Before IMS Version 9, only the IMS type-2 SVC module could be dynamically updated. Any updates to the DBRC type-4 SVC required restarting z/OS.

You must define the IMS type-2 SVC and the DBRC type-4 SVC to z/OS before IMS starts. After you add the SVC definitions to IMS and restart z/OS, you can use the DFSUSVC0 utility to update the SVC routines without having to restart z/OS.

For more info see IMS Version 9: Release Planning Guide, GC17-7831

Using the same SVC numbers for different releases of IMS: IMS uses Type 2 supervisor calls (SVCs) in the range of 200 through 255 for batch, DBCTL, DCCTL, and DB/DC IMS control program functions, and a type 4 SVC in the same range for DBRC functions.

Note that, as in the past, the SVCs themselves are also downward compatible. For us, this means that during our migration we can use the V9 SVCs for both our IMS V9 and V8 systems.

Using the enhanced CHANGE.RECON command to upgrade the RECON data set without bringing systems down: Before migrating a system to IMS V9, we had to upgrade the RECON data set to the V9 level—you cannot migrate IMS until you do so. We used the enhanced CHANGE.RECON command, which ships as part of the V9 coexistence support SPE, to convert the RECON data set to the V9 level without shutting down active systems. This command must be run in batch mode because the RECON data set being upgraded to V9 still resides on a V8 system.

We performed the following steps to upgrade our RECON data set using the enhanced CHANGE.RECON command:

1. Installed the V9 coexistence support SPE PQ72840 and UQ82290.
2. Used the DBRC command utility, DSPURX00, to issue the CHANGE.RECON UPGRADE command. This command upgrades the RECON data set to the V9 level without shutting down all IMS activity. It also uses the DBRC I/O recovery algorithms to recover from failures during the upgrade.

   The following is the output from our DSPURX00 command utility job that issued the CHANGE.RECON UPGRADE command:

```
         IMS VERSION 9 RELEASE 1  DATA BASE RECOVERY CONTROL
  CHANGE.RECON UPGRADE
DSP0251I  RECON COPY 1 UPGRADE IS BEGINNING
DSP0252I  RECON COPY 1 UPGRADED SUCCESSFULLY
DSP0251I  RECON COPY 2 UPGRADE IS BEGINNING
DSP0252I  RECON COPY 2 UPGRADED SUCCESSFULLY
DSP0203I  COMMAND COMPLETED WITH CONDITION CODE 00
DSP0220I  COMMAND COMPLETION TIME 05.041 13:17:02.3
         IMS VERSION 9 RELEASE 1  DATA BASE RECOVERY CONTROL
DSP0211I  COMMAND PROCESSING COMPLETE
DSP0211I  HIGHEST CONDITION CODE = 00
```

Using a new JCL execution member for OLDS for coexistence: While we were running in coexistence mode with both IMS V9 and V8 systems, we needed two skeletal JCL execution members that kick off the online log data set (OLDS) archive—one for each release. The default skeletal JCL member for the log archive utility, ARCHJCL, points to the IMS V9 target library, RESLIB. For our V9 IMS systems, we created a new skeletal JCL execution member, ARCHJCL9, that points to the IMS V9 target library, SDFSRESL. To ensure that we invoke the new ARCHJCL9 execution member for our V9 systems, we pointed our VSPEC parameter to a new DFSVSM*xx* member of IMS.PROCLIB, which contains the following ARCHDEF statement:

```
ARCHDEF ALL MAXOLDS(1) MEMBER(ARCHJCL9)
```

Updating our change accumulation utilities, image copy utilities, and recovery jobs: We updated our change accumulation utilities, image copy utilities, and recovery jobs to point to the IMS V9 libraries. This is necessary for IMS V9 and V8 to coexist. After we completed the updates, all of these utilities and jobs ran successfully.

Updating IPCS and ISPF panels: We updated our IPCS and ISPF dialog panels to point to the IMS V9 libraries.

Upgrading the IMS V9 utilities: We needed to upgrade the following IMS V9 utilities:

- IMS Library Integrity Utilities for z/OS, V1.1 5655-I42 replaces our current IMS Library|Management Utilities 5655-E04.
- IMS Database Control Suite for z/OS, V3.1 5655-L08 replaces our current V2.2 level.
- IMS High Performance Pointer Checker for z/OS, V2.1 5655-K53 replaces our current V1.1 level.

Applying additional service for IMS V9: We did not need to apply any additional service to migrate to IMS V9.

Exploiting new functions in IMS V9: We have completed our migration to IMS V9 and we are currently evaluating ways to exploit new functions, such as High Availability Large Database (HALDB) Online Reorganization. As we implement new functions, we will report on our experiences with them in upcoming editions of our test report.

After our migration to IMS V9 is completed successfully, we will do the following:

- **Update the RECON MINVERS parm:** Use the `CHANGE.RECON` command to update options in the RECON status record to specify V9R1:

  ```
  change.recon minivers(91)
  ```

  For more information see IMS Database Recovery Control (DBRC) Guide and Reference (SC18-7818-00)
- **Uninstall DFSMRCL0:** Our final V9 migration step will be to uninstall module DFSMRCL0 from SYS1.LPALIB. See 1 on page 81 for more information.

Migrating to the integrated IMS Connect

IMS Connect was always a separately orderable product. IMS Version 9 provides an integrated IMS Connect function that offers a functional replacement for the IMS Connect tool (program number 5655-K52). The integrated IMS Connect is included in the IMS System Services function modification identifier (FMID), HMK9900; the integrated IMS Connector for Java for z/OS is included with the IMS Java FMID, JMK9906; and the Integrated IMS Connector for Java distributed can be downloaded from the IMS Web site:

```
www.ibm.com/software/data/ims/
```

For more information see IMS Version 9: Release Planning Guide, GC17-7831

During the IMS V9 migration we chose to migrate from IMS Connect V2.1 to IMS V9 integrated IMS Connect.

Migrating to IRLM Version 2 Release 2

During the IMS migration we also chose to migrate from IRLM Version 2 Release 1 to Version 2 Release 2. This was a simple migration that included the following steps:

- Updated PET.PROCLIB(IRLM) to remove unused parameters:

  ```
  PC=YES
  MAXCSA=12
  ```

- Updated PET.PROCLIB(IRLM) to add new IRLM 2.2 parameter:

  ```
  MEMLIMIT=2G
  ```

Although we chose to do the following migrations within a very short period of time, no major problems were discovered:

- IMS V8 to V9,
- IMS Connect 2.1 to the integrated IMS Connect
- IRLM 2.1 to 2.2

This was by far, the smoothest IMS migration we have performed.

Chapter 7. Implementing the IMS Common Service Layer and the Single Point of Control

The IMS Common Service Layer (CSL) is a collection of IMS manager address spaces that provide the necessary infrastructure for systems management tasks. The IMS CSL reduces the complexity of managing multiple IMS systems by providing you with a single-image perspective in an IMSplex. That is, you can now manage multiple IMS subsystems in an IMSplex as if they were one system.

An IMS single point of control (SPOC) is a program with which you can manage operations of all IMS systems within an IMSplex.

We used the following documentation to help us implement the CSL and SPOC in our production IMSplex:

- *IMS Version 8: Common Service Layer Guide and Reference*, SC27-1293
- *IMS Version 8: Common Queue Server Guide and Reference*, SC27-1292
- *IMS Version 8: Installation Volume 2: System Definition and Tailoring*, GC27-1298

Setting up the Common Service Layer

The CSL address spaces, or CSL managers, include the operations manager (OM), resource manager (RM), and structured call interface (SCI). The CSL managers perform the following functions:

- **Operations manager (OM):** Helps control the operations of all IMS systems in an IMSplex. The OM receives processing control when an OM request (an IMS command, for example) is received by the OM application programming interface (API). All commands and responses to those commands must come through the OM API.
- **Resource manager (RM):** Helps manage resources that are shared by multiple IMS systems in an IMSplex. The RM provides the infrastructure for managing global resource information and coordinating IMSplex-wide processes.
- **Structured call interface (SCI):** Allows IMSplex members to communicate with one another. Communication between IMSplex members can occur within a single z/OS image or among multiple images. The individual IMSplex members do not need to know where the other members reside or what communication interface to use.

See Figure 29 on page 89 for a depiction of these address spaces.

Steps for setting up the CSL

We performed the following steps to set up the CSL on our z/OS production systems:

1. Added PGMNAME(BPEINI00) to the PPT (SCHED00):

```
PPT PGMNAME(BPEINI00)       /* PROGRAM NAME = BPEINI00              */
                 CANCEL     /* PROGRAM CAN BE CANCELED              */
                 KEY(7)     /* PROTECT KEY ASSIGNED IS 7            */
                 NOSWAP     /* PROGRAM IS NON-SWAPPABLE             */
                 NOPRIV     /* PROGRAM IS NOT PRIVILEGED            */
                 DSI        /* REQUIRES DATA SET INTEGRITY          */
                 PASS       /* CANNOT BYPASS PASSWORD PROTECTION    */
                 SYST       /* PROGRAM IS A SYSTEM TASK             */
                 AFF(NONE)  /* NO CPU AFFINITY                      */
                 NOPREF     /* NO PREFERRED STORAGE FRAMES          */
```

Note: BPEINI00 can also be used to start CQS, so the CQSINIT0 entry is no longer needed. Once we migrated all of our production systems to IMS V8.1, we removed the entry for CQSINIT0.

---

2. Added the IMSPLEX parameter to the CQSIP*xxx* member on each system:

```
CQSGROUP=SQGRP,
IMSPLEX(NAME=PROD),
SSN=CQSA,
STRDEFG=ALL,
STRDEFL=PEA
```

---

3. Added the RSRCSTRUCTURE parameter to the CQSSGALL member:

```
STRUCTURE(
 STRNAME=FFMSGQ_STR,
 OVFLWSTR=FFOVFLO_STR,
 STRMIN=0,
 SRDSDSN1=CQS.FF.SRDS1,
 SRDSDSN2=CQS.FF.SRDS2,
 LOGNAME=CQS.FF.LOGSTRM,
 OBJAVGSZ=1024,
 OVFLWMAX=50
 )
STRUCTURE(
 STRNAME=FPMSGQ_STR,
 OVFLWSTR=FPOVFLO_STR,
 STRMIN=0,
 SRDSDSN1=CQS.FP.SRDS1,
 SRDSDSN2=CQS.FP.SRDS2,
 LOGNAME=CQS.FP.LOGSTRM,
 OBJAVGSZ=512,
 OVFLWMAX=50
)
RSRCSTRUCTURE(STRNAME=CSLRMGR_PROD)
```

Note: A resource structure is not needed if only one RM is used in the IMSplex. For availability reasons, we chose to start two RMs and defined a resource structure.

---

4. Created a DFSCG*xxx* member:

```
CMDSEC=N,
IMSPLEX=PROD,
LEOPT=N,
NORSCCC=(),
OLC=LOCAL
```

---

5. Added the CSLG parameter to the DFSPB*xxx* member on each system:

```
DLINM=DLIGRP81,DBRCNM=DBRCGP81,
AUTO=N,
GRSNAME=IMSPETGR,
SUF=1,
CRC=#,LHTS=512,NHTS=512,UHTS=512,
CMDMCS=Y,
CSLG=PET,
APPC=N,AOIS=S,
FIX=HP,VSPEC=81,PRLD=DB,SPM=02,
RSRMBR=,GRNAME=NATIVE2,
...
```

---

6. Created the initialization proclib members for the CSL manager address spaces:

   Example: The following is the SCI initialization member:

```
*-------------------------------------------------------------------*
* Sample SCI Initialization Proclib Member.                         *
*-------------------------------------------------------------------*

ARMRST=N,                   /* ARM should restart OM on failure  */
SCINAME=SCI1,               /* SCI Name (SCIID = SCI1SCI)        */
IMSPLEX(NAME=PROD)          /* IMSplex Name                      */
```

   Example: The following is the OM initialization member:

```
*-------------------------------------------------------------------*
* Sample OM Initialization Proclib Member.                          *
*-------------------------------------------------------------------*

ARMRST=N,                   /* ARM should restart OM on failure  */
CMDLANG=ENU,                /* Use English for Commmand Desc     */
CMDSEC=N,                   /* No Command Security               */
CMDTEXTDSN=IMS810.SDFSDATA, /*                                   */
OMNAME=OM1,                 /* OM Name (OMID = OM1OM)            */
IMSPLEX(NAME=PROD)          /* IMSplex Name (CSLPLEX1)           */
```

   Example: The following is the RM initialization member:

```
*-------------------------------------------------------------------*
* Sample RM Initialization Proclib Member.                          *
*-------------------------------------------------------------------*

ARMRST=N,                   /* ARM should restart RM on failure  */
CQSSSN=CQSC,
IMSPLEX(NAME=PROD,          /* IMSPLEX NAME                      */
RSRCSTRUCTURE(STRNAME=CSLRMGR_PROD)),
RMNAME=RMC                  /* RM Name (RMID = RM1RM)            */
```

---

7. Created the CSL startup procedures:

   Example: The following is our SCI startup procedure, CSLSCI:

```
//CSLSCI   PROC RGN=3000K,SOUT=A,
//             IMSVAR=&IMSVAR,
//             BPECFG=BPECFG00,
//             SCIINIT=000,
//             PARM1=(SCINAME=&SCINAME)
//*
//SCIPROC  EXEC PGM=BPEINI00,REGION=&RGN,
//  PARM='BPECFG=&BPECFG,BPEINIT=CSLSINI0,SCIINIT=&SCIINIT,&PARM1'
//*
//STEPLIB  DD  DISP=SHR,DSN=IMS810.&IMSVAR..SDFSRESL
//         DD  DSN=SYS1.CSSLIB,DISP=SHR
//PROCLIB  DD  DSN=D10.PETDSW4.PROCLIB,DISP=SHR
//SYSPRINT DD  SYSOUT=&SOUT
//SYSUDUMP DD  SYSOUT=&SOUT
//*
```

   Example: The following is our OM startup procedure, CSLOM:

```
//CSLOM    PROC RGN=3000K,SOUT=A,
//             IMSVAR=&IMSVAR,
//             BPECFG=BPECFG00,
//             OMINIT=000,
//           PARM1=(OMNAME=&OMNAME)
//*
//OMPROC   EXEC PGM=BPEINI00,REGION=&RGN,
//  PARM='BPECFG=&BPECFG,BPEINIT=CSLOINI0,OMINIT=&OMINIT,&PARM1'
```

```
//*
//STEPLIB  DD  DSN=IMS810.&IMSVAR..SDFSRESL,DISP=SHR
//         DD  DSN=SYS1.CSSLIB,DISP=SHR
//PROCLIB  DD  DSN=D10.PETDSW4.PROCLIB,DISP=SHR
//SYSPRINT DD  SYSOUT=&SOUT
//SYSUDUMP DD  SYSOUT=&SOUT
//*
```

Example: The following is our RM startup procedure, CSLRM:

```
//CSLRM    PROC RGN=0M,SOUT=A,
//             IMSVAR=&IMSVAR,
//             BPECFG=BPECFG00,
//             INIT=CSLRINI0,
//             RMINIT=&RMINIT
//*
//RMPROC   EXEC PGM=BPEINI00,REGION=&RGN,
//   PARM='BPEINIT=&INIT,BPECFG=&BPECFG,RMINIT=&RMINIT'
//STEPLIB  DD  DSN=IMS810.&IMSVAR..SDFSRESL,DISP=SHR
//         DD  DSN=SYS1.CSSLIB,DISP=SHR
//PROCLIB  DD  DSN=D10.PETDSW4.PROCLIB,DISP=SHR
//SYSPRINT DD  SYSOUT=&SOUT
//SYSUDUMP DD  SYSOUT=&SOUT
//*
```

---

8. Updated the SCI registration exit routine (DSPSCIX0) and placed it into an authorized library:

```
PTBLEYEC DS    0H                    TABLE EYECATCHER
         DC    C'PLEXTABL'
PLEXTABL DS    0H
         DC    CL(DSNL)'RECON1.PROD'             RECON NAME
         DC    CL(PNL)'PROD '                    IMSplex name
         DC    XL(RCL)'00000000'           RC00 = use the IMSplex name
         DC    CL(DSNL)'RECON2.PROD'             RECON NAME
         DC    CL(PNL)'PROD '                    IMSplex name
         DC    XL(RCL)'00000000'           RC00 = use the IMSplex name
         DC    CL(DSNL)'RECON3.PROD'             RECON NAME
         DC    CL(PNL)'PROD '                    IMSplex name
         DC    XL(RCL)'00000000'           RC00 = use the IMSplex name
```

---

9. Defined the resource manager coupling facility structure in the CFRM policy:

```
STRUCTURE NAME(CSLRMGR_PROD)
          SIZE(32000)
          INITSIZE(20000)
          ALLOWAUTOALT(YES)
          FULLTHRESHOLD(60)
          DUPLEX(ALLOWED)
          PREFLIST(CF2,CF1,CF3)
```

Our CSL and SPOC configuration

Figure 29 on page 89 illustrates our the CSL and SPOC configuration in our IMSplex:

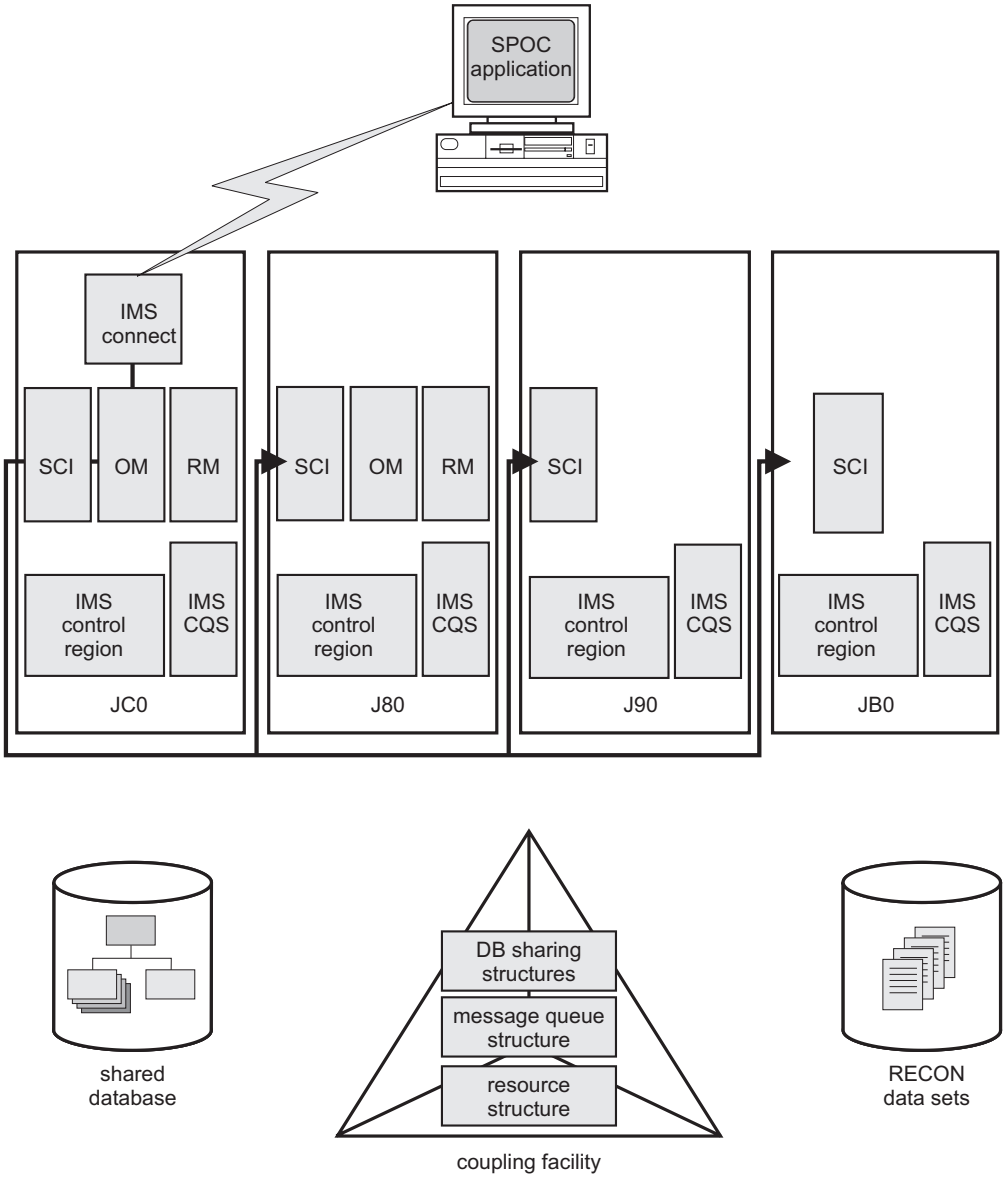


Figure 29. Our IMS CSL and SPOC configuration

Note the following about our configuration:

- We run one SCI address space on each z/OS system where IMS subsystems run.
- We only run OM and RM address spaces on systems J80 and JC0.
- We use automations to start the CSL address spaces following system IPLs. However, we found that if the RM doesn't detect the required CQS address space within 10 minutes, it terminates with a U0010-00000508 user abend. To avoid this, we added the CQS startup to automations, instead of allowing IMS to automatically start the CQS address space. This ensures that the CQS address space is available when the RM expects it.

IMS performance considerations for CSL

For the CLS address spaces, IBM recommends using the SYSSTC service class or a service class with higher importance (that is, a lower-numbered value) than the CNTL and CQS address spaces and all dependent regions. Since WLM provides

five levels of importance, a general guideline would be to group resources into service classes with the following relative importance:

IMPORTANCE		
Level	**Value**	**Address spaces**
higher	N	IRLM
	N+1	VTAM, APPC, DBRC, SCI, OM, RM
	N+2	CNTL, CQS
	N+3	DLIS
lower	N+4	dependent regions

Thus, when CPU resources are constrained, the following rules would apply:

- All dependent regions should have the lowest dispatching priority among the other IMS address spaces.
- CNTL and CQS, the address spaces with the next largest CPU consumption, should have a lower dispatching priority than the CSL address spaces.

Setting up the single point of control

A SPOC communicates with one OM address space; the OM then communicates with all of the other IMS address spaces in the IMSplex, through the SCI, as required for operations.

Steps for setting up the single point of control

We performed the following steps to set up the single point of control:

1. Verified that IMS service PQ69527 (PTF UQ73719) is installed.

2. Verified that IMS Connect is installed.

   We are currently running IMS Connect V2.1. However, note that if you are running IMS Connect V1.2, you must install PQ62379 (PTF UQ69902) and PQ70216 (PTF UQ74285).

3. Updated the HWS configuration member to add the EXIT and IMSPLEX parameters:

```
HWS
 (ID=HWSC,RACF=N)
TCPIP
 (HOSTNAME=TCPIP,RACFID=RACFID,PORTID=(9999,9998,9997,9996,9995,9994,
 9993,9992,9991,9990),
 EXIT=(HWSCSLO0,HWSCSLO1),
 MAXSOC=51,TIMEOUT=9999)
DATASTORE
 (ID=IMSC,GROUP=NATIVE2,MEMBER=HWSC,TMEMBER=IMSPETJC)
IMSPLEX
 (MEMBER=IMSPLEXC,TMEMBER=PROD)
```

4. Installed DB2 UDB V8.1 (DB2 Control Center) on the workstation.

   We are currently running at the FixPak 4 service level. You can get the latest FixPaks from the DB2 Technical Support Web site at www.ibm.com/cgi-bin/db2www/data/db2/udb/winos2unix/support/index.d2w/report.

Steps for setting up DB2 Control Center for the IMS SPOC

We performed the following steps to set up DB2 Control Center for the IMS SPOC:

1. Started the Control Center, then clicked **Selected → Add** from the menu bar.

---

2. In the **Add System** dialog box:
   a. Selected the **IMS** button
   b. In the **System name** box, typed the name of our IMSplex: PROD
   c. In the **Host name** box, typed the IP address of the system where the IMS Connect subsystem is located
   d. In the **Port number** box, typed the IMS Connect port number we wanted to use: 9995
   e. Clicked **OK**

   Example: Figure 30 is an example of the **Add System** dialog box:

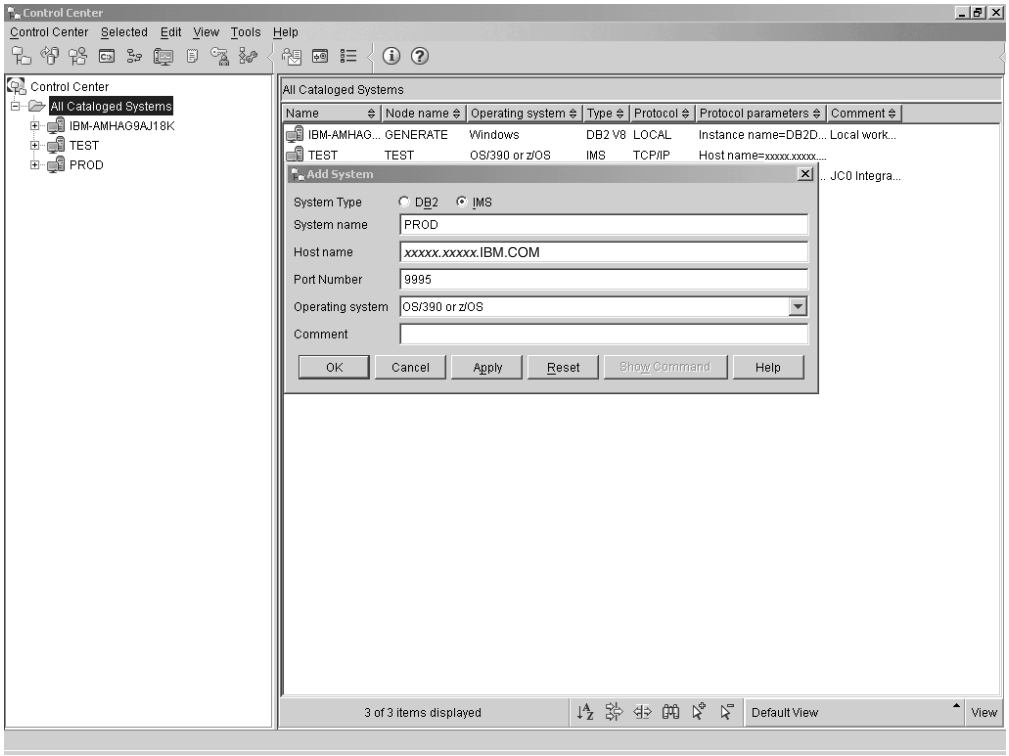


Figure 30. Example of the Control Center Add System dialog

---

3. Started the Command Center by clicking **Tools → Command Center** from the menu bar.

---

4. In the Command Center:
   a. In the **Command type** field, selected **IMS commands** from the pull-down menu
   b. In the **IMS sysplex** field, selected PROD (the name of our IMSplex) from the **Select Connection** dialog
   c. When prompted, entered the user ID and password that we had set during the installation of DB2 Control Center.

Example: Figure 31 is an example of the initial setup of the Command Center: **Add System** dialog box:

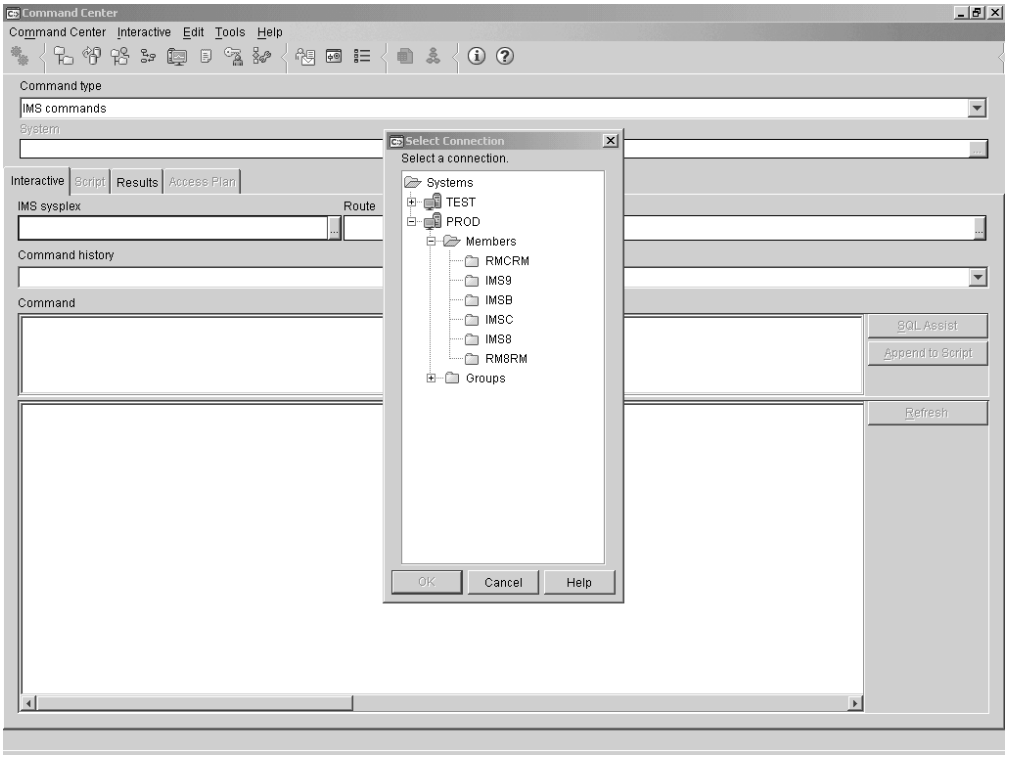


Figure 31. Example of the Command Center initial setup

---

5. To issue an IMS command:
   a. In the **Route** field, selected the IMSplex member to which the command is to be issued
   b. In the **Command** field, entered the IMS command to be issued
   c. Clicked the **Execute** icon at the far left side of the icon bar, in the upper left corner

   Example: Figure 32 on page 93 is an example of using the Command Center to issue the DIS QCNT LTERM MSGAGE 0 command to member IMSC in our PROD IMSplex:

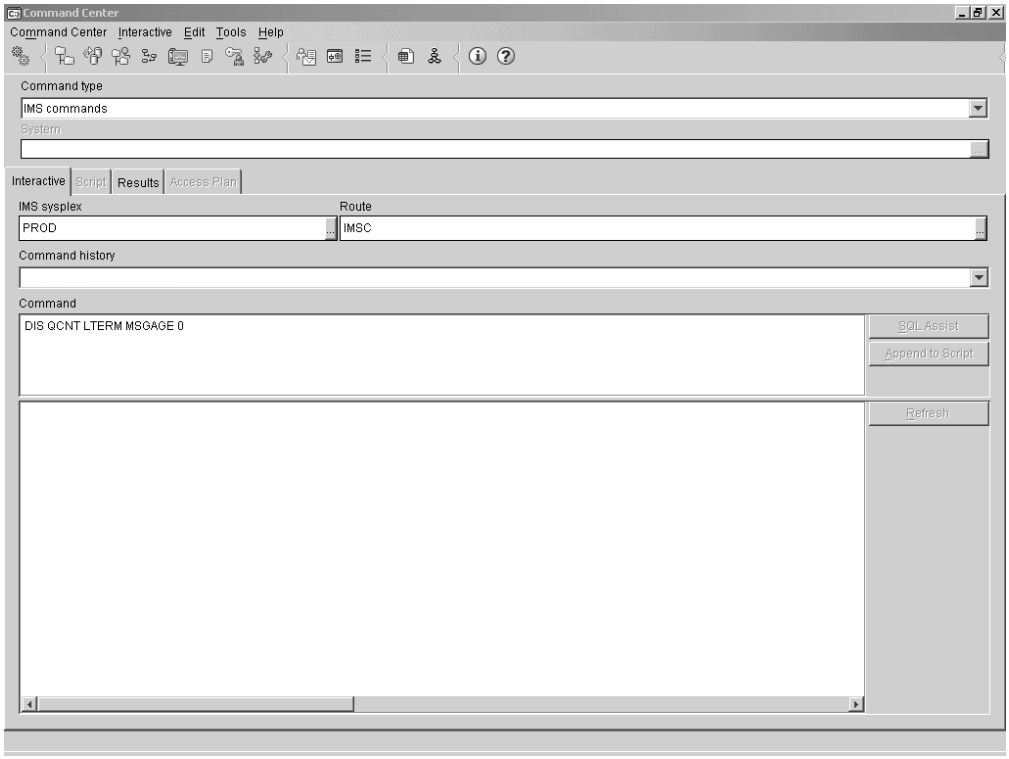


Figure 32. Example of issuing an IMS command to IMSplex member IMSC

Result: Figure 33 on page 94 is an example of the response to the DIS QCNT LTERM MSGAGE 0 command that was issued to member IMSC. Note that the response appears on a separate tab, **Results**, in the Control Center display.

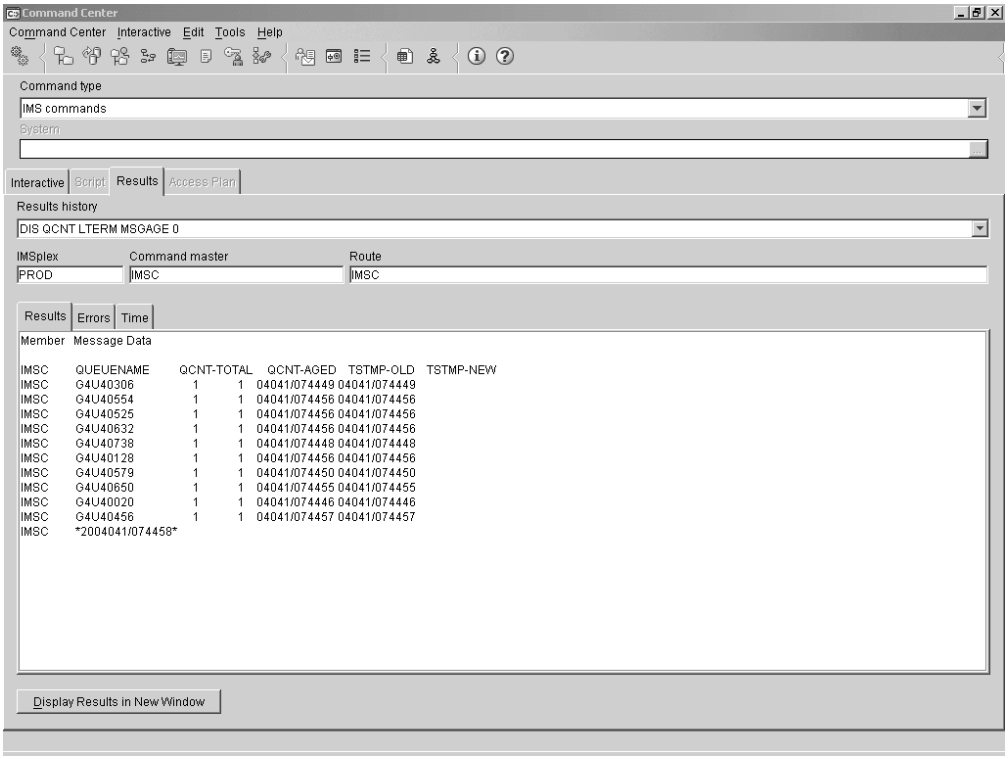


Figure 33. Example of the response to an IMS command that was issued to IMSplex member IMSC

Example: Figure 34 on page 95 is an example of issuing the DIS LINE 1 command to all members of the IMSplex by selecting `All_Members` in the **Route** field:

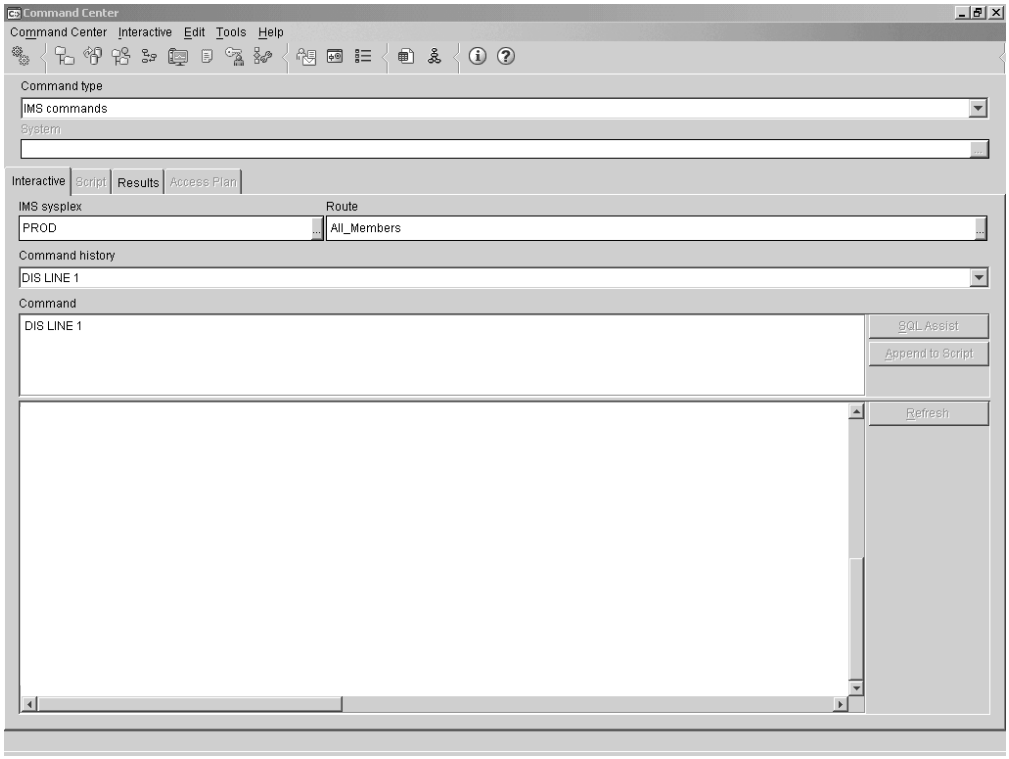


Figure 34. Example of issuing an IMS command to all members of the IMSplex

Result: Figure 35 on page 96 is an example of the response to a command that was issued to all members of the IMSplex:

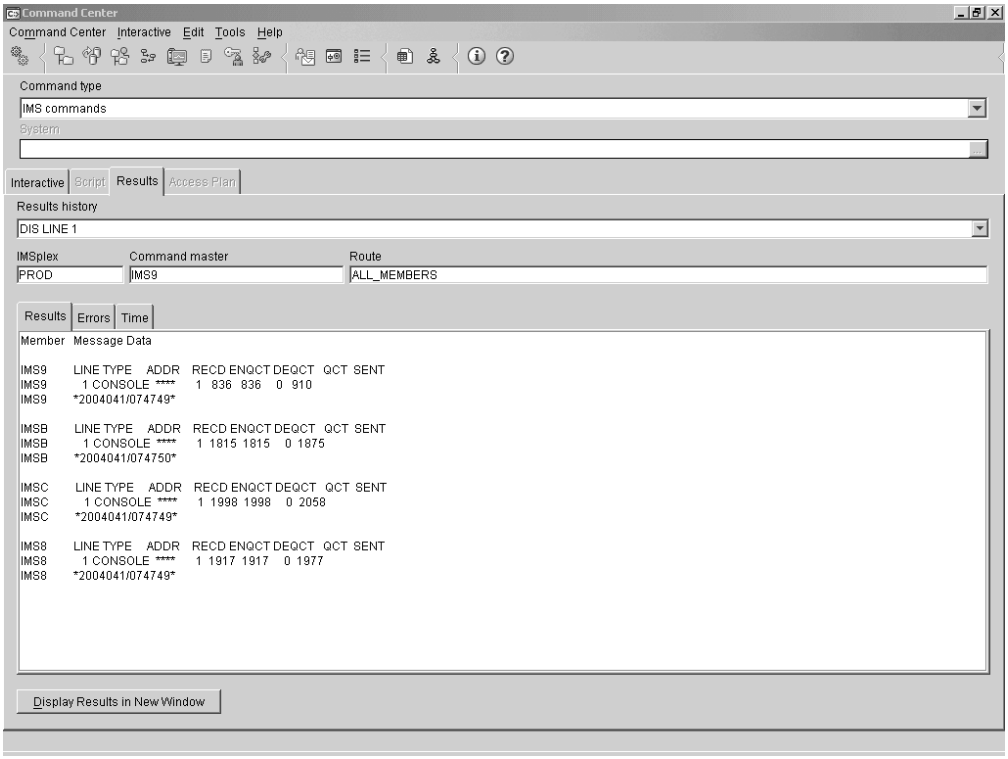


Figure 35. Example of the response to an IMS command that was issued to all members of the IMSplex

Chapter 8. Parallel Sysplex automation

In this chapter, we typically describe how we use automation to more efficiently operate our sysplex from a single point of control, and to automate the startup, shutdown, and restart of many of our major subsystems and applications.

Our early experiences with automation

We began writing about Parallel Sysplex automation in our 1997 test reports. At that time, we were just beginning to use NetView and System Automation for OS/390 (then called SA/MVS) to more efficiently operate our sysplex. We were running NetView V3R1 and SA/MVS V1R2.

We eventually migrated to Tivoli NetView for OS/390 V1R4 and System Automation for OS/390 (SA OS/390) V1R3, including the sysplex automation enhancements that IBM delivered in October, 1999, as an SPE in APAR OW39485. For information about our use of those products, see our December 2001 edition.

Automation with msys for Operations

Managed System Infrastructure for Operations (msys for Operations), which was introduced as a new base element in z/OS V1R2, simplifies the day-to-day operation of z/OS and z/OS.e Parallel Sysplex configurations by automating typical operator tasks and events. msys for Operations actually includes parts of two licensed standalone products: Tivoli NetView for OS/390 and System Automation for OS/390. We tested and ran msys for Operations along with Tivoli Netview for OS/390 V5R1 and SA OS/390 V1R3, prior to migrating to SA OS/390 V2R3.

Migrating to System Automation for OS/390 Version 2 Release 3

We have now completed our migration from msys for Operations to SA OS/390 V2R3. We followed the instructions in *IBM Tivoli System Automation for z/OS Planning and Installation*, SC33-8261, in the appendix about migrating to SA OS/390 from msys for Operations. Also, for basic information, we found *IBM Tivoli System Automation for z/OS User's Guide*, SC33-8263, to be very useful. You can find the SA OS/390 publications on the z/OS Internet Library at www.ibm.com/servers/eserver/zseries/zos/bkserv/ or under the **Library** link on the System Automation Web site at www.ibm.com/servers/eserver/zseries/software/sa/.

We continue to run Tivoli Netview for OS/390 V5R1. We also continue to run the NetView focal points, as we have discussed in previous years' test reports, on our current release of NetView. (See our December 2001 edition for more information about our NetView focal points.)

Applying service for SA OS/390: We needed to apply the fixes for the following SA OS/390 APARs: OA04046, OA04152, and OA05945.

Migrating the contents of our AOFCUST member: Our migration included using the INGCUST dialog to migrate the contents of our AOFCUST member to automation control file (ACF) fragments. As we reported on previously, we had customized our AOFCUST member to define a set of spare, local page data sets that can automatically be added when we experience an auxiliary storage shortage (see our December 2003 edition).

Starting the automation manager: In our sysplex, we use a startup procedure called HSAMPROC to start the automation manager. In our environment, we always start automations using a cold start. We generally do not use automations to control DB2, CICS, and IMS because the nature of our testing often requires that we vary the start and stop times for those subsystems, rather than leave them on a regular schedule.

We experienced no problems in migrating to System Automation for OS/390 Version 2 Release 3. We are continuing to run with it.

Using SA OS/390

Our operations staff invokes the INGPLEX command in full mode to access the main menu of sysplex-related functions in SA OS/390.

Using the DRAIN and ENABLE subcommands

From the INGPLEX main menu, we make frequent use of the DRAIN subcommand for clearing off our coupling facilities for maintenance. We find that this function saves us considerable time in our coupling facility maintenance activities.

Currently, when the DRAIN function completes, the coupling facility status changes to DRAINED NOHWACC because we do not have the BCP internal interface working. We then use the HMC to manually deactivate and re-activate the drained coupling facility.

After re-activating the coupling facility, we use the ENABLE subcommand to repopulate it with structures.

Refreshing the automation manager

Each time you make changes to the ACF, you must refresh the automation manager. Failure to refresh the automation manager following an ACF build results in the following message:

```
AOF618I NO VALID ACF FOUND FOR sysname - ACF TOKEN MISMATCH
```

This means that the ACF does not have the same token as the automation manager's configuration file.

We perform the following steps to refresh the automation manager after making changes to the current ACF:

1. From a NetView agent session, issue the following command:

   ```
   INGAMS
   ```

   Result: The following is an example of the dialog panel that appears:

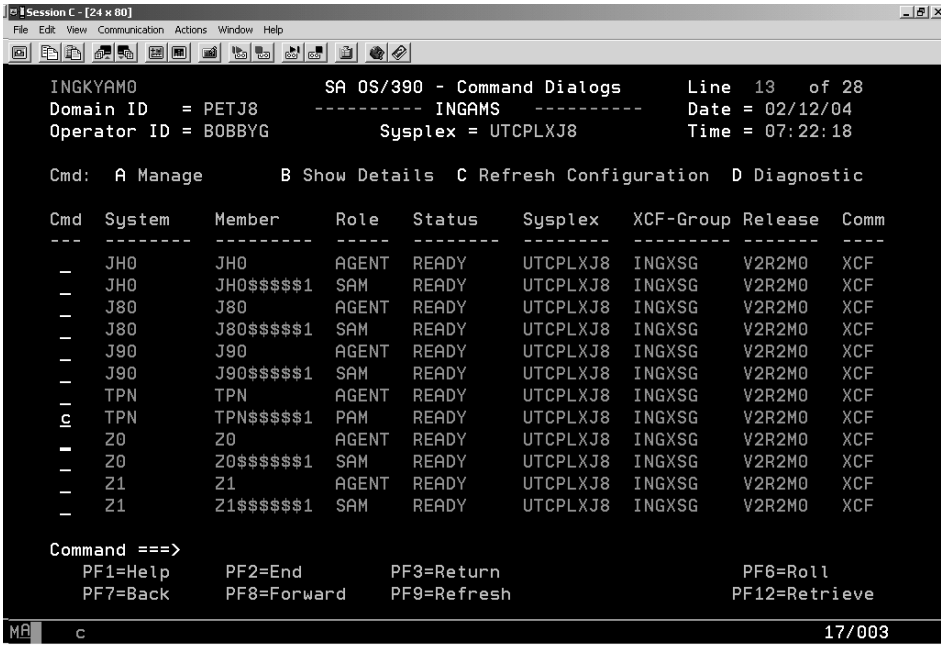


Figure 36. Example of the INGAMS dialog

2. Locate the entry for the system that is acting as the primary automation manager (PAM). The entry will indicate PAM in the Role column.
   In the above example dialog, system TPN is acting as the PAM.

3. Enter the `C` (refresh configuration) line command next to the PAM system and press Enter.
   Result: The following is an example of the dialog panel that appears:

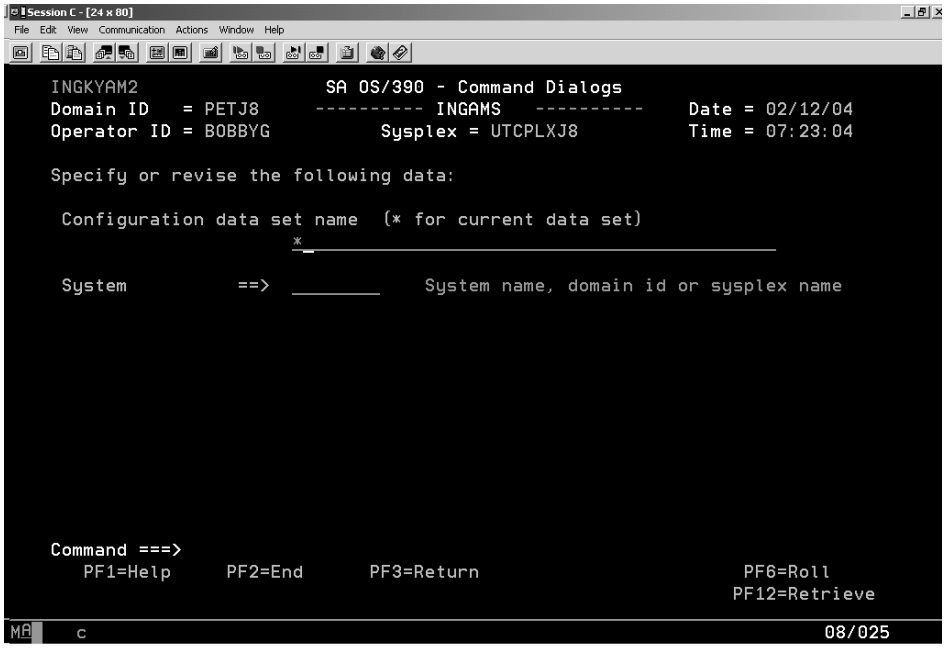


Figure 37. Example of the Refresh Configuration dialog

4. Enter an asterisk (*) for the configuration data set name and press Enter.

This refreshes the automation manager's configuration from the updated ACF.

Turning off the automation flag for a resource

During our testing, we often need to turn off automations for various resources so that we can manually control them. This turns the automation flag off in the automation manager, not the automation agent. The automation manager will remember the flag's setting unless all automation managers are brought down and restarted COLD.

We perform the following steps to turn off the automation flag for a resource:

1. From the NetView console, enter the following command:

   DS *subsystem*

   Example: To display the LDAP servers, we would issue the following command:

   DS LDAP*

   Result: The following is an example of the dialog panel that appears:

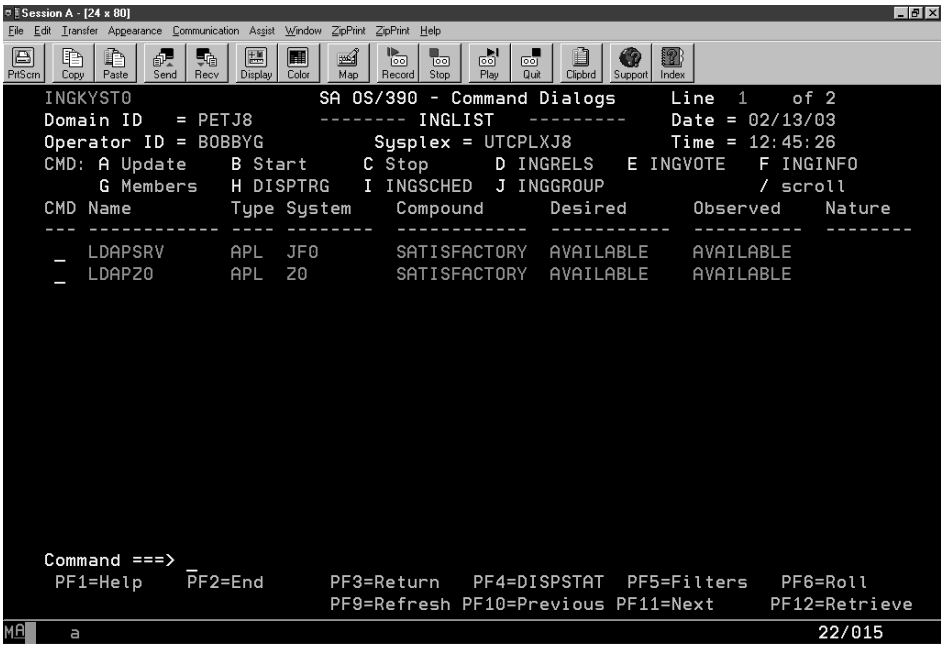


Figure 38. Example display from the DS LDAP command*

---

2. Enter the A (update) line command next to the desired resource and press Enter.

   Example: To update the automation settings for the LDAPSRV server, enter an A next to that resource.

   Result: The following is an example of the dialog panel that appears:

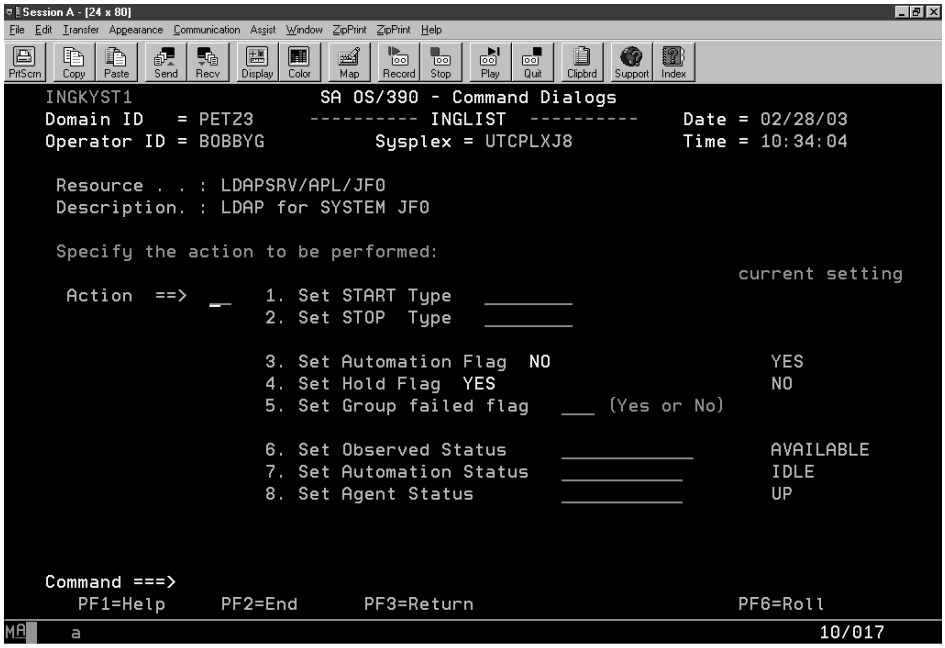


Figure 39. Example of the automation settings dialog for the LDAPSRV server (automation flag is on)

Note that the value under the **current setting** column for the automation flag is YES. This means that automation is turned on for this resource.

---

3. To turn off the automation flag, enter 3 (Set Automation Flag NO) on the **Action** line and press Enter.

   Result: The following is an example of the dialog panel that appears:

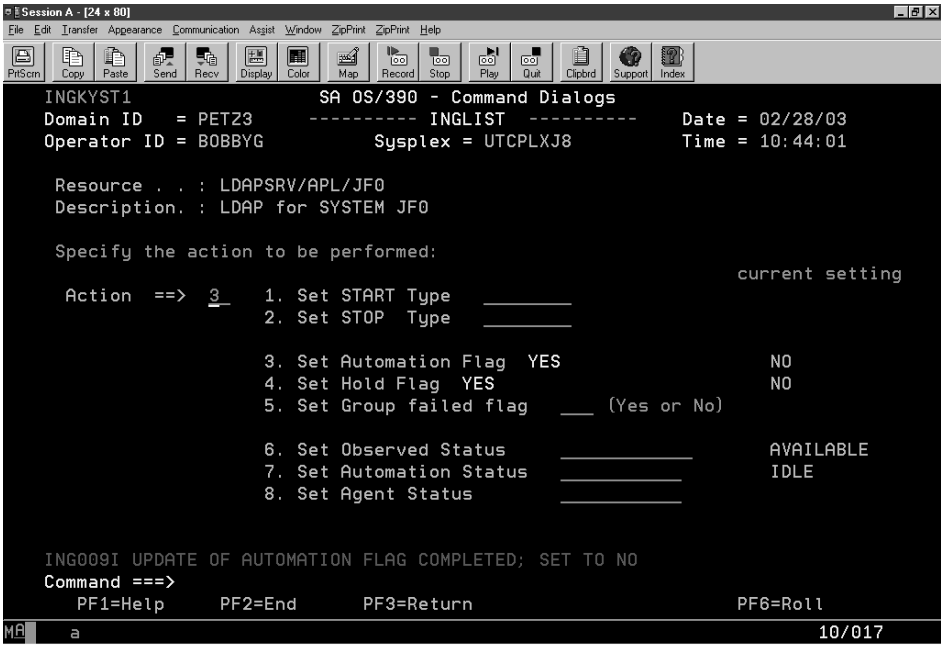


Figure 40. Example of the automation settings dialog for the LDAPSRV server (automation flag is off)

Note that the value under the **current setting** column for the automation flag is now NO. This means that automation is turned off for this resource.

The resource can now be manually started and stopped.

Chapter 9. Testing SPE Console Restructure (APAR OA09229)

We installed and tested with the V1R6 level of APAR OA09229 (concerning SPE Console Restructure). Please review the APAR description to see if you are experiencing the reported problem.

Chapter 10. Using IBM Health Checker for z/OS

Because so many system problems are caused by incorrect configuration settings, IBM set out to make it easier to make sure installations have the right configuration settings. They started with a prototype tool, the IBM Health Checker for z/OS and Sysplex prototype, a batch job that analyzes a configuration, looks for exceptions to suggested settings, and returns a report that includes a description of the exception, how to fix it, and where to look for more information. IBM used feedback from users of the popular prototype to transform it into a z/OS product. The new IBM Health Checker for z/OS is an integrated part of z/OS V1R7 as well as being available as a Web deliverable for z/OS V1R4, R5, and R6 of z/OS and z/OS.e. (Note that the Web deliverable is functionally identical to the integrated version and should not be confused with the prototype.)

In this section, we'll report our experiences with both the prototype and the IBM Health Checker for z/OS product:

- "Using the prototype"
- "Using the product"

Using the prototype

The IBM Health Checker for z/OS and Sysplex is a tool that checks the current, active z/OS and sysplex settings and definitions for an image and compares their values to those either suggested by IBM or defined by the installation as the criteria. The objective of the Health Checker is to identify potential problems before they impact system availability or, in the worst cases, cause outages.

We are using Version 3 of the IBM Health Checker for z/OS and Sysplex prototype, which we downloaded from the z/OS downloads page at www.ibm.com/servers/eserver/zseries/zos/downloads/. The documentation, *z/OS and Sysplex Health Checker User's Guide*, SA22-7931, is also available on this Web page.

Using the default USERPARM member supplied with the Health Checker, we created and customized several new members to perform various types of checking. For instance, we use one member with one set of parameters to perform XCF checks, another member with different parameters to perform APF and LINKLST checks, and so on. This also makes the reports easier to look at and use. It also allows us to isolate the checks that examine values that have a sysplex scope so that we can run them on only one z/OS image, rather than on every image in the sysplex—thereby eliminating redundant information from the reports for each image.

Using the product

The current IBM Health Checker for z/OS product is an integrated part of z/OS V1R7, as well as being available as a Web deliverable, called IBM Health Checker, for V1R4, R5, and R6 of z/OS and z/OS.e. The Web deliverable is functionally identical to the integrated version - don't confuse it with the prototype!

IBM Health Checker for z/OS consists of:

- The framework, which provides the services for the checks and the externals for operators and system programmers. It is also called the backbone, and runs on the system as a started task.

- Checks, which look for component, element, or product specific z/OS settings and definitions, checking for potential problems. The specific component or element owns, delivers, and supports the checks. For example, RACF has supplied checks in the RACF element. You can also create your own checks - at this point we are using just the IBM component checks.

A check issues its output as messages, which you can view using SDSF, the HZSPRINT utility, or a log stream that collects a history of check output. If a check finds a potential problem, it issues a WTO exception message text. The check exception messages are also issued to the message buffer in a version including both text and explanation of the potential problem found, including the severity, as well as information on what to do to fix the potential problem.

To get the best results from IBM Health Checker for z/OS, you should let it run continuously on your system so that you will know when your system has changed. When you get an exception, you should resolve it using the information in the check exception message or overriding check values, so that you do not receive the same exceptions over and over.

You can use either the SDSF CK interface, the HZSPRMxx parmlib member, or the IBM Health Checker for z/OS MODIFY (F hzsproc) command to manage checks. We use all of these interfaces to manage IBM Health Checker for z/OS and the component checks. We use SDSF and the MODIFY command to make temporary check changes, and HZSPRMxx to create an IBM Health Checker for z/OS policy that changes checks permanently.

We installed, set up, and are running IBM Health Checker for z/OS on 13 systems with a total of 58 IBM component checks. We used the procedures and examples in *IBM Health Checker for z/OS: User's Guide*, SA22-7994 to do the install and set up. The following are some of the specifics of installation and set up in our environment:

- We copied the following IBM Health Checker for z/OS HZS samples from SYS1.SAMPLIB to a data set we call HCHECKER.PET.JOBS:
  - HZSALLCP
  - HZSMSGNJ
  - HZSPRINT
- We copied the IBM Health Checker for z/OS procedure, HZSPROC, from SYS1.SAMPLIB to our system proclib. We kept the name HZSPROC.
- We copied the HZSALLCP job from SYS1.SAMPLIB and used it to allocate the HZSPDATA data set on each z/OS system where we're running IBM Health Checker for z/OS. The HZSPDATA data set saves check data between restarts. In our environment, we use a high level qualifier of HCHECK.*sysname*.HZSPDATA. We altered HZSPROC to reflect this HZSPDATA data set name.
- We set up an HZSPRMxx parmlib member for each system. You don't have to set up HZSPRMxx parmlib member in order to run IBM Health Checker for z/OS, but we use it to:
  - Make permanent changes to checks, just as deactivating checks that are not appropriate in our environment. Check changes listed in active HZSPRMxx members are applied every time we restart IBM Health Checker for z/OS.
  - Turn on system logger support for IBM Health Checker for z/OS for a system every time you start IBM Health Checker for z/OS.

To identify each member, we use a convention where the *xx* in each HZSPRM*xx* member is the system name. For example, the parmlib member for system J80 would be HZSPRMJ8.

We like to automate everything we can, so we use the system name symbolic to tie the correct parmlib member to the right system when System Automation starts IBM Health Checker for z/OS. For example, System Automation uses the following command to start IBM Health checker for z/OS on system J80:

```
'S HZSPROC,HZSPRM=J8'
```

The following example shows our HZSPRMJ8 parmlib member:

```
/* ------------------------------------------------------------- */
/*                                                               */
/*   LICENSED MATERIALS - PROPERTY OF IBM                        */
/*   5694-A01                                                    */
/*   (C) COPYRIGHT IBM CORP. 2004, 2005                          */
/*                                                               */
/* ------------------------------------------------------------- */
/* The LOGGER command and POLICY statements can be used in HZSPRMxx */
/* to enable logger support, and change the default behavior of  */
/* target checks.   Common syntax of both the LOGGER and POLICY  */
/* statements are documented below.                              */
/* For a complete syntax of the LOGGER command, POLICY statements, */
/* and other commands that can be specified in the HZSPRMxx system */
/* parmlib members, see the                                      */
/* IBM Health Checker for z/OS and Sysplex User's Guide          */
/* ------------------------------------------------------------- */
/*                                                               */
/*                                                               */
   LOGGER=ON,LOGSTREAMNAME=HZS.HEALTH.CHECKER.HISTORY
/*   can be used to enable log stream processing to the specified */
/*   log stream                                                  */
/*                                                               */
/*                                                               */
/* {ADD | ADDREPLACE},POLICY,STATEMENT=statementname,UPDATE,filters,*/
/*        update_options,REASON=(reason text),DATE=yyyymmdd      */
/*                                                               */
/*   can be used to define policy statements that modify the     */
/*   behavior of specified checks.                               */
/*                                                               */
/* Where                                                         */
/*   ADD -     This is a new policy statement that is not active. */
/*             If the named policy statement is already active, the */
/*             new policy statement is rejected.                 */
/*   ADDREPLACE - The specified policy statement may already be  */
/*             active.                                           */
/*             If the policy statement is already active, the    */
/*             existing policy statement is replaced.            */
/*   statementname - 1-16 character policy statement name used to */
/*             identify the policy statement.                    */
/*   UPDATE -  Indicates the policy statement overrides check    */
/*             defaults                                          */
/*   filters - Filters that indicate which check(s) are targeted by */
/*             this policy statement:                            */
/*             CHECK(owner,name) - (Required.) The 1-6 character */
/*                                 check owner, and 1-32 character */
/*                                 check name.  Wild card symbols */
/*                                 '*' and '%' are permitted.    */
/*             CATEGORY(filter_type,Ù category-1,category-2Ù...) */
/*                Allows additional filter capacity based on the */
/*                current assigned categories                    */
/*             EXITRTN=exitrtnÙ - The name of the HZSADDCHECK    */
/*                                 dynamic exit routine that was */
/*                                 used to add the check.        */
/*   Update_options-The options used to override the check       */
```

```
|                     /*            defaults:                                          */
|                     /*            ,ACTIVE|INACTIVEÙ                                  */
|                     /*               Indicates the target check(s) are ACTIVE or     */
|                     /*               INACTIVE.                                       */
|                     /*            ,ADDCAT=(cat1,...,cat16)Ù                          */
|                     /*               Add the target check(s) to the specified        */
|                     /*               categories                                      */
|                     /*            ,DESCCODE=(desccode1,...,desccode#)Ù               */
|                     /*               Additional descriptor code(s) which will be used */
|                     /*               when an exception message is written by the     */
|                     /*               target check(s)                                 */
|                     /*            ,{INTERVAL=ONETIME|INTERVAL=hhh:mm}Ù               */
|                     /*               The interval at which the target check(s) will  */
|                     /*               be run.                                         */
|                     /*            ,PARM=parameterÙ                                   */
|                     /*               The check specific parameter that will be passed */
|                     /*               to the target check.                            */
|                     /*            ,ROUTCODE=(routcode1,..,routcode#Ù)Ù               */
|                     /*               Additional route code(s) which will be used when */
|                     /*               an exception message is written by the target   */
|                     /*               check(s)                                        */
|                     /*            ,SEVERITY={HIGH|MEDIUM|LOW|NONE}Ù                  */
|                     /*               The severity of target check(s)                 */
|                     /*            ,WTOTYPE={CRITICAL|EVENTUAL|                       */
|                     /*                      INFORMATIONAL|HARDCOPY|NONE}Ù            */
|                     /*               Specifies what message will be used when an     */
|                     /*               exception message is written by the target      */
|                     /*               check(s).  Note: If WTOTYPE is not specified,   */
|                     /*               the message is determined by the check severity. */
|                     /*   REASON -  1-126 character reason that documents why the policy */
|                     /*             statement statement was added to HZSPRMxx.        */
|                     /*   DATE   -  (yyyymmdd) The date when the policy statement was  */
|                     /*             added to HZSPRMxx.                                */
|                     /*                                                               */
|                     /*---------------------------------------------------------------*/
|                     /*---------------------------------------------------------------*/  00000491
|                     /*                                                               */  00000981
|                     /* MACRO-STMT:                                                   */  00001471
|                     /*                                                               */  00001961
|                     /* DESCRIPTIVE-NAME: Exceptions  HZSPRMxx Member                 */  00002451
|                     /*                                                               */  00002941
|                     /*  LICENSED MATERIALS - PROPERTY OF IBM                         */  00003431
|                     /*  5694-A01                                                     */  00003921
|                     /*  (C) COPYRIGHT IBM CORP. 2005                                 */  00004411
|                     /*                                                               */  00004901
|                     /* STATUS:                                                       */  00005391
|                     /*                                                               */  00005881
|                     /* FUNCTION: This is to override polices to make them inactive   */  00006371
|                     /*           until the exceptions they generate get fixed        */  00006861
|                     /*                                                               */  00007351
|                     /*                                                               */  00007841
|                     /* ============================================================= */  00008331
|                     /*                                                               */  00008821
|                     /* CHANGE-ACTIVITY:                                              */  00009311
|                     /*                                                               */  00010781
|                     /* ------------------------------------------------------------- */  00011271
|                     /* ------------------------------------------------------------- */
|                     /*  CHECK(IBMCNZ,CNZ_CONSOLE_MSCOPE_AND_ROUTCODE)                */
|                     /* ------------------------------------------------------------- */
|                     ADDREPLACE POLICY STMT(CNZ_POLICY_2)
|                     UPDATE CHECK(IBMCNZ,CNZ_CONSOLE_MSCOPE_AND_ROUTCODE)
|                            DATE(20050728)
|                            INACTIVE
|                            SEVERITY(LOW)
|                            INTERVAL(24:00)   /* RUN ONCE A DAY */
|                     REASON('Make Check inactive to fixed')
|                     /* ------------------------------------------------------------- */
```

```
/*  CHECK(IBMRACF,RACF_SENSITIVE_RESOURCES_DFLT)                    */
/*                                                                  */
/* Check that certain sensitive resources are protected.            */
/*                                                                  */
/* PARAMETERS:                                                      */
/*       1. A user ID may be specified. The                         */
/*         RACF_SENSITIVE_RESOURCES check performs an authorization */
/*         check using this user ID. This parameter is optional.    */
/* ---------------------------------------------------------------- */
ADDREPLACE POLICY STMT(RACF_SENS_DFLT)
UPDATE CHECK(IBMRACF,RACF_SENSITIVE_RESOURCES)
       DATE(20050617)
       INACTIVE
       SEVERITY(HI)
       INTERVAL(08:00)
REASON('Make Check inactive to fixed')
/*----------------------------------------------------------------*/
/*----------------------------------------------------------------*/
/* CHECK(IBMRSM,RSM_MEMLIMIT)                                     */
/*                                                                */
/*                                                                */
/*   AUDITS THE SETTING OF MEMLIMIT IN SMFPRMxx                   */
/*                                                                */
/*  PARAMETERS:                                                   */
/*                                                                */
/*   NONE                                                         */
/*----------------------------------------------------------------*/
ADDREPLACE POLICY STMT(RSM_MEMLMDEF)
UPDATE CHECK(IBMRSM,RSM_MEMLIMIT)
       DATE(20050802)
       INACTIVE
       SEVERITY(LOW)
       INTERVAL(ONETIME)
 REASON('Make Check inactive to fixed')
/*----------------------------------------------------------------*/
/*  CHECK(IBMXCF,XCF_CF_STR_PREFLIST)                             */
/*                                                                */
/* Check that each structure is where it is desired to be based on  */
/* its preference list.                                           */
/*                                                                */
/* PARAMETERS:                                                    */
/*   1. NONE                                                      */
/* -------------------------------------------------------------- */
ADDREPLACE POLICY STMT(XCFPOL15)
UPDATE CHECK(IBMXCF,XCF_CF_STR_PREFLIST)
       DATE(20050617)
       INACTIVE
       SEVERITY(MED)
       INTERVAL(08:00)
 REASON('Make Check inactive to fixed')
/*----------------------------------------------------------------*/
/*  CHECK(IBMGRS,GRS_CONVERT_RESERVES)                             */
/*                                                                 */
/* Check that all RESERVES are being converted if in STAR mode.    */
/*                                                                 */
/* PARAMETERS: None.                                               */
/* --------------------------------------------------------------- */
ADDREPLACE POLICY STMT(IBMGRS_DEFAULT03)
UPDATE CHECK(IBMGRS,GRS_CONVERT_RESERVES)
       DATE(20050616)
       INACTIVE
       SEVERITY(LOW)
       INTERVAL(ONETIME)
REASON('Make Check inactive to fixed')
```

Our approach to automation with IBM Health Checker for z/OS

There are numerous ways you can automate IBM Health Checker for z/OS and its exception messages, depending on the products installed in your shop and a million other variables. Right now, we've implemented a very simple approach to automation, we may add to that in the future. For more on automation, see More automation ideas in *IBM Health Checker for z/OS: User's Guide*.

Our approach to automation on a test sysplex:

1. **Automate start up:** We set up our systems so that IBM Health Checker for z/OS starts automatically every time a system IPLs. We do this by running the HZSPROC from our System Automations.
2. **Automate HZSPRINT to keep a record of check messages on each system:** We use System Automation running under NetView to automate HZSPRINT. We code the HZSPRINT JCL so that it automatically prints the messages from checks that found an exception. You can code the JCL for HZSPRINT so that it prints the message buffer to a sequential data set or simply to SYSOUT. Our JCL looks prints the message buffer data to a sequential data set for any check that finds an exception, as shown in the following example:

```
//HZSPRINT JOB 'ACCOUNTING INFORMATION','HZSPRINT JOB',
//         CLASS=A,MSGCLASS=A,MSGLEVEL=(1,1)
/*JOBPARM SYSAFF=*
//HZSPRINT EXEC PGM=HZSPRNT,TIME=1440,REGION=0M,
//*   PARM=('CHECK(check_owner,check_name)')
//    PARM=('CHECK(*,*)',
//    'EXCEPTIONS')
//*   PARM=('LOGSTREAM(HZS.HEALTH.CHECKER.HISTORY)')
//*   PARM=('LOGSTREAM(HZS.HEALTH.CHECKER.HISTORY)',
//*   'CHECK(owner,name)')
//*   PARM=('LOGSTREAM(HZS.HEALTH.CHECKER.HISTORY)','EXCEPTIONS',
//*   'CHECK(owner,name)')
//*   PARM=('LOGSTREAM(HZS.HEALTH.CHECKER.HISTORY)','EXCEPTIONS')
//*   PARM=('LOGSTREAM(HZS.HEALTH.CHECKER.HISTORY)','SYSNAME(sysname)')
//*   PARM=('LOGSTREAM(HZS.HEALTH.CHECKER.HISTORY)','SYSNAME(sysname)',
//*   'CHECK(owner,name)')
//*   PARM=('LOGSTREAM(HZS.HEALTH.CHECKER.HISTORY)','EXCEPTIONS',
//*   'SYSNAME(sysname)',
//*   'CHECK(owner,name)')
//*   PARM=('LOGSTREAM(HZS.HEALTH.CHECKER.HISTORY)','EXCEPTIONS',
//*   'SYSNAME(sysname)')
//*YSOUT   DD SYSOUT=A,DCB=(LRECL=256)
//SYSOUT   DD DSN=HCHECKER.PET.CHKEXCPT.SEQ.REPORT,DISP=MOD
```

3. **Automate HZSPRINT on each system to send e-mail messages:** You can add a step to the HZSPRINT JCL for each system that uses the Simple Mail Transfer Protocol (SMTP) FTP command to send e-mail messages. To do this, you must have SMTP set up - see *z/OS Communications Server: IP User's Guide and Commands*. We're using SMTP to send an e-mail alert whenever a check finds an exception. To do this, we key off of the HZS exception messages - see Using HZS exception messages for automation in *IBM Health Checker for z/OS: User's Guide*.

Part 2. Networking and application enablement

The following chapters describe the networking and application enablement aspects of our computing environment.

Chapter 11. About our networking and application enablement environment

In this chapter we describe our networking and application enablement environment, including a high-level view of our configurations and workloads. We discuss networking and application enablement together because the two are greatly intertwined. You need the networking infrastructure in place before you can run many of the application enablement elements and features.

Our networking and application enablement configuration

Figure 41 illustrates at a high level our networking and application enablement configuration. In the figure, the broad arrows indicate general network connectivity of a given type, rather than specific, point-to-point, physical connections.

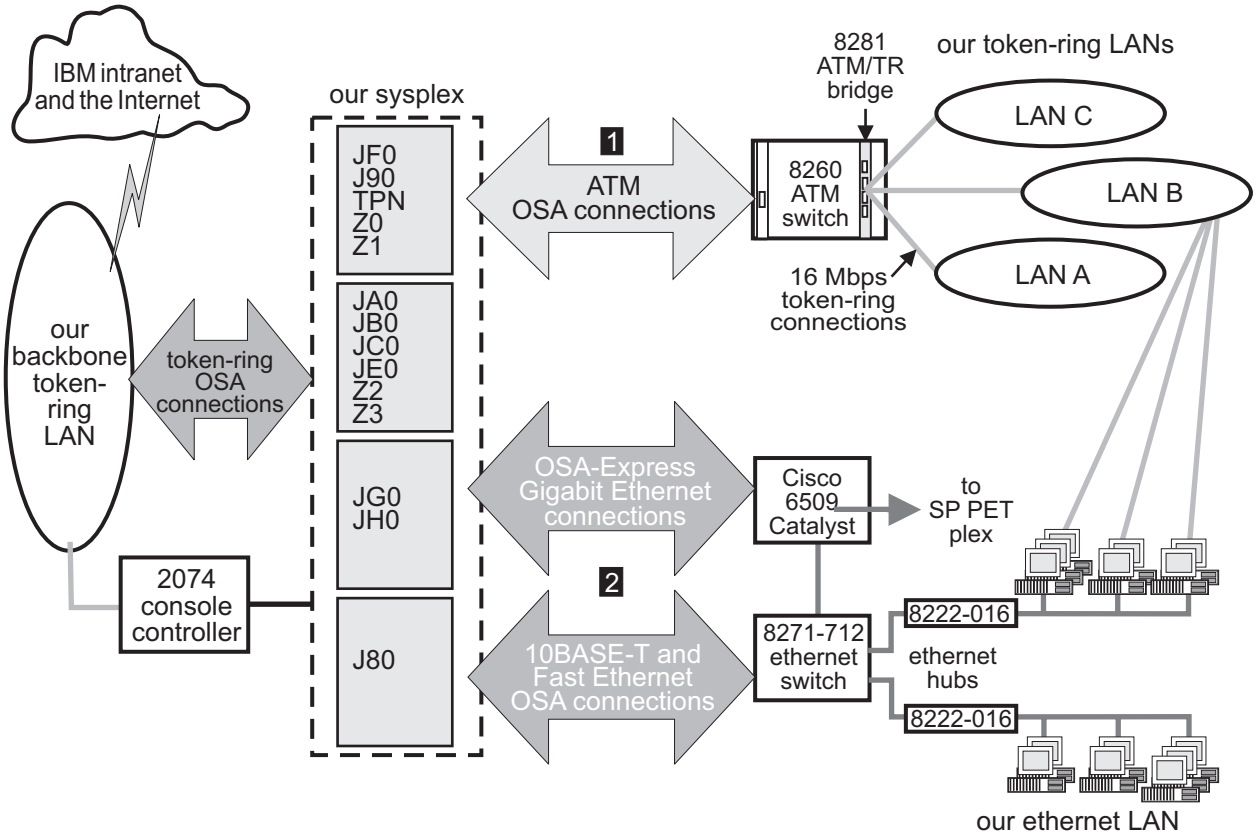


Figure 41. Our networking and application enablement configuration

Note the following about Figure 41:

- We use the following OSA features to connect our systems to our LANs:
  - OSA-2
    ENTR (Ethernet/Token Ring)
  - OSA-Express
    ATM (Asynchronous Transfer Mode)
    FENET (Fast Ethernet)
    Gigabit Ethernet (GbE)

- All ATM connections (1) use ATM LAN emulation; we have no native ATM connections. Although not shown, some of our CPCs that do not have an ATM connection instead use OSA-2 ENTR to directly connect to each of our token-ring LANs.
- Host system Ethernet connections (2) use either OSA-2 ENTR 10BASE-T, OSA-Express FENET, or OSA-Express Gigabit Ethernet features depending on the CPC model and the type of adapter it supports.
- Although not shown, all RS/6000s on LAN A also have a direct connection to the backbone token ring.
- We recently replaced our Gigabit Ethernet switch with a Cisco 6509 Catalyst switch. This new switch handles all of our Gigabit Ethernet and some of our Ethernet connections. Eventually, all of our Ethernet traffic will flow through the Cisco 6509 and we'll remove the 8271-712 Ethernet switch. (For technical details about the Cisco 6500 Catalyst family, go to http://www.cisco.com.)
- We also added Gigabit Ethernet connectivity between our sysplex and a remote AIX cluster owned by the SP PET team. We use this connectivity for the AIX portion of our bookstore application.

For an illustration of our VTAM configuration, see "Our VTAM configuration" on page 16.

If you are familiar with our test reports, then you know that we have always described our networking configuration in exacting detail, as we felt that the complexity of our environment required a great deal of explanation. For example, at one time we were very specific about which of our system images could access which of our network resources. However, as we progress, we are concentrating more and more on TCP/IP and expanding our use of Ethernet. As a result, things are becoming more similar than dissimilar and connectivity between our host systems and network resources is approaching any-to-any.

Accordingly, we have shifted our networking discussion to a somewhat more conceptual level and focus on how our infrastructure enables us to test and exploit new features and functions. We will continue to highlight specific aspects of our configuration as significant changes occur and we introduce new technologies.

Our Ethernet LAN configuration

Our network configuration includes an Ethernet LAN. We primarily use it for FTP testing from Windows 95 and Windows NT clients and for VIPA testing. (For more information about VIPA, see our December '99 edition.) Many of our Ethernet client workstations also contain a token-ring adapter that connects the workstations to our token-ring LAN B as well. We use an OS/2 LAN Server on LAN B to drive the FTP testing on the Ethernet clients. You can read more about this setup in "What's happening in LAN B?" on page 125

Our systems' Ethernet connectivity includes a combination of 10BASE-T, Fast Ethernet, and Gigabit Ethernet connections using OSA-2 ENTR, OSA-Express FENET, and OSA-Express Gigabit Ethernet features, respectively.

Note that the connections between our OSA-Express Gigabit Ethernet features and our Cisco 6509 Catalyst switch operate at 1000 Mbps. The Fast Ethernet connections between our OSA-Express FENET features and our 8271 Ethernet switch, as well as those between our Cisco 6509 and the 8271, operate at 100 Mbps. The 10BASE-T connections from the 8271 to the 8222 Ethernet hubs and client workstations operate at 10 Mbps.

The OSA-Express FENET feature operates at either 10 or 100 Mbps in half- or full-duplex mode and supports auto-negotiation with its attached Ethernet hub, router, or switch. We used the latest edition of *zSeries OSA-Express Customer's Guide and Reference* and the OSA/SF GUI for Windows to install and configure the OSA-Express FENET feature. (See our December 1999 edition for our experiences installing the OSA/SF GUI for Windows.) We also recommend that you check with your IBM support representative to ensure that you have the latest microcode level for this feature.

Our ATM configuration

As we note above, our configuration includes OSA-Express ATM features operating in LAN emulation mode only. Therefore, when you see the term *ATM* in this chapter, understand it to mean *ATM LAN emulation*. (See our December 1998 edition for details on our ATM implementation.)

We use ATM for high-speed, bi-directional, asynchronous connectivity between our z/OS systems and our 8260 ATM switch. The 8260 then connects to the 8281 LAN bridge and provides access to all three of our token-ring LANs. The ATM links operate at 155 Mbps while the token-ring LANs still operate at 16 Mbps. Therefore, the maximum combined token-ring traffic from all three LANs is only 64 Mbps, which *each* ATM link easily accommodates.

Note that because of the wide variety of hardware we employ, not every CPC in our sysplex has an ATM connection. For those CPCs that do not, we use OSA-2 ENTR to provide direct connections to each of our token-ring LANs. Either way, it's all transparent to the end user.

Our ipV6 Environment Configuration

With z/OS V1R6, we now have an ipV6 environment equivalent to our ipV4 environment. V1R6 now supports OSPF V3 for ipV6 and ipV6 support for DVIPA and Sysplex Distributor.

We used the following manuals as guides in setting up ipV6.

- *z/OS Communications Server: IP Configuration Guide*, SC31-8775
- *z/OS Communications Server: IP Configuration Reference*, SC31-8776
- *z/OS Communications Server: IPv6 Network and Application Design Guide*, SC31-8885

To configure a z/OS image for ipV6 the following changes have to be made:

Note: This is not meant to be an all inclusive guide for ipV6 setup.

1. Add new NETWORK, AF_INET6 to BPXPRMxx statement.
2. Add New INTERFACE to TCPIP profile for ipV6 'device'.
3. Add support for DYNAMIC XCF
4. Create DVIPA for ipV6
5. Add INTERFACE to OMPROUTE profile.
6. Make appropriate additions to Nameserver.

z/OS UNIX System Services changes and additions

The following are the changes and additions we made to z/OS UNIX System Services:

1. Changing BPXPRMxx to add ipV6 support

We made the following changes to BPXPRMxx to add ipV6 support:

```
NETWORK DOMAINNAME(AF_INET6)
DOMAINNUMBER(19)
MAXSOCKETS(60000)
TYPE(INET)
```

Note: INADDRANYPORT and INADDRANYCOUNT values are used for both ipV4 and ipV6 when the BPXPRMxx is configured for ipV4 and ipV6 support. If AF_INET is specified, it is ignored and the values from the NETWORK statement for AF_INET are used if provided. Otherwise, the default values are used.

2. Adding NETWORK statements to have a stack that supports ipV4 and ipV6

   We added the following two NETWORK statements to have a stack that supports ipV4 and ipV6:

```
FILESYSTYPE TYPE(CINET) ENTRYPOINT(BPXTCINT)
NETWORK DOMAINNAME(AF_INET)
DOMAINNUMBER(2)
MAXSOCKETS(2000)
TYPE(CINET)
INADDRANYPORT(20000)
INADDRANYCOUNT(100)
NETWORK DOMAINNAME(AF_INET6)
DOMAINNUMBER(19)
MAXSOCKETS(3000)
TYPE(CINET)
SUBFILESYSTYPE NAME(TCPCS) TYPE(CINET) ENTRYPOINT(EZBPFINI)
SUBFILESYSTYPE NAME(TCPCS2) TYPE(CINET) ENTRYPOINT(EZBPFINI)
SUBFILESYSTYPE NAME(TCPCS3) TYPE(CINET) ENTRYPOINT(EZBPFINI)
```

TCPIP Profile changes

We made the following additions to our IPv6 INTERFACE statements:

```
INTERFACE OSA9E0V6
DEFINE IPAQENET6
PORTNAME GBPRT9E0
IPADDR FEC0:0:0:1:x:xx:xx:xxx  ;(Site-Local Address)
3FFE:0302:0011:2:x:xx:xx:xxx ; (Global Address)
```

Note: In order to configure a single physical device for both IPv4 and IPv6 traffic, you must use DEVICE/LINK/HOME for the IPv4 definition and INTERFACE for the IPv6 definition, so that the PORTNAME value on the INTERFACE statement matches the device_name on the DEVICE statement.

Dynamic XCF addition

We made the following addition for our Dynamic XCF:

```
IPCONFIG6 DYNAMICXCF FEC0:0:0:1:0:168:49:44
```

Dynamic VIPA additions

The following statement was added to our VIAPDYNAMIC section:

Note: V6Z2FTP is the INTERFACE name for this VIPA.

```
VIPADEFINE V6Z2FTP 2003:0DB3:1::2
VIPADISTRIBUTE SYSPLEXPORTS V6Z2FTP PORT 20 21
DESTIP FEC0:0:0:1:0:168:49:37
```

OMPROUTE addition

Setting up OMPROUTE only requires adding the INTERFACE name to the OMPROUTE profile for the basic setup that we used.

```
IPV6_OSPF_INTERFACE
Name = OSA9E0V6;
```

Note: During testing we encountered the following message:

```
EZZ7954I  IPv6 OSPF adjacency failure, neighbor 192.168.25.33, old state 128,
 new state 4, event 10
```

The neighbor id in the message is the ROUTERID from the OMPROUTE profile. It will not show an ipV6 address.

NAMESERVER changes

We created seperate ipV6 names for each LPAR. To keep things simple for the system name, we used the existing LPAR name with IP6 as the suffix. For the ipV6 ip addresses, we used a common prefix and used the ipV4 address as the suffix. This made it easier to identify for diagnosing problems.

Forward file changes

The following change was made to our forward file:

```
J80IP6                IN AAAA 3FFE:302:11:2:9:12:20:150
```

Reverse file entry addition

We added the following for the reverse file entry:

```
$TTL 86400
$ORIGIN 2.0.0.0.1.1.0.0.2.0.3.0.E.F.F.3.IP6.ARPA.
@       IN SOA  Z0EIP.PDL.POK.IBM.COM.  ALEXSA@PK705VMA (
                  012204  ;DATE OF LAST CHANGE TO THIS FILE
                  21600   ;REFRESH VALUE FOR SECONDARY NS (IN SECS)
                  1800    ;RETRY VALUE FOR SECONDARY NS (IN SECS)
                  48384   ;EXPIRE DATA WHEN REFRESH NOT AVAILABLE
                  86400 ) ;MINIMUM TIME TO LIVE VALUE (SECS)
@                  IN NS   Z0EIP.PDL.POK.IBM.COM. ; PRIMARY DNS
0.5.1.0.0.2.0.0.2.1.0.0.9.0.0.0 IN PTR J80IP6.PDL.POK.IBM.COM.
```

Our token ring LAN configuration

As Figure 41 illustrates, we have a total of four token-ring LANs: a backbone ring and three test LANs that use various:

- Communications protocols (TCP/IP, SNA, NetBIOS, and Internet Packet Exchange (IPX))
- Workstation operating systems (AIX, Linux, OS/2, PC DOS, and Microsoft Windows NT, Windows 95, and Windows 2000)
- Workstation types (RS/6000s and various types of PCs)

LANs A, B, and C in Figure 41 use only the token-ring LAN protocol. The three LANs connect to our host systems through the 8281 LAN bridge and 8260 ATM switch as described above. (You can read about our ATM experiences in our December 1998 edition.) For host systems running on CPCs that do not have an ATM connection, we instead use OSA-2 ENTR features to provide direct token-ring connections to each of the three LANs (these connections are not shown in Figure 41).

Note that we also have an OS/2 LAN Server with a CLAW protocol channel adapter that connects to system JE0 for LAN Server. This is not shown in Figure 41; see Figure 44 on page 127 for an illustration of this.

All of the systems in our sysplex can connect to the IBM SNA network using VTAM as long as either system Z0 or system J80 (the network node server) is available. In addition, all systems can get to the IBM TCP/IP network directly through our backbone token ring.

We discuss how we use the backbone and LANs A, B, and C in greater detail in the following sections.

More about our backbone token ring

The token-ring backbone connects our test environment to the IBM corporate network or intranet and, beyond that, to the Internet. Rather than exist as an isolated entity, our ability to connect to the rest of the corporation and to the outside world yields us a much more viable and robust test environment. Some specific advantages include:

- We are able to access our network resources from our offices or while working from home, instead of having to be on the test floor all the time. This convenience and flexibility allows us to be more productive.
- We can perform more complete and realistic test scenarios with products and features, such as:
  - Tivoli Storage Management (TSM, formerly ADSM)
  - Firewall
  - NFS
  - Infoprint® Server
  - Rlogin
  - Telnet
  - Web access
- When we encounter a complex problem, we are able to have product developers from our local site and from other IBM locations work with us in our own test environment to help diagnose and resolve the problem.
- We keep our own documentation, such as test plans and run procedures, on our Web server and can access it from anywhere. As a result, we also implicitly test our networking environment just by performing our day-to-day administrative work.
- We install our configuration tools (for Firewall and OSA/SF, for example) on workstations attached to the backbone so that we can provide central access to the tools and share them across multiple systems.

For many of the same reasons, we also recently switched from running our RS/6000 workloads on LAN A to running them on the backbone, mostly to allow greater access to other resources and provide more realistic testing. See the next section for more about LAN A.

What's happening in LAN A?

Our RS/6000 workstations reside on LAN A but they also directly connect to the backbone. This additional connectivity allowed us to shift a majority of the workloads that we once performed exclusively on LAN A over to the backbone. LAN A itself still exists in our environment, but we don't use it for anything special from a functional standpoint.

Figure 42 on page 125 depicts our z/OS UNIX DCE test configuration in LAN A, including the connections from the RS/6000s to the backbone (which, for clarity, are not shown in Figure 41 above).

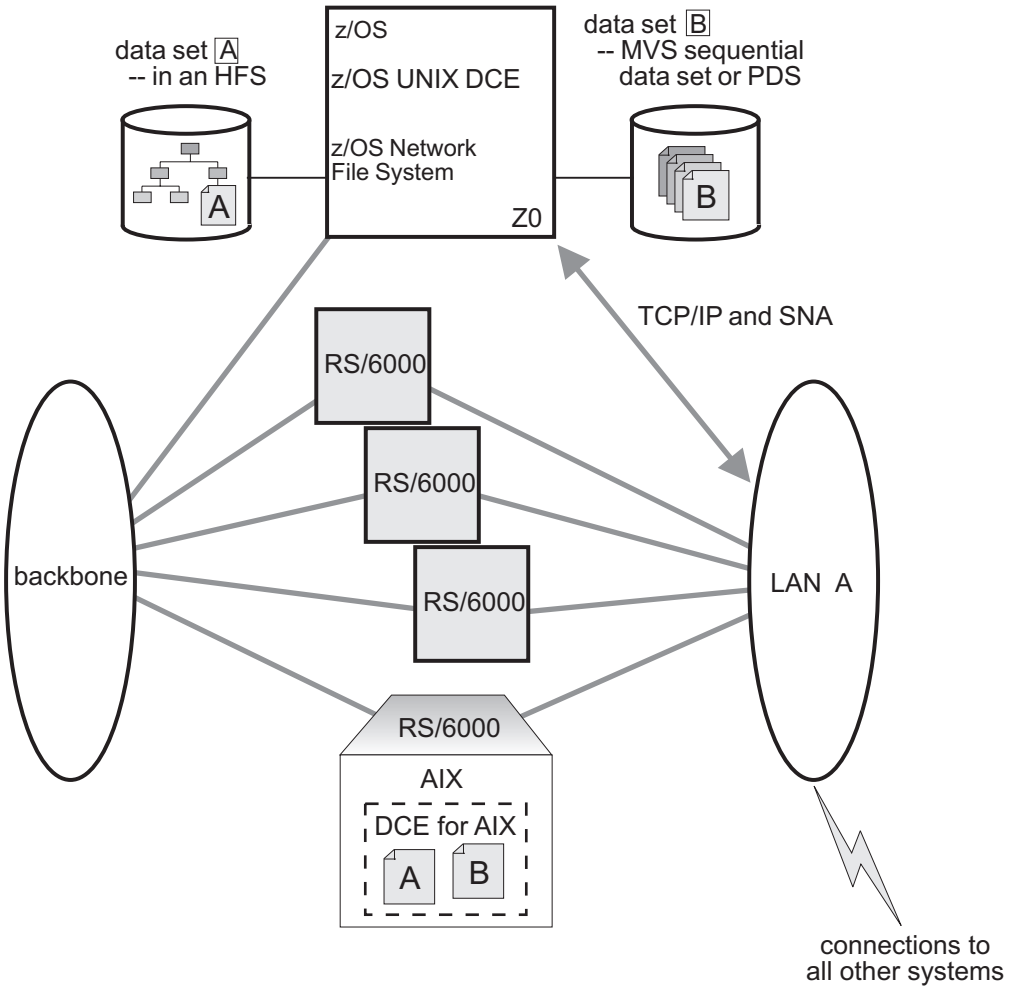


Figure 42. Our token-ring LAN A

The RS/6000 workstations on LAN A all run the AIX operating system. We use them to exercise the z/OS UNIX, DCE, and DFS™ functions. See “Our workloads” on page 19 for a more detailed description of these workloads. For more information about DCE and DFS, see “DCE and DFS Publications” in Appendix E, “Useful Web sites,” on page 463.

What’s happening in LAN B?

You might recall from our December 1996 edition that our LANs B and C started out as two functionally separate LANs. Later on, we combined their functionality and collectively referred to them as logical LAN BC. Well, we’ve now come full circle. For better performance and throughput, we are back to using LANs B and C as two functionally separate LANs.

LAN B has an OS/2 NFS function and an FTP function using TCP/IP. The OS/2 LAN Server on LAN B acts as a control workstation for our NFS and FTP workloads. The control data consists of the commands that start, stop, and otherwise regulate the execution of the workloads. The test data or workload data is the actual data that the workloads manipulate.

The workstations that run the FTP workloads connect to both our token-ring LAN B and to our Ethernet LAN. The FTP control data comes from the OS/2 server to the clients over LAN B. The test data that the workloads manipulate travels over the Ethernet LAN.

The NFS function communicates with z/OS NFS using TCP/IP, and both the control data and the workload data travel over LAN B. (See “Comparing the network file systems” on page 128 for a description of the different types of NFSs we use.)

Figure 43 depicts our NFS and FTP test configuration in LAN B. For more information about NFS, see “Network File System Publications” in Appendix E, “Useful Web sites,” on page 463.

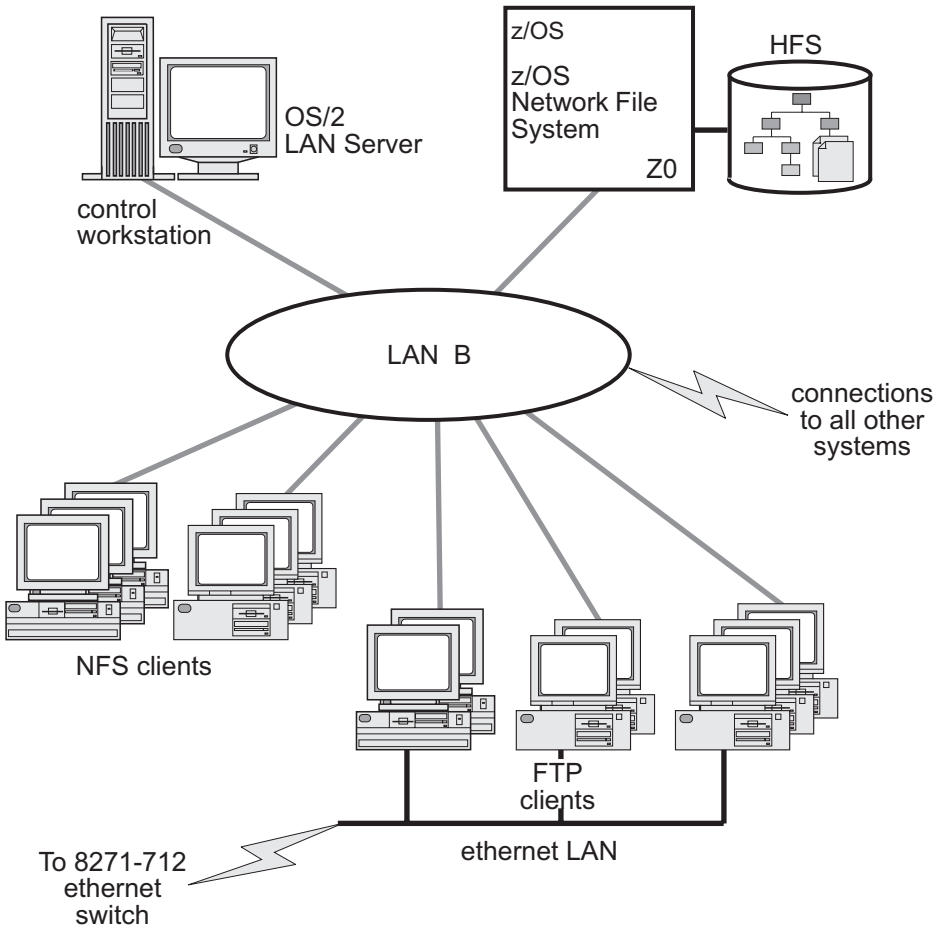


Figure 43. Our token-ring LAN B

What’s happening in LAN C?

LAN C runs two different types of LAN Server scenarios using OS/2 LAN Servers as front-end processors (FEPs) to z/OS LAN Server. z/OS LAN Server expands the file storage capability of the OS/2 LAN Servers by storing workstation-format files in VSAM linear data sets on the z/OS host. These data sets are not readable by MVS users, but appear to the clients as though they are stored on the OS/2 LAN Servers.

First, we have an OS/2 LAN Server acting as a FEP (**A**) with a SNA connection to LAN Server in system Z0. We could conceivably connect the OS/2 LAN Server to

any z/OS system, but we currently happen to be using Z0. We use Communications Manager/2 for the SNA connection and APPC communications.

We also have another OS/2 LAN Server acting as a FEP (**B**) with a CLAW protocol connection to LAN Server in system JE0.

Typically, a LAN file server contains one or more large-capacity hard disk drives on which it stores files for access by the clients (or requesters). However, in our setup, the OS/2 LAN Servers do not store any workload-related programs or data on their own hard disks for use by the clients. All the workload-related programs and data reside on the z/OS system. This is completely transparent to the requesters, as they are only aware of the OS/2 LAN Servers which, in turn, interact with z/OS LAN Server on the host. The OS/2 servers do keep setup files, automation programs, and workstation configuration files on their own local disk drives.

Figure 44 depicts our LAN Server test configuration in LAN C. For more information about LAN Server, see “LAN Server Publications” in Appendix E, “Useful Web sites,” on page 463.

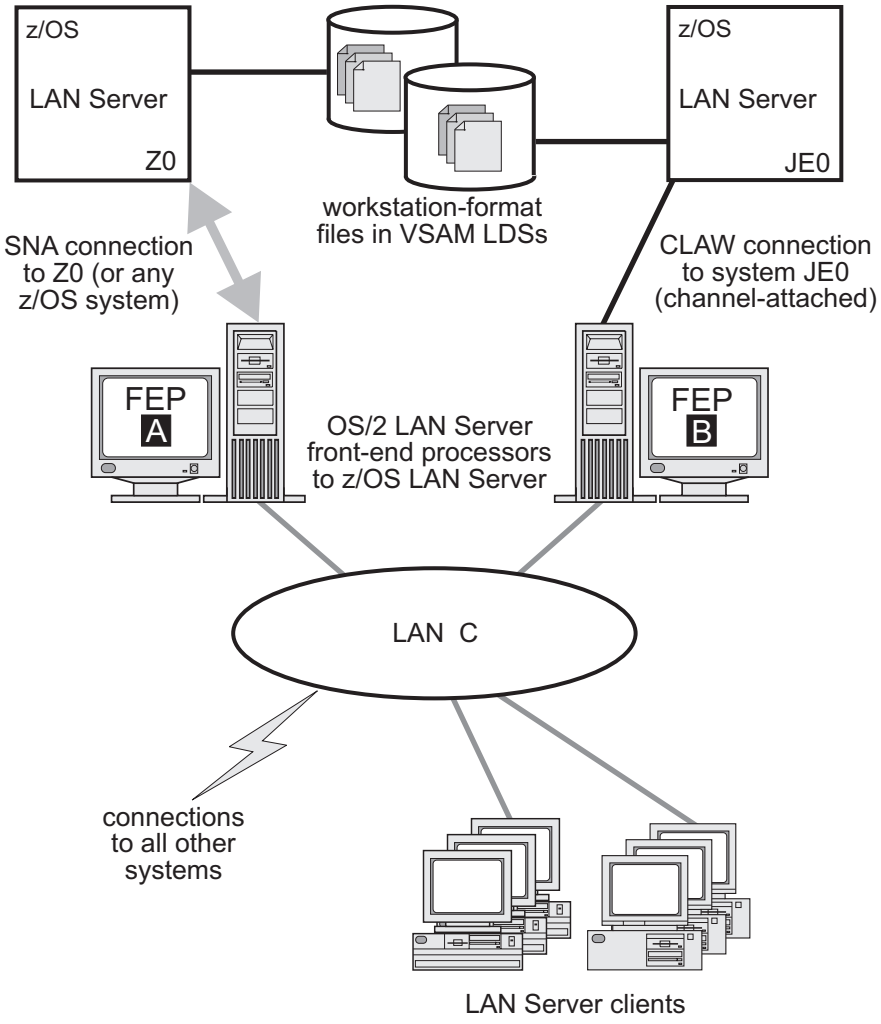


Figure 44. Our token-ring LAN C

Comparing the network file systems

If you are a faithful reader of our test report, you might have noticed that we have changed our Network File System (NFS) approach a number of times, depending on the circumstances at the moment. Currently, we have the z/OS NFS (called DFSMS/MVS® NFS in OS/390 releases prior to R6) on system Z0.

NFS allow files to be transferred between the server and the workstation clients. To the clients, the data appears to reside on a workstation fixed disk, but it actually resides on the z/OS server.

With z/OS NFS, data that resides on the server for use by the workstation clients can be either of the following:

- z/OS UNIX files that are in a hierarchical file system (HFS). The z/OS NFS is the only NFS that can access files in an HFS. You need to have z/OS NFS on the same system as z/OS UNIX and its HFS if you want to use the NFS to access files in the HFS.
- Regular MVS data sets such as PS, VSAM, PDSs, PDSEs, sequential data striping, or direct access.

Migrating to the z/OS NFS: We plan to implement some of the new functions available in z/OS NFS, such as file locking over the z/OS NFS server and file extension mapping support. You can read descriptions of these new functions in *z/OS Network File System Guide and Reference*, SC26-7417. In addition, you can read about WebNFS support in our December 1999 edition, and the use of the LAN Server NFS in our June 2004 edition. We hope to have additional experiences with these new functions to share with you in a future test report.

Note that APAR OW40134 recommends a change to the SHAREOPTIONS specified in the sample JCL for the IDCAMS job used to allocate the mount handle data sets. This sample JCL is both shipped in *hlq*.NFSSAMP(GFSAMHDJ) and illustrated in *z/OS Network File System Guide and Reference*. The sample JCL currently uses SHAREOPTIONS(3 3). However, the APAR instead recommends SHAREOPTIONS(1 3). While the sample code does work as it stands, it allows programs other than NFS to update the files. Using SHAREOPTIONS(1 3) limits the possibility of corruption to the mount handle database.

Networking and application enablement workloads

For information about our networking and application enablement workloads, see “Our workloads” on page 19.

Enabling NFS recovery for system outages

In z/OS V1R6, we improved NFS recoverability and availability by using Automatic Restart Management (ARM) and dynamic virtual IP address (DVIPA) with our NFS server. With these enhancements, the NFS server is automatically moved to another MVS image in the sysplex during a system outage.

Note: We are running a shared HFS environment.

We used the following documentation to help us implement ARM for NFS recovery.

- Automatic Restart Management
  - ARMWRAP as described in the IBM Redpaper *z/OS Automatic Restart Manager* available on the IBM Redbooks Web site.

  - *z/OS MVS Setting Up a Sysplex*, SA22-7625
- Dynamic VIPA(DVIPA)
  - *z/OS Communications Server: IP Configuration Guide*, SC31-8775

Setting up the NFS environment for ARM and DVIPA

Part 1 of Figure 45 on page 130: illustrates how the NFS server on MVS A acquires DVIPA 123.456.11.22. The AIX clients issue a hard mount specifying DVIPA 123.456.11.22. Before the enhancements, the AIX clients specified a static IP address for MVS A. A system outage would result in the mounted file systems being unavailable from the AIX client's perspective until MVS A was restarted.

Part 2 of Figure 45 on page 130 : illustrates that when an outage of MVS A occurs, ARM automatically moves the NFS server to MVS B. The NFS Server on MVS B acquires the DVIPA 123.456.11.22. From the AIX client's perspective the mounted file systems become available once the NFS server has successfully restarted on MVS B. The original hard mount persists.

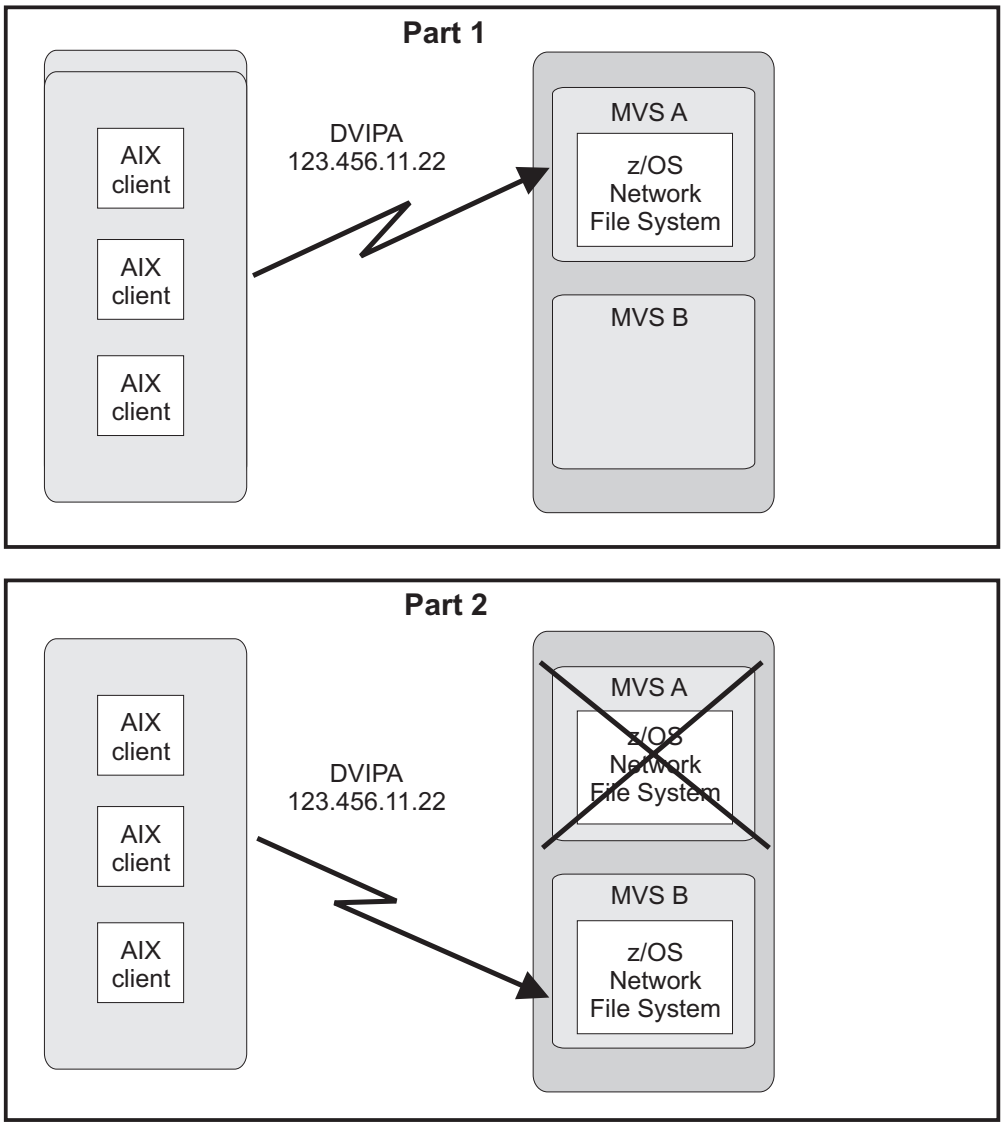


Figure 45. NFS configuration

Note: An ARM enabled NFS will not automatically move back to MVS A after MVS A recovers.

Step for setting up our NFS environment

We performed the following steps to set up our NFS environment for ARM and DVIPA:

1. Acquiring dynamic VIPA:

   We added the following statement in the TCP/IP profiles for MVSA and MVSB to allow NFS to acquire dynamic VIPA:

   ```
   VIPARANGE DEFINE 255.255.255.255 123.456.11.22 ; NFS VIPA
   ```

   We recycled TCPIP on MVSA and MVSB to activate the above changes.

   Note: You could also use the `VARY TCPIP,,OBEYFILE` command with a data set that contains VIPARANGE statement.

   ---

2. Defining the NFS element:

We added the following statement to our ARM policy member (ARMPOLxx) in SYS.PARMLIB member to define the NFS element:

```
RESTART_GROUP(NFSGRP)
  TARGET_SYSTEM(MVSB)
  FREE_CSA(600,600)
    ELEMENT(NFSSELEM)
      RESTART_ATTEMPTS(3,300)
      RESTART_TIMEOUT(900)
      READY_TIMEOUT(900)
```

---

3. Loading the ARM policy:

   We ran the IXCMIAPU utility to load ARMPOLxx and then activated the policy:

   ```
   setxcf start,policy,type=arm,polname=armpolxx
   ```

---

4. Registering NFS using an ARM policy:

   We used ARMWRAP, the ARM JCL Wrapper with the following parameters to register NFS as ARM element:

```
//*******************************************************************
//*REGISTER ELEMENT 'NFSSELEM' ELEMENT TYPE 'SYSTCPIP' WITH ARM
//*REQUIRES ACCESS TO SAF FACILITY IXCARM.SYSTCPIP.NFSSELEM
//ARMREG EXEC PGM=ARMWRAP,
//       PARM=('REQUEST=REGISTER,READYBYMSG=N,',
//             'TERMTYPE=ALLTERM,ELEMENT=NFSSELEM,',
//             'ELEMTYPE=SYSTCPIP')
//* ---------------------------------------------------------------- *
//* DELETE VIPA FOR NFS SERVER                                       *
//* ---------------------------------------------------------------- *
//DELVIPA  EXEC PGM=EZBXFDVP,
//            PARM='POSIX(ON) ALL31(ON) /-p TCPIP -d &VIPA'
//SYSPRINT DD SYSOUT=*
//* ---------------------------------------------------------------- *
//* ACQUIRE VIPA FOR NFS SERVER                                      *
//* ---------------------------------------------------------------- *
//DEFVIPA  EXEC PGM=EZBXFDVP,
//            PARM='POSIX(ON) ALL31(ON) /-p TCPIP -c &VIPA'
//SYSPRINT DD SYSOUT=*
```

---

5. Terminating the address space:

   The following example shows what is executed when the address space is terminated:

```
//* ---------------------------------------------------------------- *
//* DELETE VIPA FOR NFS SERVER                                       *
//* ---------------------------------------------------------------- *
//DELVIPA  EXEC PGM=EZBXFDVP,
//            PARM='POSIX(ON) ALL31(ON) /-p TCPIP -d &VIPA'
//SYSPRINT DD SYSOUT=*
//*******************************************************************
//*FOR NORMAL TERMINATION,DEREGISTER FROM ARM
//*FOR NORMAL TERMINATION,DEREGISTER FROM ARM
//*******************************************
//ARMDREG EXEC PGM=ARMWRAP,
//        PARM=('REQUEST=DEREGISTER')
```

Chapter 12. Using z/OS UNIX System Services

In this chapter, we cover the following z/OS UNIX System Services topics:
- "z/OS UNIX enhancements in z/OS V1R5"
- "z/OS UNIX enhancements in z/OS V1R6" on page 141
- "z/OS UNIX enhancements in z/OS V1R7" on page 160
- "Using the hierarchical file system (HFS)" on page 181
- "Automount enhancement for HFS to zSeries file system (zFS) migration" on page 181
- "Using the zSeries file system (zFS)" on page 182

z/OS UNIX enhancements in z/OS V1R5

z/OS UNIX made several enhancements in z/OS V1R5. In this section, we cover the following topics:
- "Remounting a shared HFS"
- "Mounting file systems using symbolic links"
- "Creating directories during z/OS UNIX initialization" on page 134
- "Temporary file system (TFS) enhancements" on page 137

We used the information in *z/OS UNIX System Services Planning* to help us plan and implement the above enhancements.

Remounting a shared HFS

Remounting a mounted shared HFS is a new function in z/OS V1R5 that allows you to remount an HFS or zFS file system within a directory tree so as to change the access mode. This function is also available for z/OS V1R4 by applying the fix for APAR OA02584.

We have utilized this new function to remount the version HFS from READ mode to RDWR mode. Our normal configuration is to have the version HFS mounted read-only, as IBM recommends. In our environment, we have a requirement to be able to make changes to /usr/lpp and other directories in the version HFS which, until z/OS V1R5, we could only accomplish during our STAGE3 processing (see the discussion of our CUSTHFS procedure in bour December 2001 edition). While we still prepare the HFS for our configuration needs prior to implementing it into production, this new function provides us with the ability to perform additional changes while the HFS is being used in the production environment.

You can perform the remount from the ISHELL panel or by using the TSO unmount command from the server or any of the client systems within the same shared HFS sysplex. The following is an example of the TSO command for remounting our version HFS in read/write mode:

```
unmount filesystem('OMVSSPN.PETPA1.ROOT.FS') remount(rdwr)
```

Mounting file systems using symbolic links

z/OS V1R5 introduces support for using MVS system symbols in symbolic links. This provides the ability to mount different file systems at a logical mount point that resolves to a different path name on different systems. This function uses two new, special identifiers in a symlink, followed by an MVS standard symbolic string template. The special identifier indicates that the text that follows it requires symbolic substitution. We tested this function using HFS and zFS file systems.

The following are the new identifiers:

- $SYSSYMR/*template*

  Results in a relative path name. The path name lookup proceeds from its current position in the path name.
- $SYSSYMA/*template*

  Results in an absolute path name. The path name lookup starts over from the root.

Note: When coding the **ln** command, the new identifier ends with a forward slash (/) and the system symbol starts with a backslash (\).

To test the relative and absolute path name lookups, we used one of our existing system symbols, &SYSCLONE. The value of &SYSCLONE. is “Z0” on our system Z0. The following examples illustrate the difference between the relative and absolute path name lookups.

Example: We issued the following **ln** command in the OMVS shell on system Z0:

```
ln -s \$SYSSYMR/\&SYSCLONE./testdir /pet5/rdir
```

On system Z0, we mounted OMVSSPN.Z0.SYMBOLIC.TEST at /pet5/rdir. The HFS was linked with a relative path name and was mounted at /pet5/Z0/testdir.

Example: We issued the following **ln** command in the OMVS shell on system Z0:

```
ln -s \$SYSSYMA/\&SYSCLONE./testdir /pet5/dir
```

On system Z0, we mounted OMVSSPN.Z0.SYMBOLIC.TEST at /pet5/dir. The HFS was linked with an absolute path name and was mounted at /Z0/testdir.

Creating directories during z/OS UNIX initialization

The z/OS UNIX parmlib member, BPXPRM*xx*, now supports a new, optional keyword, MKDIR, on the existing ROOT and MOUNT statements. The MKDIR keyword allows one or more directories to be created in the mounted file system as part of the mount process during z/OS UNIX initialization. You can specify multiple MKDIR keywords on each ROOT or MOUNT statement; the directories are created in the order in which the MKDIR keywords occur. Such directories can serve as mount points that can be used in subsequent MOUNT statements.

The MKDIR keyword has the following syntax:

```
MKDIR('pathname')
```

where *pathname* specifies a relative path name of a directory to be dynamically created after the file system has been successfully mounted. The path name must not start with a slash (/) and must be enclosed in single quotes.

The path name is relative to the file system’s mount point (specified by the MOUNTPOINT keyword) and can contain intermediate directory components but each component must already exist in the file system hierarchy. You can use multiple MKDIR keywords to create the necessary intermediate directories. Note that the length of the MKDIR path name plus the length of the MOUNTPOINT path name must not exceed the value of the PATH_MAX configuration variable.

The directory to be created must reside in a file system that is mounted in RDWR mode. The directory will have permission bits of 755 and will inherid the UID and GID from its parent directory. These attributes will be overlaid when this directory is actually used as a mount point.

Note the following about the usage of the MKDIR keyword:

- Failure to create a directory does not cause the mount to fail. A message is written to the system log if there is a problem creating a directory. No message is written if the directory already exists.
- MKDIR is only supported in the BPXPRM*xx* parmlib member. There is no downlevel support for MKDIR; therefore, only use MKDIR in a common BPXPRM*xx* member when all sharing systems are at z/OS V1R5 or higher.
- File system reinitialization using the MODIFY BPXOINIT,FILESYS=REINIT command does not support the use of MKDIR in the BPXPRM*xx* member.
- The OMVS restart function (that is, MODIFY OMVS,SHUTDOWN followed by MODIFY OMVS,RESTART) does support the use of MKDIR in the BPXPRM*xx* member.
- MKDIR should not be used for file systems that mount asynchronously, such as the network file system (NFS). In such cases, the creation of the directory cannot be guaranteed. Message BPXF025I is issued to the system log when a file system is to be mounted asynchronously.
- Do not use MKDIR with the SYSNAME keyword when SYSNAME identifies a remote system to perform the mount, as the results are unpredictable. MKDIR will not process on a file system that is already mounted on a remote system.

Note also that, in addition to checking statement syntax, the SETOMVS SYNTAXCHECK=(*xx*) command also checks the MVS catalog for the existence of the HFS or zFS data set names used in each ROOT and MOUNT statement in the specified BPXPRM*xx* member. Messages are written to the syslog if any errors are found. Although mount points are not verified, this can help to ensure that mounts will succeed.

Testing the MKDIR keyword

We made the following changes to the mounts for the sysplex root (/) file system, each system-specific /tmp file system, and a zFS /pet3 file system in our common parmlib member, SYS1.PARMLIB(BPXPRM00):

```
ROOT FILESYSTEM('OMVSSPN.SYSPLEX.ROOT.FS') TYPE(HFS)
   MODE(RDWR) MKDIR('mkdirrootv1r5')                                  A

MOUNT FILESYSTEM('OMVSSPN.&SYSNAME..TMP.FS') TYPE(HFS)
   MODE(RDWR) MOUNTPOINT('/&SYSNAME./tmp') UNMOUNT
   PARM('FSFULL(90,5)') MKDIR('mkdirtmpv1r5')                         B

MOUNT FILESYSTEM('OMVSSPN.PET3.ZFS.FS') TYPE(ZFS) MODE(RDWR)
   MOUNTPOINT('/pet3') AUTOMOVE(I,Z0,Z1,Z2,Z3) MKDIR('mkdirpet3v1r5')  C
```

We issued the SETOMVS SYNTAXCHECK=(00) command to perform syntax and data set name checking on the member. The following message appeared:

```
IEE252I MEMBER BPXPRM00 FOUND IN SYS1.PARMLIB
```

We then checked the syslog to verify that there were no error messages.

We observed the following results the next time the systems were initialized:

A — For the sysplex root (/) file system: We had to wait until we could unmount the sysplex root (/) file system before the directory on the MKDIR keyword could be created the next time the root was mounted during z/OS UNIX initialization. The MKDIR on the ROOT statement will not process as long as the root file system is mounted on any system in the sysplex. Therefore, we tested this by taking down all of the systems in the sysplex and re-IPLing. The first system to join the sysplex mounted the root file system and successfully

processed the MKDIR keyword to create the /mkdirrootv1r5 directory. The directory had permission bits of 755 and had the same UID and GID as the parent directory.

B **— For the system-specific /tmp file systems:** Each system's /tmp file system is unmounted when the system is removed from the sysplex. Thus, as we IPLed each system, it mounted the /tmp file system and successfully processed the MKDIR keyword to create the /&SYSNAME./tmp/mkdirtmpv1r5 directory.

C **— For the /pet3 file system:** When we had the /pet3 file system remotely mounted in the sysplex, the MKDIR keyword did not process on that file system. When we unmounted the /pet3 file system, since this file system is defined in the common BPXPRM00 member, the next system to initialize z/OS UNIX mounted the /pet3 file system and successfully processed the MKDIR keyword to create the /pet3/mkdirpet3v1r5 directory.

All processing messages were written to the system log, not to the console.

We also tested to make sure that multiple MKDIR keywords worked properly on the ROOT and MOUNT statements. We added the following MKDIR keywords to our BPXPRM00 member (following the MKDIR keyword that we had previously added):

```
ROOT FILESYSTEM('OMVSSPN.SYSPLEX.ROOT.FS') TYPE(HFS)
   MODE(RDWR) MKDIR('mkdirrootv1r5')
              MKDIR('mkdirrootv1r5/mkdirrootv1r5dir2')                A
              MKDIR('mkdirrootv1r52')                                 B
              MKDIR('mkdirrootv1r52/mkdirrootv1r52dir2')              C

MOUNT FILESYSTEM('OMVSSPN.&SYSNAME..TMP.FS') TYPE(HFS)
   MODE(RDWR) MOUNTPOINT('/&SYSNAME./tmp') UNMOUNT
   PARM('FSFULL(90,5)') MKDIR('mkdirtmpv1r5')
              MKDIR('mkdirtmpv1r5/mkdirtmpv1r5dir2')
              MKDIR('mkdirtmpv1r52')
              MKDIR('mkdirtmpv1r52/mkdirtmpv1r52dir2')

MOUNT FILESYSTEM('OMVSSPN.PET3.ZFS.FS') TYPE(ZFS) MODE(RDWR)
   MOUNTPOINT('/pet3') AUTOMOVE(I,Z0,Z1,Z2,Z3) MKDIR('mkdirpet3v1r5')
              MKDIR('mkdirpet3v1r5/mkdirpet3v1r5dir2')
              MKDIR('mkdirpet3v1r52')
              MKDIR('mkdirpet3v1r52/mkdirpet3v1r52dir2')
```

We added three new MKDIR keywords to each of the above file system mounts. Using the first one (ROOT) as an example, we added MKDIR keywords, as follows:

A — To create a new directory under an existing directory

B — To create a new directory upon the next mount activity

C — To create a new directory under the directory created in **B**

The file systems were mounted and the directories were successfully created in the same manner as previously described. Further, we did notice that when a mount contains a series of MKDIR keywords, if one of the MKDIRs in the series fails, it does not prevent the subsequent MKDIRs from being attempted.

Testing the SYNTAXCHECK keyword

After making the above changes to the BPXPRM00 parmlib member, we issued the following command:

```
SETOMVS SYNTAXCHECK=(00)
```

Error messages, if any, are only written to the system log.

When we ran this command on a z/OS V1R5 system, it reported no errors for the MKDIR keyword. When we ran it on a z/OS V1R4 system and specified our V1R5 BPXPRMxx member, it reported errors for the MKDIR keyword.

Early in our testing, we experienced a problem such that if the syntax check encountered an uncataloged file system data set, it would then flag all file system data sets after it as being uncataloged, whether they were or were not. z/OS UNIX APAR OA05966 resolved this problem.

Temporary file system (TFS) enhancements

The temporary file system (TFS) is an in-memory physical file system that supports in-storage mountable file systems. A TFS can run in the z/OS UNIX kernel address space but, for 64-bit exploitation, it is preferable to run it in a logical file system (LFS) colony address space.

Overview of the TFS enhancements that we tested

Other enhancements to TFS in z/OS V1R5 include the following:

- "New parameters for mounting a TFS"
- "STOP and MODIFY command support for TFS colony address spaces" on page 138
- "Access control list (ACL) support" on page 139

New parameters for mounting a TFS: Each TFS mount in 64-bit mode consumes space, as requested, above the 2G bar. In addition, TFS allocates some control blocks and a buffer cache below the bar. The default buffer cache size is 1M bytes.

The **mount** command for a TFS supports the following parameters:

Parameter	Description
-s *size*	*size* is the number of megabytes for the file system (default=1). If the specified value is larger than the size that can be supported, the maximum size will be used.
-b *block*	*block* specifies the blocking factor used to set the size of a TFS block. Range is 0-4 (default=0). The blocking factor relates to the TFS block size as follows:

Blocking factor	Resulting TFS block size
0	4K
1	8K
2	16K
3	32K
4	64K

-c *cache*	*cache* is the amount of buffer storage, in megabytes, that TFS will use in the 31-bit address range to support a 64-bit file system. This parameter is ignored for file systems allocated in the 31-bit range. Range is 1-64; the default value is calculated based on the TFS block size such that the number of cache buffers is 256. Out-of-range values will be set to the closest range boundary.

-u *uid*	*uid* is the numeric UID to be assigned to the file system's root directory (default=0).
-g *group*	*group* is the numeric GID to be assigned to the file system's root directory (default=0).
-p *perm*	*perm* is the permission bits, in octal, to be assigned to the file system's root directory (default=0777).
-3	Specifies that TFS is to allocate the file system in 31-bit storage, regardless of system capabilities.

TFS dynamically determines if 64-bit addressing is enabled and, if so, places file systems above the bar. The -3 parameter on the mount command forces TFS to place a file system in 31-bit storage even if 64-bit addressing is enabled. Because locating a file system above the bar still requires a buffer pool to reside below the bar, TFS will only locate a file system above the bar when it is at least 5M bytes large and the amount of below-the-bar storage needed is less than the size of the file system above the bar.

The maximum file size that TFS can support is a function of the TFS block size. The following are the approximate maximum file sizes based on the blocking factor:

Blocking factor	Approximate maximum file size
0	2 gigabytes (G)
1	25G
2	240G
3	2 terabytes (T)
4	17T

The maximum file system size is also a function of the TFS block size, but is always limited to a maximum of 2**31–1 (X'7FFFFFFF') blocks. Using the default block size of 4K, this yields a maximum file system size of about 2**43 bytes. Increasing the block size to 64K yields a maximum file system size of about 2**47 bytes.

For information about our test experiences, see “Testing TFS colony startup and mounting the file system” on page 139.

STOP and MODIFY command support for TFS colony address spaces: TFS, running in a colony address space, will now respond to the MVS STOP and MODIFY commands. (The STOP and MODIFY commands are not supported when TFS runs in the kernel address space.) When you issue the STOP command, TFS will stop if no file systems are mounted. The following MODIFY commands are also available to stop TFS or to force it to stop or terminate even if file systems are mounted:

MODIFY parameter	Description
STOP	This is the same as the STOP command. It causes TFS to exit if no file systems are mounted. A WTOR message is issued allowing TFS to be restarted.
TERM	Causes TFS to exit if no file systems are mounted and does not

issue a WTOR to restart TFS. The SETOMVS RESET=(*xx*) command can be used to start another TFS.

FORCESTOP Similar to STOP, but TFS will terminate even if there are mounted file systems.

FORCETERM Similar to TERM, but TFS will terminate even if there are mounted file systems.

For information about our test experiences, see “Testing TFS colony STOP and MODIFY commands” on page 140.

Access control list (ACL) support: TFS now supports ACLs. There are no unique external interfaces other than ACL limits. The number of ACL entries that TFS supports is limited by the block size. Each ACL uses one TFS block. For example, if the TFS block size is set to 4K (the default: -b0), it will limit the number of entries in any ACL to about 500 entries.

For information about our test experiences, see “Testing TFS colony access control list support” on page 141.

Testing the TFS enhancements

The following are some of our experiences with testing the TFS enhancements in z/OS V1R5:

Testing TFS colony startup and mounting the file system: We did the following to start TFS in a colony address space and mount the file system:

1. Created the following TFS startup procedure in *hlq*.PROCLIB(TFS):

```
//TFS    PROC REGSIZE=0M
//TFSGO  EXEC PGM=BPXVCLNY,REGION=&REGSIZE,TIME=1440
//SYSIN    DD DUMMY
//SYSPRINT DD DUMMY
//SYSOUT   DD DUMMY
//CEEDUMP  DD DUMMY
//*     PEND
```

2. Modified *hlq*.PARMLIB(BPXPRM00) (our common z/OS UNIX parameter member) to specify that the TFS file system is to start in a colony address space using the TFS start up procedure:

```
FILESYSTYPE TYPE(TFS)
ENTRYPOINT(BPXTFS)
ASNAME(TFS,'SUB=MSTR')
```

   Note: We chose to start the TFS physical file system outside of JES (SUB=MSTR) which imposes some restrictions for SYSOUT (see *z/OS UNIX System Services Planning* for more information). Otherwise, to start TFS under JES, the ASNAME parameter would simply be `ASNAME(TFS)`.

We currently do not use a TFS for the /tmp file system. We have a /tmp/tfs directory in the /tmp file system on one of our 64-bit systems (Z0) and we mount a TFS at this mount point.

3. Mounted the TFS file system in *hlq*.PARMLIB(BPXPRMZ0), which is a system-specific z/OS UNIX parameter member (we use both BPXPRM00 and BPXPRMZ0 to initialize OMVS on system Z0):

```
MOUNT FILESYSTEM('/Z0/TMP/TFS') TYPE(TFS) MODE(RDWR)
   MOUNTPOINT('/tmp/tfs') PARM('-s 10') UNMOUNT
```

Following the next IPL of system Z0, the TFS colony started in 64-bit mode outside of JES. The TFS was successfully mounted at the /tmp/tfs mount point.

4. We tested cancelling TFS and restarting it. We issued the following command to cancel TFS:

   ```
   CANCEL TFS
   ```

   Result: The following messages appeared:

   ```
   BPXF063I FILE SYSTEM /Z0/TMP/TFS 121
   WAS SUCCESSFULLY UNMOUNTED.
   *nnnn BPXF032D FILESYSTYPE TFS TERMINATED.  REPLY 'R' WHEN READY TO
   RESTART. REPLY 'I' TO IGNORE.
   ```

   We replied `R` to the WTOR message and TFS successfully restarted.

---

5. We tested unmounting and remounting the TFS file system using various combinations of parameters on the **mount** command. We also tested the -3 parameter, which forced the TFS to be mounted in 31-bit mode, even though it was running on a 64-bit system. The messages associated with a TFS mount go to the syslog.

   Example: The following are examples of the TFS mount messages that appear in the syslog:

   ```
   BPXTF006I TFS MOUNTED /Z0/TMP/TFS
   BPXTF007I FILESYSTEM SIZE=1,048,576  MAX FILE SIZE=2,147,483,648
   ```

During our testing, we also observed the following:

- Double messages appeared in the syslog for the TFS mounts. This was resolved by z/OS UNIX APAR OA05417.
- When we tried using some incorrect parameters or out-of-range parameter values on the mount, certain displays (such as the **df** shell command and the D OMVS,F system command) still showed the incorrect information without indicating any error. In the case of an out-of-range parameter value, the parameter's default value was automatically used in place of the out-of-range value. This behavior is documented in z/OS UNIX documentation APAR OA06175.

Testing TFS colony STOP and MODIFY commands: We tested various combinations of the STOP and MODIFY commands on an active TFS colony.

1. Using the STOP TFS or MODIFY TFS,STOP command while no file system was mounted, TFS stopped, issued the WTOR message to restart, and did not allow any TFS mounts in the interim.

   Example: `STOP TFS` or `MODIFY TFS,STOP`

   Result:

   ```
   *nnnn BPXF032D FILESYSTYPE TFS TERMINATED.
   REPLY 'R' WHEN READY TO RESTART. REPLY 'I' TO
   IGNORE.
   ```

   When we attempted to mount the file system, we received the following error, as expected:

   ```
   RETURN CODE 0000007A, REASON CODE 052C00B6. THE MOUNT FAILED FOR FILE SYSTEM /Z0/TMP/TFS.
   ```

We then replied R to the WTOR message. TFS restarted and we successfully mounted the file system.

---

2. Using the STOP TFS or MODIFY TFS,STOP command while a file system was mounted, TFS did not stop until the file system was unmounted (or FORCESTOP was issued, as below).

   Example: `STOP TFS` or `MODIFY TFS,STOP`

   Result:

   ```
   BPXTF002I TFS TERMINATION REQUEST FAILED DUE TO ACTIVE MOUNTS
   ```

   Once we unmounted the file system, the STOP and MODIFY TFS,STOP commands functioned as in case 1, above.

   Note: When we issued the MODIFY TFS,FORCESTOP command with and without a file system mounted, TFS did stop each time.

---

3. Using the MODIFY TFS,TERM command while a file system was mounted, TFS did not stop until the file system was unmounted.

   Example: `MODIFY TFS,TERM`

   Result:

   ```
   BPXTF002I TFS TERMINATION REQUEST FAILED DUE TO ACTIVE MOUNTS
   ```

   When we issued the same command with no active file system mounts, TFS was terminated and did not issue a WTOR message to restart:

   ```
   BPXTF001I TFS TERMINATION REQUEST ACCEPTED
   ```

   To restart TFS, we issued the SETOMVS RESET=(00) command. TFS successfully started and we successfully mounted the file system.

---

4. Using the MODIFY TFS,FORCETERM command (both with and without a file system mounted), TFS was terminated and did not issue a WTOR message to restart.

   Example: `MODIFY TFS,FORCETERM`

   Result:

   ```
   BPXTF003I TFS UNCONDITIONAL TERMINATION REQUEST ACCEPTED
   ```

   To restart TFS, we issued the SETOMVS RESET=(00) command. TFS successfully started and we successfully mounted the file system.

Testing TFS colony access control list support: Support for access control lists in TFS uses the same interfaces as for the HFS and zFS file systems. We tested the **setfacl** and **getfacl** commands using files and directories in the TFS and they successfully functioned the same way they do for HFS and zFS.

z/OS UNIX enhancements in z/OS V1R6

z/OS UNIX made several enhancements in z/OS V1R6. In this section, we cover the following topics:

- "Shells and utilities support for 64-bit virtual addressing" on page 147
- "Using distributed BRLM" on page 155
- "Using ISHELL enhancements" on page 157

We used the information in *z/OS UNIX System Services Planning* to help us plan and implement these enhancements.

Using multipliers with BPXPRMxx parameters

The z/OS UNIX parmlib member, BPXPRM*xx*, now allows the use of multipliers with certain parameters. For example, if you currently use MAXFILESIZE(1073741824); this function will let you to enter MAXFILESIZE(1M).

The BPXPRM*xx* parmlib parameters that accept the multiplier function are:

- MAXFILESIZE
- MAXCORESIZE
- MAXASSIZE
- MAXMAPAREA
- MAXSHAREPAGES
- IPCSHMMPAGES

Each parameter has specific limits, which are found in *z/OS MVS Initialization and Tuning Reference*, SA22-7592.

The following character abbreviations are used:

Table 14. Character Parameter Limit Multipliers

Denomination value	Character abbreviation	Bytes
Null		1
Kilo	K	1,024
Mega	M	1,048,576
Giga	G	1,073,741,824
Tera	T	1,099,511,627,776
Peta	P	1,125,899,906,842,624

Testing the multipliers

We used the SETOMVS command to test the new multiplier function. The following commands were issued:

- SETOMVS MAXSHAREPAGES=3M
- SETOMVS MAXMMAPAREA=130K
- SETOMVS MAXCORESIZE=8M
- SETOMVS MAXCORESIZE=100M
- SETOMVS IPCSHMMPAGES=16283G
- SETOMVS MAXFILESIZE=1G

Using the superkill option

The superkill option allows you to force the ending of a process or job. The superkill option is available in the following environments:

- kill command

  The superkill option was added to the kill command (-K).

You must issue a kill signal to the process you want to superkill first.

Examples:

1. We issued superkill without issuing kill first.

```
kill -K 84017224
kill: FSUMF344 84017224: Cannot superkill without prior KILL signal to process
```

2. We attempted unsuccessfully to superkill all processes.

```
kill -K -- -1
kill: FSUMF342-1: Cannot superkill pid-1 (all processes)
```

3. We attempted unsuccessfully to superkill a process group.

```
kill -K -- -2
kill: FSUMF343-2: Cannot superkill a process group
```

See *z/OS UNIX System Services Command Reference*.

- console support

  The superkill option was added to the MODIFY BPXOINIT console command (SUPERKILL=pid). You are not required to send a KILL signal to the process before issuing the superkill from the console support.

  Example: To obtain the Process Identification (PID) of the process you want to work with, issue a command such as `D OMVS,A=ALL` or (in the shell) `ps -ef`.

```
F BPXOINIT,SUPERKILL=50462791
BPXM027I COMMAND ACCEPTED.
IEA989I SLIP TRAP ID=X422 MATCHED. JOBNAME=ALEASE2, ASID=0171.
   <<Note that we have the S422 dump suppressed, otherwise it would have
     produced a dump for a X'422' abend, reason code X'0109'>>
BPXB0181 THREAD 2675698000000002, IN PROCESS 50462791, ENDED 153
WITHOUT BEING UNDUBBED WITH COMPLETION CODE OF 03422000, AND REASON CODE
0D2C0109.
```

  See *z/OS MVS System Commands*.

- ISHELL support

  There is TSO ISHELL support for superkill.

  Logon to TSO —> ISPF —> ISH —> Tools —> 1. Work with processes (ps) —>

  After a list of processes is displayed, and you enter an ″s″ (S=Signal) action code, the superkill signal number will be ″99″.

  Note that you must enter a sigkill (signal number 9), at least 3 seconds prior to entering the superkill, or you will be presented with a message with return code of Errno=79x (the parameter is incorrect), and Reason=0D1005D8 (JRSigkillNotSent).

The following set of restrictions applies:

- You cannot do a superkill via pthread_kill or sigqueue(). The superkill option is ignored for these services.
- You cannot do a superkill to a group or specify a PID of –1 (kill everyone).
- Superkills will be deferred in the case where a target process has blocked all signals via the BPX1SDD service. The 'defer signal' function was created for conditions which cannot deal with z/OS UNIX System Services abends on their system task. For this reason superkills will also have no effect on these processes. The kill() will not fail but will simply be ignored by the target process.
- A regular SIGKILL must be sent to a process before it can be superkilled. If not, the attempt will result in EINVAL/JRSigkillNotSent. This is analogous to the required 'cancel' before a 'force arm'. However, if using the console form of superkill, the sigkill (cancel) before does not apply.

If the environment is valid then the target process will be abended with a X'422' abend, reason code X'0109'.

Using wildcard characters in the automove system list (SYSLIST)

We tested the new wildcard character support for the automove system list (SYSLIST) on our systems. This function lets you use wildcards in certain situations when you specify the automove system list. Before this enhancement, if an AUTOMOVE INCLUDE with the SYSLIST function was used for a file system mount, only the list of systems specified were eligible to become owners of the file system. If none of the systems specified were active, the system would then unmount the file system. Now, however, using the wildcard support, you can both specify your preferred ownership system candidate systems and use a wildcard to allow any of the remaining systems in the shared HFS sysplex eligible to become the file system owner to prevent the system from unmounting the file system.

We tested this support by mounting a file system using the INCLUDE statement, and specifying a subset of the systems in our 14-way sysplex as well as a wildcard character (*). In the example below shows a MOUNT statement for filesystem OMVSSPN.PET1.FS with an AUTOMOVE system list:

```
MOUNT FILESYSTEM('OMVSSPN.PET1.FS') TYPE(HFS) MODE(RDWR)
  MOUNTPOINT('/pet1') AUTOMOVE(I,Z1,Z2,Z3,*)
```

Display of mounted filesystem showing automove attributes follows:

```
HFS            15 ACTIVE                      RDWR
  NAME=OMVSSPN.PET1.FS
  PATH=/pet1
  OWNER=J80       AUTOMOVE=I CLIENT=Y
  INCLUDE SYSTEM LIST:  Z1        Z2       Z3       *
```

Note that system J80 is the owning system for the file system. In the event that either someone issues a file system shutdown on system J80 or if system J80 leaves the sysplex, the system transfers ownership of the file system to system Z1, if it's active. If Z1 is inactive, Z2 gets ownership, and so forth down the list. If system Z3 isn't active then any remaining active image in the sysplex will be randomly selected to become the owner.

You can also use either AUTOMOVE(I,*) or AUTOMOVE(YES) to specify that **any** active system in the sysplex is eligible to take ownership of the file system. For example, the following two MOUNT statements would yield the same result that any active system can take over OMVSSPN.PET5.ZFS:

1

```
MOUNT FILESYSTEM('OMVSSPN.PET5.ZFS') TYPE(ZFS) MODE(RDWR)
 MOUNTPOINT('/pet5') AUTOMOVE(I,*)
```

2

```
MOUNT FILESYSTEM('OMVSSPN.PET5.ZFS') TYPE(ZFS) MODE(RDWR)
 MOUNTPOINT('/pet5') AUTOMOVE(YES)
```

In all methods of issuing a MOUNT, the wildcard in AUTOMOVE must **always** be the last item in the system list. This includes PARMLIB, TSO, shell, ishell, C program, assembler program and REXX program methods.

Note that the system does not validate the system identifiers specified in the system list (Z1, for example) until ownership of a file system is being transferred. However, using the wildcard at the end of the list ensures that the file system can always find a new owner even if you spell every single system identifier incorrectly. This feature will prevent your file system from being unmounted unexpectedly. The wildcard feature is very useful for installations that want to:

- Make sure a file system is always mounted
- Do not want to list every system in the system list

Using the clear and uptime shell commands

We tested the new V1R6 clear and uptime shell commands:

- "Using the clear command"
- "Using the uptime command"

For more information about these commands, see the *z/OS UNIX System Services Command Reference*.

Using the clear command

The clear shell command clears the screen of all previous output and places the prompt at the top of the page. Similarly to the `tput clear` command, you cannot use this command if you've accessed the shell using a 3270 window. The clear utility has no options, and if you try to enter any options, the system issues a usage message.

The following is our experience with the clear utility:

- **From OMVS (TSO)**: From the shell, we entered `clear`. The command cleared the screen, leaving a blank line and the prompt at the top of the screen. We were able to use the PF7 key to return to previous pages. We also entered more display commands, ls –al for example, and then entered the clear command again. Again, the command cleared the screen, put the prompt on the top. We used PF7 (BACKSCR) and PF8(SCROLL) to navigate.
- **From rlogin or telnet (AIX)**: We accessed from AIX using the rlogin command and then entered `clear`. The command cleared the screen and the prompt was displayed at the top of the screen. We also entered more display commands, ls –al for example, and then entered the clear command again. Again, the command cleared the screen, put the prompt on the top. Note that from rlogin, the clear command actually removes the data on the screen, so that even if you scroll back, the data will no longer be displayed. When we did scroll back, the command prompt went back to the top of the screen when we began typing again.
- **From telnet (3270 window)**: We accessed the shell using telnet on TSO then entered `clear`. The command **did not** clear the screen. The prompt is simply redisplayed.

Using the uptime command

The uptime command gives a one-line display with the following information:

- Current time
- How long the system has been running
- Number of users who are currently logged into z/OS UNIX and the system load averages for the past 1, 5, and 15 minutes. Load averages are not supported on z/OS UNIX, and are displayed as 0.00

We tested the uptime command from telnet, rlogin, and TSO (OMVS) sessions. Note that the uptime command has no documented parameters, and when we tried to use parameters, we received a usage message.

The following example shows how we entered the uptime command and the output from it:

```
# uptime
06:49PM  up 5 day(s), 01:55,  1 users,  load average: 0.00, 0.00, 0.00
```

The load average value is always 0.00 on our systems because we are running on z/OS UNIX.

Enhanced latch contention detection

In z/OS V1R6 changes were implemented to eliminate outages caused by address spaces that terminate without cleaning up the ownership of the acquired z/OS UNIX System Services global resource serialization latch. The kernel now detects latch contention on a timed basis and initiates one of the following:

- Attempts to correct the problem
- Issues a message that contention exists.

An action is taken if the latch that is causing contention is held for an excessive amount of time. If the kernel detects that the oldest latch holder's address space or process no longer exist, it corrects the latch contention problem. If the kernel detects a latch holder's address space and process still exist, the following eventual action message is displayed indicating that additional actions might be required:

BPXM056E UNIX SYSTEM SERVICES LATCH CONTENTION DETECTED

If the message does not get DOMed after a reasonable amount of time, your installation should have an automation script or an operator to react to this message and eventually issue the **F BPXOINIT,RECOVER=LATCHES** command to attempt to resolve the contention.

The abnormal termination is caused by a 422-1A5 abend that generates a system dump. The dump is generated because of the indication of an internal system problem. If more than one latch is in contention, multiple tasks can abend and result in multiple dumps being requested. However, prior to issuing the recovery command, it is advisable to use the `D GRS` command to determine the resources and address spaces that are involved with the contention. For example, use `D GRS,C`.

Once the latch contention is resolved, message BPXM056E will be DOMed. This command can take several minutes to resolve the latch contention. If the command cannot resolve the latch contention within a reasonable amount of time, the following eventual action message is displayed and message BPXM056E is DOMed: *BPXM057E UNIX SYSTEM SERVICES LATCH CONTENTION NOT RESOLVING*.

Note: A new 422-1A5 abend is introduced that can terminate a user task holding a z/OS UNIX System Services latch for an excessive amount of time.

The following new message indicates the entry of an unsupported operand when using the **F BPXOINIT,RECOVER=** command: *BPXM058I MODIFY BPXOINIT RECOVER COMMAND REJECTED*.

Testing contention recovery

The following example shows what occurred when we used **F BPXOINIT,RECOVER=LATCHES**:

The SYS.BPX.AP00.PRTB1.PPRA.LSN type latches were held for approximately 6 hours on one system. After issuing **F BPXOINIT,RECOVER=LATCHES**, these latches were relieved (received abend 422/1A5), and the BPXM056E message was DOMed. In our installation no dump was taken because we have S422 abends suppressed (SLIP SET,C=422,ID=Y422,A=NODUMP,E).

```
Example:
D GRS,C
ISG343I 10.34.16 GRS STATUS 167
S=STEP    SYSZBPX  PROCINIT
SYSNAME   JOBNAME            ASID       TCBADDR   EXC/SHR    STATUS
JC0       U078023            0242       008E79C0 EXCLUSIVE    OWN
JC0       U078023            0242       008E7B58 EXCLUSIVE    WAIT
NO REQUESTS PENDING FOR ISGLOCK STRUCTURE
LATCH SET NAME:  SYS.BPX.AP00.PRTB1.PPRA.LSN
CREATOR JOBNAME: OMVS      CREATOR ASID: 000F
  LATCH NUMBER:  908
    REQUESTOR  ASID  EXC/SHR    OWN/WAIT
    U078025    0221  EXCLUSIVE  OWN
    U078023    0242  EXCLUSIVE  WAIT

F BPXOINIT,RECOVER=LATCHES
BPXM027I COMMAND ACCEPTED.
IEA989I SLIP TRAP ID=Y422 MATCHED.  JOBNAME=U078025 , ASID=0221.
BPXP018I THREAD 26A6D5F000000002, IN PROCESS 524404, ENDED 171
WITHOUT BEING UNDUBBED WITH COMPLETION CODE 0F422000, AND REASON CODE
000001A5.
BPXM067I UNIX SYSTEM SERVICES LATCH CONTENTION RESOLVED

D GRS,C
ISG343I 10.36.39 GRS STATUS 188
NO ENQ RESOURCE CONTENTION EXISTS
NO REQUESTS PENDING FOR ISGLOCK STRUCTURE
NO LATCH CONTENTION EXISTS
```

There were instances when we issued the **F BPXOINIT,RECOVER=LATCHES** and received the BPXM067I message with no S422/1A5 abends. This indicates that there is no latch contention for this function to attempt recovery from.

```
Example:
F BPXOINIT,RECOVER=LATCHES
BPXM027I COMMAND ACCEPTED.
BPXM067I UNIX SYSTEM SERVICES LATCH CONTENTION RESOLVED
```

Shells and utilities support for 64-bit virtual addressing

We tested several z/OS UNIX shell utilities that were enhanced to support 64-bit virtual addressing. These enhanced utilities support the creation and use of 64-bit applications.

Overview of 64-bit support

The utilities that we tested fall into one of three groups:

- Utilities that report information about an executable or object file that has been compiled in 64-bit mode (such as **nm** and **file**): These utilities recognize 64-bit executables and symbols within executables and object files and libraries.

  For example, the **file** utility indicates whether a file is an executable and, if so, whether it is a 64-bit executable.

- Utilities that report information about 64-bit processes (such as **ps** and **ipcs**): These utilities report information about memory usage by 64-bit processes and threads.

  For example, **ps** reports memory usage above the bar by a running process. The **ipcs** utility reports information on shared memory that can be allocated and attached above the bar by 64-bit programs.

- Utilities that manage object files or executables (such as **ar**, **cp** and **mv**, and the **lex** and **yacc** libraries). These utilities support 64-bit executables and object files.

  For example, the **ar** utility, which creates and manages object libraries, now stores the addressing mode symbols. The **cp** and **mv** utilities, when used to

move executables from MVS data sets to the z/OS UNIX file system, re-binds 64-bit executables. Also, **lex** and **yacc** provide object libraries with 64-bit versions of functions to support 64-bit code created using **lex** or **yacc**.

The shell utilities themselves are not compiled as 64-bit applications.

Examples of the utilities that we tested

The following are some examples that highlight our testing of the 64-bit virtual addressing support in various shell utilities.

The file utility: The **file** utility determines the format of each file by inspecting the attributes and, for a regular file, by reading an initial part of the file. If the **file** is an executable, file determines its addressing mode for output. If the file is not an executable, **file** compares it to templates found in a magic file to determine the file type.

A word about the magic file: The magic file defines the following output text for an executable:

```
OpenEdition MVS executable
```

This wording is outdated; therefore, you may wish to update your /etc/magic file using the new /samples/magic file. The updated /samples/magic file now defines the following output text for an executable:

```
z/OS UNIX executable
```

Examples of testing the file utility: The following examples highlight our experiences testing the **file** utility.

Example: `file /bin/makedepend`

Result: The file utility does not support the display of information for external links and issues the following response:

```
FSUM8718 /bin/makedepend:       cannot open: EDC5129I No such file or directory.
```

The output from the **ls -al** command shows that /bin/makedepend is an external link:

```
erwxrwxrwx   1 ALEASE1  OMVSGRP        8 Jun 22 09:01 /bin/makedepend -> CCNEMDEP
```

Example: `file /bin/*`

Result: The following excerpt of the command response shows both AMODE 31 and AMODE 64 executables:

```
⋮
/bin/dbx24:.z/OS Unix executable
/bin/dbx31:.z/OS Unix executable
/bin/dbx31vdbg:.z/OS Unix executable (amode=31)
/bin/dbx64:.z/OS Unix executable
/bin/dbx64vdbg:.z/OS Unix executable (amode=64)
/bin/dce_err:.z/OS Unix executable (amode=31)
/bin/dce_login:.z/OS Unix executable (amode=31)
/bin/dcecf_postproc:.commands text  - Bourne or POSIX shell script
⋮
```

The nm utility: The man pages for the **nm** utility indicate that the –M option inserts three columns preceding the symbol name in the command output. The three columns have the following format:

```
rmode amode compiler_options
```

The rmode and amode columns display one of the following:
- 24-bit mode
- 31-bit mode
- 64-bit mode
- ANY mode
- MIN mode
- Undetermined or not applicable

The compiler options column dispays a character for each compiler option in effect, or a dash if no options are in effect, as follows:

I Symbol is compiled with IPA. (IPA will not be seen when running nm against an executable as that information is no longer available.)

X Symbol is compiled with XPlink.

Examples of testing the nm utility: The following examples highlight our experiences testing the **nm** utility.

As in the example of the **file** utility above, the **nm** utility does not support the display of information for external links and issues the same error message as above.

Example: `nm -M /bin/dbx64vdbg`

Result:

```
560 T  64  64 -    BPX4PTR
560 U --- --- -    BPX4PTR
224 T MIN MIN X    BPXISD64
208 T  64  64 X    BPXISD64#C
  0 U --- --- -    B_IMPEXP
  0 U --- --- -    B_LIT
  0 U --- --- -    B_PRV
  0 U --- --- -    B_PRV
  0 U --- --- -    B_PRV
  0 U --- --- -    B_PRV
  0 U --- --- -    B_PRV
  0 U --- --- -    B_PRV
208 U --- --- -    B_TEXT
  0 U --- --- -    B_TEXT
584 U --- --- -    B_TEXT
760 U --- --- -    B_TEXT
560 U --- --- -    B_TEXT
952 U --- --- -    B_TEXT
840 U --- --- -    B_TEXT
608 T MIN MIN -    CEELLIST
760 T  64  64 -    CELQETBL
760 U --- --- -    CELQETBL
584 U --- --- -    CELQLLST
584 U --- --- -    CELQLLST
584 T  64  64 -    CELQLLST
  0 T  64  64 -    CELQSTRT
  0 U --- --- -    CELQSTRT
960 T MIN MIN X    CELQTLOC
952 T  64  64 -    CELQTLOE
840 T  64  64 -    CELQTRM
840 U --- --- -    CELQTRM
224 T MIN MIN X    CELQVDBG
```

```
0 U --- --- -    C_DATA64
0 T ANY ANY -    IEWBCIE
0 T ANY ANY -    IEWBLIT
0 U --- --- -    IEWBLIT
```

The ps utility: The **ps** utility now shows the memlimit and and amount of storage in use above the 2-gigabyte bar. Two new output specifiers (vszlmt64 and vsz64) are also available.

The following are the pertinent fields of the **ps** display:

vsz — Displays the amount of memory (virtual storage) that the process is using, as a decimal number of kilobytes.

vszlmt64 — Displays the maximum amount of virtual storage above the 2-gigabyte bar allowed for the current process. In the display, each value is followed by a multiplier indicating the units represented: (space) = no multiplier; K = Kilo; M = Mega; G = Giga; T = Tera; P = Peta.

vsz64 — Displays the virtual storage used above the 2-gigabyte bar. In the display, each value is followed by a multiplier indicating the units represented: (space) = no multiplier; K = Kilo; M = Mega; G = Giga; T = Tera; P = Peta.

Example of testing the ps utility: The following example highlights our experiences testing the **ps** utility.

1. We issued the following command to create a 64-bit compiled module for a private program called brlmfcntl.c using the new xlc compile invocation utility available in z/OS V1R6. (We used the default configuration file at /usr/lpp/cbclib/xlc/etc/xlc.cfg and the utility command at /usr/lpp/cbclib/xlc/bin.)

   ```
   /usr/lpp/cbclib/xlc/bin/xlc_64 -o brlmfcntl.out64 brlmfcntl.c
   ```

   This creates an executable named brlmfcntl.out64.

---

2. Our first attempt to run the new program failed because we had used the default MEMLIMIT value, which is zero. The following is an example of how we invoked the program and the resulting error message:

   ```
   brlmfcntl.out64 brlmf1 120
   ```

   Result:

   ```
   1 + Done(137) brlmfcntl.out64 /
    17695742      Killed  ./brlmfcntl.out64
   ```

---

3. To resolve the problem in step 2, we issued the following MVS operator command to set the MEMLIMIT for the process under which we were running the program. In this case, that process was the shell session. We set the MEMLIMIT to 10M.

   ```
   SETOMVS PID=68026746,MEMLIMIT=10M
   ```

   To verify this change, we issued the following operator command and checked the MEMLIMIT value:

   ```
   DISPLAY OMVS,L,PID=068026746
   ```

Note: When setting the MEMLIMIT on your systems, carefully consider factors such as a system-wide setting, override capability, and process-specific settings.

---

4. Our brlmfcntl program takes as the second parameter the number of seconds to remain active. We forked three programs to hold for two minutes (120 seconds) each, as follows:

```
brlmfcntl.out64 brlmf1 120 &
brlmfcntl.out64 brlmf2 120 &
brlmfcntl.out64 brlmf3 120 &
```

---

5. We issued the ps command to display the vsz64 and vszlmt64 fields, as follows:

```
ps -e -f -o jobname,pid,ppid,vsz,vsz64,vszlmt64,args
```

Result:

```
JOBNAME        PID       PPID     VSZ       VSZ64   VSZLMT64 COMMAND
⋮
ALEASE19   68026754     917883    4804    8388608        10M brlmfcntl.out64 brlmf1 120
ALEASE11     917891     917883    4804    8388608        10M brlmfcntl.out64 brlmf2 120
ALEASE12     917892     917883    4804    8388608        10M brlmfcntl.out64 brlmf3 120
⋮
```

The above display indicates that the programs are using 8M of storage above the bar (VSZ64) and that the limit is 10M (VSZLMT64).

The ipcs utility: The **ipcs** utility writes information to the standard output stream about active inter-process communication facilities. The PGSZ and SEGSZ fields are added to the list of fields under the –x option. The SEGSZPG field is now displayed with the –x option. These fields are defined as follows:

SEGSZPG
: The size, in pages, of the associated shared memory segment.

PGSZ
: The page size of the associated shared memory segment.

SEGSZ
: The size, in bytes, of the associated shared memory segment.

Note that the new PGSZ field is not properly defined in the z/OS V1R6 documentation or the man pages for the **ipcs** command. See documentation APAR OA08772 for more information.

Examples of testing the ipcs utility: The following examples highlight our experiences testing the **ipcs** utility.

We ran the command using the three options (–a, –b, and –x) that display the SEGSZPG, PGSZ, and SEGSZ fields on a system where we had some shared memory activity. The following examples show excerpts of the displays.

Example: `ipcs -a`

Result:

```
⋮
Shared Memory:
T         ID     KEY       MODE       OWNER    GROUP  CREATOR    CGROUP   NATTCH   SEGSZPG PGSZ     SEGSZ     ATIME    DTIME    CTIME        CPID      LPID
m      40004 0x023625dc --rw-rw----  LORAIN0    IMWEB  LORAIN0    IMWEB         1     1      4K       1793     20:33:41 00:00:00 20:33:41     327706    327706
```

```
m      40005 0x033625dc --rw-rw----  LORAIN0    IMWEB  LORAIN0    IMWEB       1    10240  4K      41943040  20:33:41 00:00:00 20:33:41    327706    327706
m      40006 0x043625dc --rw-rw----  LORAIN0    IMWEB  LORAIN0    IMWEB       1    1      4K      99        20:33:41 00:00:00 20:33:41    327706    327706
⋮
```

Example: `ipcs -b`

Result:

```
⋮
Shared Memory:
T         ID      KEY       MODE       OWNER      GROUP   SEGSZPG PGSZ     SEGSZ
m      40004 0x023625dc --rw-rw----  LORAIN0    IMWEB    1      4K       1793
m      40005 0x033625dc --rw-rw----  LORAIN0    IMWEB    10240  4K       41943040
m      40006 0x043625dc --rw-rw----  LORAIN0    IMWEB    1      4K       99
⋮
```

Example: `ipcs -x`

Result:

```
⋮
Shared Memory:
T     KEY      OWNER    GROUP   SEGSZPG PGSZ     SEGSZ     ATPID     ATADDR                INFO
m 0x023625dc  LORAIN0   IMWEB    1      4K       1793      327706    0x00000000273f6000
m 0x033625dc  LORAIN0   IMWEB    10240  4K       41943040  327706    0x0000000027500000     M
m 0x043625dc  LORAIN0   IMWEB    1      4K       99        327706    0x00000000273fd000
⋮
```

The ar utility: You can use the **ar** utility to store multiple versions of the same object file within one archive library. This is useful if you are providing an archive library which may be used to resolve references from code compiled with various compiler options. These options cause differences in the object files which must be matched with the archive library member attributes. Attributes for **ar** are AMODE, XPLINK, and IPA. The **ar** utility stores the attribute information for each entry in the symbol table. The linkage editor uses the attribute information to resolve external references with the appropriate archive library member. Because the names of archive library members consist of only the final component of the path name, the member names must be unique for the different object file versions. It's a good idea to establish a naming convention for the object files and to implement build procedures to generate the correct names.

To display the attributes of the symbols within an object file or an archive library of object files, use the **nm** command, which displays the symbol table of object, library, or executable files.

Examples of testing the ar utility: The following example highlights our experiences testing the **ar** utility.

We performed the following steps to create an archive library, add members to it, delete members from it, and display its contents:

1. Using the **xlc** utility, we compiled a source file (displayfs.c) using various compiler options—31-bit, 31-bit with XPLINK, and 64-bit (which also forces XPLINK)—as follows:

   ```
   /usr/lpp/cbclib/xlc/bin/xlc    -o displayfs.out31 displayfs.c
   /usr/lpp/cbclib/xlc/bin/xlc_x  -o displayfs.out31x displayfs.c
   /usr/lpp/cbclib/xlc/bin/xlc_64 -o displayfs.out64 displayfs.c
   ```

   ---

2. We created an archive library called libdisplayfs.a containing the three members:

   ```
   ar  -ruv libdisplayfs.a displayfs.out31 displayfs.out31x displayfs.out64
   ```

3. The following command displays the contents of the archive library:

```
ar  -tv libdisplayfs.a
```

Result: The archive library contains three members:

```
rwxrwxrwx 0/0   77824 Jul 28 13:17 2004 displayfs.out31
rwxr-xr-x 0/0   81920 Jul 28 13:19 2004 displayfs.out31x
rwxr-xr-x 0/0   61440 Jul 28 13:17 2004 displayfs.out64
```

4. We created another 64-bit compiled object (as in step 1) named displayfs.out64b and then added it to the archive library using the following command:

```
ar  -rcv libdisplayfs.a displayfs.out64b
```

Result:

```
a - displayfs.out64b
```

5. Displayed the contents once again:

```
ar  -tv libdisplayfs.a
```

Result: The archive library now contains four members:

```
rwxrwxrwx 0/0   77824 Jul 28 13:17 2004 displayfs.out31
rwxr-xr-x 0/0   81920 Jul 28 13:19 2004 displayfs.out31x
rwxr-xr-x 0/0   61440 Jul 28 13:17 2004 displayfs.out64
rwxr-xr-x 0/0   61440 Jul 28 13:32 2004 displayfs.out64b
```

6. We then deleted the last member that we added (displayfs.out64b):

```
ar  -dsv libdisplayfs.a displayfs.out64b
```

Result:

```
d - displayfs.out64b
```

7. The following command attempts to display the member we just deleted:

```
ar  -tv  libdisplayfs.a displayfs.out64b
```

Result:

```
ar: displayfs.out64b not found
```

8. Displayed the contents one more time:

```
ar  -tv libdisplayfs.a
```

Result:

```
rwxrwxrwx 0/0   77824 Jul 28 13:17 2004 displayfs.out31
rwxr-xr-x 0/0   81920 Jul 28 13:19 2004 displayfs.out31x
rwxr-xr-x 0/0   61440 Jul 28 13:17 2004 displayfs.out64
```

The cp and mv utilities: As of z/OS V1R6, the **cp** and **mv** utilities can now copy or move 64-bit executables between MVS and the z/OS UNIX file systems and

correctly rebind executables, just as these utilities do for 24- and 31-bit applications. There are no external changes to the way you use these commands.

The ulimit utility: The **ulimit** utility sets or displays resource limits on processes created by the user. There are two new options available, as follows:

–A Set or display the maximum address space size for the process, in units of 1024 bytes. If the limit is exceeded, storage allocation requests and automatic stack growth will fail. An attempt to set the address space size limit lower than the size that is already in use will fail.

–M Set or display the amount of storage above the 2-gigabyte bar (MEMLIMIT), in one megabyte increments, that a process is allowed to have allocated and unhidden.

You can specify unlimited as the new limit. Using these options without specifying a limit value will simply display the current setting. These new limits also appear in the display using the `–a` option.

Examples of testing the ulimit utility: The following examples highlight our experiences testing the **nm** utility.

Example: `ulimit -a`

Result:

```
core file         15842b
cpu time          unlimited
data size         unlimited
file size         unlimited
stack size        unlimited
file descriptors  65535
address space     72808k
memory above bar  10m
```

Example: `ulimit -M`

Result:

```
10
```

Example: `ulimit -A`

Result:

```
72808
```

The limit and unlimit (tcsh) utilities: The **limit** utility limits the consumption of resources by the current process and each process it creates so that, individually, those processes cannot exceed a maximum-use value for a specified resource. If no maximum-use value is specified on the command, then the current limit is displayed. If no resource is specified, then the limitations for all resources are displayed.

The tcsh **limit** command includes two new resources, memlimit and addressspace, as follows:

addressspace The maximum address space size for the process, measured in kilobytes. If a process exceeds the limit, functions such as malloc()

and mmap() will fail. Also, automatic stack growth will fail. An attempt to set the address space size limit lower than the size that is already in use will fail.

memlimit — The amount of storage, in megabytes, above the 2-gigabyte bar that a process is allowed to have allocated and unhidden at any given time.

The **unlimit** utility removes the limitation on the specified resource. If no resource is specified on the command, then all resource limitations are removed.

Examples of testing the limit and unlimit utilities: The following examples highlight our experiences testing the **limit** and **unlimit** utilities.

Example: `limit`

Result:

```
cputime         unlimited
filesize        unlimited
datasize        unlimited
stacksize       unlimited
coredumpsize    7921 kbytes
descriptors     65535
addressspace    72808 kbytes
memlimit        10 megabytes
```

Example:

```
limit memlimit 8
limit memlimit
```

Result:

```
memlimit        8 megabytes
```

Example:

```
limit memlimit 8m
limit memlimit
```

Result:

```
memlimit        8 megabytes
```

Using distributed BRLM

With V1R6, byte range lock manager (BRLM) has changed to support distributed BRLM. Instead of a single, central BRLM, distributed BRLM means that each system in the sysplex runs a seperate BRLM, which is responsible for locking files in the file systems owned and mounted on that system. This means that a file system can be moved while byte range locks are held for files in the file system. When a file system changes owners, the corresponding locking history changes BRLM servers at the same time. (Note that this is not the case when a system failure occurs.)

For this reason, distributed BRLM is now the only supported method when all systems are at the V1R6 level and distributed BRLM is automatically activated on every system for an all z/OS V1R6 sysplex. Each system runs a BRLM and is responsible for handling lock requests for files whose filesystems are mounted and owned locally on that system.

If you are already running with a z/OS UNIX couple data set (CDS) indicating that distributed BRLM is enabled (DISTBRLM set to 1), there is no change required to activate distributed BRLM for V1R6. Likewise, if your sysplex only has systems at the V1R6 level, there is no change required, because distributed BRLM is the default. V1R6 systems ignore the z/OS UNIX CDS DISTBRLM setting.

However, if you migrate to V1R6 by running mixed levels in a sysplex, you should enable distributed BRLM before IPLing the V1R6 system because a V1R6 system may attempt to activate distributed BRLM when the central BRLM server leaves the sysplex, regardless of the z/OS UNIX CDS setting. The inconsistency between distributed BRLM being active and central BRLM being defined in the z/OS UNIX CDS can cause an EC6-BadOmvsCds abend on downlevel systems. This is a notification-only abend indicating that the CDS should be updated. z/OS UNIX will still operate normally, and distributed BRLM will be active in the sysplex. See *z/OS Migration* for more information.

We used the following display command on each system to display whether distributed BRLM is enabled and active:

```
F BPXOINIT,FILESYS=DISPLAY,GLOBAL
```

We got the following output from the display command:

```
BPXM027I COMMAND ACCEPTED.
BPXF040I MODIFY BPXOINIT,FILESYS PROCESSING IS COMPLETE.
BPXF041I 2004/08/10 14.10.09 MODIFY BPXOINIT,FILESYS=DISPLAY,GLOBAL
SYSTEM   LFS VERSION ---STATUS---------------------- RECOMMENDED ACTION
Z0         1.  6.  0 VERIFIED                       NONE
JA0        1.  6.  0 VERIFIED                       NONE
TPN        1.  6.  0 VERIFIED                       NONE
Z1         1.  6.  0 VERIFIED                       NONE
J90        1.  6.  0 VERIFIED                       NONE
JF0        1.  6.  0 VERIFIED                       NONE
JB0        1.  6.  0 VERIFIED                       NONE
JC0        1.  6.  0 VERIFIED                       NONE
JE0        1.  6.  0 VERIFIED                       NONE
Z2         1.  6.  0 VERIFIED                       NONE
Z3         1.  6.  0 VERIFIED                       NONE
J80        1.  6.  0 VERIFIED                       NONE
JG0        1.  6.  0 VERIFIED                       NONE
JH0        1.  6.  0 VERIFIED                       NONE
CDS VERSION=  2        MIN LFS VERSION=  1.  6.  0
BRLM SERVER=N/A        DEVICE NUMBER OF LAST MOUNT=    9266
MAXIMUM MOUNT ENTRIES=     800   MOUNT ENTRIES IN USE=     699
MAXIMUM AMTRULES=           51   AMTRULES IN USE=            9
DISTBRLM ENABLED=YES             DISTBRLM ACTIVE=YES
```

We're planning to use the enhancement allowing a filesystem to be moved even when it contains locked files. Prior to z/OS V1R6, you would receive an enomove return code error results if you issued filesystem move commands while a file was open and was byte range locked. In z/OS V1R6, this error code now only occurs if you have a pre-z/OS R6 system in the sysplex. In a pre-z/OS V1R6 system, an enomove return code prevents the filesystem move. In order to move filesystems that contain locked files, all systems in the sysplex must be at the z/OS V1R6 level.

Note that the system does not necessarily report an enomove return code.

Restriction: With distributed BRLM, certain cross-system deadlock scenarios may not be detected. Locking applications must ensure that they do not cause deadlocks. See *z/OS UNIX System Services Planning*.

Using ISHELL enhancements

In z/OS R6, we tested the following enhancements to the ISPF shell (ISHELL) commands. For additional ISHELL information, use the help panels that come with the product.

Wild card support for the command filter: z/OS UNIX System Services now supports the command **filter** on the directory list. If you enter the ISHELL command without any argument, a panel will be displayed to enter the new filter enhancements. You can use any characters with the wild card character (*) in the filter, and the wild card character * can match any number of characters or no characters. For example, the command filter *.c will show only files that end with .c. Filter *a* will show only file names that contain an a. The filter is case sensitive. If there is not a match for the filter then the entire directory list is given and the filter is disabled. The following example shows a series filters issued, and the output displayed:

```
filter *.c
EUID=0  *.c    /u/lates/
   Type  Filename
 _ File  hello.c
 _ File  rlimit.c
 _ File  wstatvfs.c

filter *a*
EUID=0  *a*    /u/lates/
  Type  Filename
_ File  a.out
_ Dir   aaa
_ File  chkosname.jar
_ File  copymap

filter w*
 EUID=0  w*    /u/lates/
   Type  Filename
 _ File  wstatvfs
 _ File  wstatvfs.c
```

Command line position panel option: To test the new command line position enhancements from an ISHELL panel we selected OPTIONS/ADVANCED. This gives us 3 command line selections; top, botttom and inherit, as follows:

```
                     Advanced Options
 Select options

 _  Bypass delete confirmations
 _  Bypass exit confirmation
 _  No auto-skip on action panels
 _  Always start initial panel with current directory

 Command line position:
 _  1.  Top
    2.  Bottom
    3.  Inherit
```

We tested all three command line positions successfully - they each positioned the command line as expected.

Options panel for displaying Permissions: To test the new permissions display from the ISHELL panel, we selected the OPTIONS/DIRECTORY list. This panel lists selections for displaying the permissions listed:

```
                    Directory List Options

Selected options and fields to be displayed with /

_  File type   ( 4 columns)
_  Permissions ( 4 columns, octal)
_  Permissions (10 columns, rwx)
_  Change time (16 columns)
_  Owner       ( 9 columns)
_  File size   (10 columns)

_  View/change sort options...
_  View/change file name highlighting...
/   Verbose directory list panel
_  Null Enter refreshes list
_  Stop processing multiple selections after a message
```

We selected ″Permissions (4 columns, octal)″ and displayed directory /pet6 as follows:

```
EUID=0   /pet6/
  Type  Perm  Filename
_ Dir    750  .
_ Dir    755  ..
_ File   644  a
_ File   644  A
_ File   644  b
_ File   644  B
_ File   644  c
_ File   644  C
_ File   644  d
_ File   644  D
_ File   644  e
_ File   644  E
_ File   644  f
```

Next we selected ″Permissions (10 columns, rwx)″ and displayed directory /pet6 as follows:

```
EUID=0   /pet6/
   Type  Permission  Filename
 _ Dir    rwxr-x---  .
 _ Dir    rwxr-xr-x  ..
 _ File   rw-r--r--  a
 _ File   rw-r--r--  A
 _ File   rw-r--r--  b
 _ File   rw-r--r--  B
 _ File   rw-r--r--  c
 _ File   rw-r--r--  C
 _ File   rw-r--r--  d
 _ File   rw-r--r--  D
 _ File   rw-r--r--  e
 _ File   rw-r--r--  E
 _ File   rw-r--r--  f
```

We then selected **both** permission selections to get the following display:

```
EUID=0   /pet6/
  Type  Perm  Permission  Filename
_ Dir    750   rwxr-x---  .
_ Dir    755   rwxr-xr-x  ..
_ File   644   rw-r--r--  a
_ File   644   rw-r--r--  A
_ File   644   rw-r--r--  b
_ File   644   rw-r--r--  B
_ File   644   rw-r--r--  c
_ File   644   rw-r--r--  C
```

```
_ File   644   rw-r--r--  d
_ File   644   rw-r--r--  D
_ File   644   rw-r--r--  e
_ File   644   rw-r--r--  E
_ File   644   rw-r--r--  f
```

Option for preserving extended attributes on copy: To test this function, we first updated file 'a' in /pet6 to have extended attributes using the following command:

```
extattr +aps a
```

We then used the ISHELL panel to do a copy (**c**) of file 'a' to file 'aaaa':

```
EUID=0   /pet6/
  Type  Perm  Owner      ------Size  Filename
_ Dir    750  LORAIN0         1952  .
_ Dir    777  LORAIN0        24576  ..
c File   644  LORAIN0            0  a
_ File   644  LORAIN0            0  A
_ File   644  LORAIN0            0  b
_ File   644  LORAIN0            0  B
```

We got the following panel, where we selected **1** to copy our file into another file:

```
                        Copy from a File

Copying from file:
/pet6/a

Destination for copy:
1   1.  File...
    2.  Data set...

Select additional options for data set copy:
_  Binary copy
_  Conversion...
```

We were prompted to enter the destination file name (aaa), as follows:

```
                     Enter the Pathname

Change this to the pathname of the target file:
                                                          More:     +
/pet6/aaaa
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
```

We were also prompted to enter the permissions for the destination file:

```
            Enter File Permissions

Permissions  . . 644  (3 digits, each 0-7)
```

Now we get to the extended attributes panel, where we selected to copy the extended attributes to the destination file:

```
                         Extended Atrributes

The selected file contains extended attributes.  Select the option below
to copy all of the extended attributes to the new file.  Note that
authority may be needed to set some extended attributes.

s  Copy extended attributes
```

When this is done, we get the following panel:

```
EUID=0   /pet6/
  Type  Perm  Owner      ------Size  Filename
_ Dir    750  LORAIN0          1952  .
_ Dir    777  LORAIN0         24576  ..
_ File   644  LORAIN0             0  a
_ File   644  LORAIN0             0  A
_ File   644  LORAIN0             0  aaaa
_ File   644  LORAIN0             0  b
```

Finally, we listed the file attributes using the directory panel and confirmed the extended attributes for the new file were copied from the source file as follows:

```
           Display File Attributes

Pathname : /pet6/aaaa
                                        More:   -
Major device  . . . . : 0
Minor device  . . . . : 0
File format . . . . . : NA
Shared AS . . . . . . : 1
APF authorized  . . . : 1
Program controlled  . : 1
Shared library  . . . : 0
Char Set ID/Text flag : 00000 OFF
Directory default ACL : 0
File default ACL  . . : 0
Seclabel  . . . . . :
```

z/OS UNIX enhancements in z/OS V1R7

z/OS UNIX made several enhancements in z/OS V1R7. In this section, we cover the following topics:

- "z/OS UNIX System Services: 64 MB Maximum for OMVS ctrace Buffer"
- "z/OS UNIX System Services: Dynamic Service Activation" on page 161
- "z/OS UNIX System Services: Display Local AF_UNIX Sockets" on page 166
- "z/OS UNIX System Services: /dev/zero, /dev/random, dev/urandom" on page 167
- "z/OS UNIX System Services: Display Information About Move or Mount Failures" on page 169
- "z/OS UNIX System Services: SETOMVS Enhancements" on page 170
- "z/OS UNIX System Services: Display Mount Latch Contention Information" on page 171
- "z/OS UNIX System Services: Enhancements to Display Filesystems" on page 174
- "z/OS UNIX System Services: ISHELL Enhancements" on page 175

z/OS UNIX System Services: 64 MB Maximum for OMVS ctrace Buffer

In z/OS V1R7, to increase the likelihood of capturing valuable trace data, the MAX setting of SYSOMVS CTRACE will be 64 MB. (Prior to z/OS V1R7, the MAX setting for the SYSOMVS component ctrace is 8 MB.) You can set this new value through the SYS1.PARMLIB member CTIBPXxx or through the **TRACE CT** command. The following is an example of setting the SYSOMVS CTRACE to 64 MB through the parmlib CTIBPXxx member:

We used CTRACE parmlib member, CTIBPX64, that defines the 64 MB setting in the parmlib dataset. The following is an excerpt from member CTIBPX64:

```
BUFSIZE(64M)
```

We modified our BPXPRM00 member in the parmlib dataset to use the new CTRACE member. The following is an excerpt from member BPXPRM00:

```
CTRACE(CTIBPX64)
```

We verified the syntax with the following:

```
SETOMVS SYNTAXCHECK=(00)
```

After IPL (and/or OMVS recycle/reinit), we verified the trace buffer setting. For example:

```
D TRACE,COMP=SYSOMVS
IEE843I 10.16.55  TRACE DISPLAY
        SYSTEM STATUS INFORMATION
ST=(ON,0500K,04500K) AS=ON  BR=OFF EX=ON  MT=(ON,140K)
  COMPONENT     MODE BUFFER HEAD SUBS
 ------------------------------------------------------
  SYSOMVS       ON   0064M
     ASIDS      *NONE*
     JOBNAMES   *NONE*
     OPTIONS    ALL
     WRITER     *NONE
```

The following is an example of setting the SYSOMVS CTRACE to 64 MB with the **TRACE CT** console command:

```
TRACE CT,64M,COMP=SYSOMVS

*0046 ITT006A SPECIFY OPERAND(S) FOR TRACE CT COMMAND.
-46,END

 IEE600I REPLY TO 0046 IS;END
 ITT038I ALL OF THE TRANSACTIONS REQUESTED VIA THE TRACE CT COMMAND WERE SUCCESSFULLY EXECUTED.
 IEE839I ST=(ON,0500K,05000K) AS=ON  BR=OFF EX=ON  MT=(ON,140K)
         ISSUE DISPLAY TRACE CMD FOR SYSTEM AND COMPONENT TRACE STATUS
         ISSUE DISPLAY TRACE,TT CMD FOR TRANSACTION TRACE STATUS

D TRACE,COMP=SYSOMVS
IEE843I 11.43.11  TRACE DISPLAY 286
        SYSTEM STATUS INFORMATION
 ST=(ON,0500K,05000K) AS=ON  BR=OFF EX=ON  MT=(ON,140K)
  COMPONENT     MODE BUFFER HEAD SUBS
 ------------------------------------------------------------
  SYSOMVS       ON   0064M
     ASIDS      *NONE*
     JOBNAMES   *NONE*
     OPTIONS    ALL
     WRITER     *NONE*
```

z/OS UNIX System Services: Dynamic Service Activation

With z/OS V1R7 or higher systems, some UNIX System Services service items can be activated dynamically without requiring an IPL. Only those APARs, PTFs, or USERMODs marked with ++HOLD REASON(DYNACT) data can use dynamic activation. The instructions must be followed with the ++HOLD documentation. For example, some fixes may require an OMVS (or another component) shutdown or the Dynamic LPA add of BPXINLPA and its ALIASes. The identification of the service libraries can be statements in the BPXPRMxx member, or set with the **SETOMVS** or **SET OMVS** console commands. These datasets must be APF authorized. The dataset names can be retrieved with ″D OMVS,O″ or the get_system_settings() C/C++ API.

Take care identifying the libraries designated for the dynamic activation. The definition requires you to enter the volume where they reside. If the dataset names are moved to other volumes, and the definition is not changed through **SETOMVS**, **SET OMVS**, and/or in member BPXPRMxx, errors can occur. You can set these new statements with **SET OMVS** or **SETOMVS**, for different target service libraries, for any given **F OMVS,ACTIVATE=SERVICE** command invocation. The complete

set of dynamic activate fixes within the libraries will be activated. The set will be activated, deactivated, or displayed, depending on the command used.

You should also stay current with UNIX System Services Component maintenance, so the system will be at a high enough level to accept the service.

We recommend that you install these service items into a separate load library from the LPALIB or LINKLIB libraries that are used for your normal install process. This would then be the load library that is regularly used to dynamically activate service on your systems. Selective items can then be copied into them for activation, if all modules are known. However, this is not intended to be used as a way to activate a large set of maintenance for preventive purposes.

BPXPRMxx pertinent statement definitions:

SERV_LPALIB('dsname','volser')
Specifies the target service library where the UNIX System Services modules that are normally built into LPA are located. Value Range:dsname is a 1-to-44 character value representing a valid MVS load library data set name. The alphabetic characters in the load library name must be uppercase. volser is a 1-to-6 character value representing a valid volume serial number for the volume that contains the specified MVS load library. The alphabetic characters in the volume serial number must be uppercase. You can change the value of SERV_LPALIB dynamically using the SETOMVS or SET OMVS command. To make a permanent change, edit the BPXPRMxx member that will be used for future IPLs.

SERV_LINKLIB('dsname', 'volser')
Specifies the target service library where the UNIX System Services modules that are normally loaded from SYS1.LINKLIB into the private area of the OMVS address space are located. Value Range:dsname is a 1-to-44 character value representing a valid MVS load library data set name. The alphabetic characters in the load library name must be uppercase. volser is a 1-to-6 character value representing a valid volume serial number for the volume that contains the specified MVS load library. The alphabetic characters in the volume serial number must be uppercase. You can change the value of SERV_LINKLIB dynamically using the **SETOMVS** or **SET OMVS** command. To make a permanent change, edit the BPXPRMxx member that will be used for future IPLs.

You will encounter a similar message if you supply the wrong volume.:

```
BPXI074I LOAD LIBRARY loadlib IS NOT ON THE SPECIFIED VOLUME voln
```

If a load library is not APF-authorized, the message issued will be one of the following:

```
BPXM059I ACTIVATE=SERVICE REQUEST FAILED,
 LPALIB LIBRARY NOT APF AUTHORIZED
```

or

```
BPXM059I ACTIVATE=SERVICE REQUEST FAILED,
 LINKLIB LIBRARY NOT APF AUTHORIZED
```

The following is an example of setting the libraries using the SETOMVS console command:

```
SETOMVS SERV_LINKLIB=('D10PET.USS.SERV.LINKLIB','SP0004')
 BPXO015I THE SETOMVS COMMAND WAS SUCCESSFUL.

SETOMVS SERV_LPALIB=('D10PET.USS.SERV.LINKLIB','SP0004')
BPXO015I THE SETOMVS COMMAND WAS SUCCESSFUL.
```

The following is an example of setting the libraries using the **SET OMVS** console command. We added the following to our main parm member, SYS1.PARMLIB(BPXPRM00):

```
SERV_LPALIB('D10PET.USS.SERV.LPALIB','SP0004')
SERV_LINKLIB('D10PET.USS.SERV.LINKLIB','SP0004')
```

We verified the syntax with the following:

```
SETOMVS SYNTAXCHECK=(00)
```

The **SET OMVS** command was used to activate the BPXPRM00 new statements. The statements are now in the BPXPRM00 member, which we use upon OMVS initialization. An IPL also validates these settings. However, you should ensure the libraries exist on the volume(s) specified or errors may occur during IPL or SET operations.

```
SET OMVS=(00)
 BPXO032I THE SET OMVS COMMAND WAS SUCCESSFUL.
```

Here is an excerpt from the OMVS Options display:

```
D OMVS,O
...
SERV_LINKLIB    = D10PET.USS.SERV.LINKLIB   SP0004
SERV_LPALIB     = D10PET.USS.SERV.LPALIB   SP0004
...
```

To display and activate the service from the dynamic activate datasets, enter the following. This has to be executed on each system you want the service activated. The amount of ECSA and OMVS address space storage consumed for those service items is also indicated. If a fix capable of dynamic activation is found that cannot be activated due to back-level service found on the active system or missing parts in the target activation libraries, the activation will fail.

```
F OMVS,ACTIVATE=SERVICE
```

This activates service at any time, first displaying the service that can be activated, and prompts users with a WTOR message (reply ″Y″ to continue). Activations should remain in effect across OMVS shutdown. And, these can be performed during a shutdown.

To deactivate the last set of activated service, enter the following. This has to be executed on each system from which you want the service deactivated:

```
F OMVS,DEACTIVATE=SERVICE
```

This deactivates (backs-off) the last set of service items, and prompts users with a WTOR message (reply ″Y″ to continue).

Note: The amount of storage consumed will not decrease when a deactivation is done, the new modules must remain in storage indefinitely.

To display sets of items that have been dynamically activated, enter the following. This has to be executed on each system you want to display these items:

```
D OMVS,ACTIVATE=SERVICE
```

This displays (most recent to oldest) all sets of service items that are currently activated dynamically.

Note: BPXEKDA can be used to retrieve this information

It also reports the library and the volume where each set of fixes were activated from, along with the amount of ECSA and OMVS address space storage that is being consumed.

The following are examples of the ++HOLD REASON(DYNACT) information:

```
++ HOLD(UA20094) SYS FMID(HBB7720) REASON(DYNACT) DATE(05209)
   COMMENT
  (*****************************************************************
  * FUNCTION AFFECTED: Unix System Services            (OA11339) *
  *                      Kernel                                   *
  *****************************************************************
  * DESCRIPTION      : Dynamic PTF Activation without an IPL     *
  *****************************************************************
  * TIMING           : Post-APPLY                                *
  *****************************************************************
  * To activate this fix you may IPL your system; or, to         *
  * avoid an IPL, you may activate this fix dynamically by       *
  * taking the following steps:                                  *
  *****************************************************************
  *                                                              *
  * SET-UP REQUIRED TO ACTIVATE SERVICE:                         *
  *  IDENTIFY CURRENT SERVICE LEVEL OF ACTIVE SYSTEM:            *
  *   The system has to be at least at the level listed here:    *
  *       HBB7720 - BASE                                         *
  *                                                              *
  *  IDENTIFY TARGET LIBRARIES:                                  *
  *   Ensure Unix System Services recognizes the target          *
  *   libraries where the PTFs are installed.  The libraries     *
  *   are specified on the SERV_LPALIB and SERV_LINKLIB          *
  *   parameters defined in the BPXPRMxx parmlib member (set     *
  *   at initialization or set/changed via the SETOMVS or        *
  *   SET OMVS command).                                         *
  *_____________________________________________________________*
  *                                                              *
  * RESOURCES REQUIRED TO ACTIVATE SERVICE:                      *
  *  ECSA and/or OMVS private storage.                           *
  *  Required amount of storage will be identified when the      *
  *  command to activate service is issued.                      *
  *_____________________________________________________________*
  *                                                              *
  * STEPS TO ACTIVATE SERVICE:                                   *
  *  Activate service by issuing the following console command:  *
  *    F OMVS,ACTIVATE=SERVICE                                   *
  *  A message is displayed with a list of service items to be   *
  *  activated and the amount of system resources consumed       *
  *  (ECSA and OMVS private storage).                            *
  *                                                              *
  *  The operator will be prompted with a WTOR asking to         *
  *  confirm the activation of service.  The operator must       *
  *  respond 'Y' to activate service.                            *
  *                                                              *
  *  If all service was successfully activated, message BPXM062I *
  *  is issued:                                                  *
  *  BPXM062I ACTIVATE=SERVICE REQUEST COMPLETED SUCCESSFULLY    *
  *                                                              *
  *  If service was unable to be activated, either message       *
  *  BPXM059I or message BPXM060I is issued.                     *
  *_____________________________________________________________*
  *                                                              *
  * STEPS TO DE-ACTIVATE SERVICE:                                *
```

```
|    *  To deactivate service, issuing the following command:       *
|    *   F OMVS,DEACTIVATE=SERVICE                                  *
|    *   No additional resources are used.  However, no resources   *
|    *   are freed.                                                 *
|    ************************************************************)
|
|  ++ HOLD(UA20084) SYS FMID(HBB7720) REASON(DYNACT) DATE(05208)
|     COMMENT
|    (************************************************************
|    * FUNCTION AFFECTED: Unix System Services            (OA12734) *
|    *                      Kernel                                *
|    ************************************************************
|    * DESCRIPTION      : Dynamic PTF Activation without an IPL     *
|    ************************************************************
|    * TIMING           : Post-APPLY                                *
|    ************************************************************
|    * To activate this fix PTF you may IPL your system; or, to     *
|    * avoid an IPL, you may activate this fix dynamically by       *
|    * taking the following steps:                                  *
|    ************************************************************
|    *                                                             *
|    * SET-UP REQUIRED TO ACTIVATE SERVICE:                        *
|    *  IDENTIFY CURRENT SERVICE LEVEL OF ACTIVE SYSTEM:           *
|    *   The system has to be at least at the level listed here:   *
|    *       HBB7720 - BASE                                        *
|    *                                                             *
|    *  IDENTIFY TARGET LIBRARIES:                                 *
|    *   Ensure Unix System Services recognizes the target         *
|    *   libraries where the PTFs are installed.  The libraries    *
|    *   are specified on the SERV_LPALIB and SERV_LINKLIB         *
|    *   parameters defined in the BPXPRMxx parmlib member (set    *
|    *   at initialization or set/changed via the SETOMVS or       *
|    *   SET OMVS command).                                        *
|    *_____________________________________________________________*
|    *                                                             *
|    * RESOURCES REQUIRED TO ACTIVATE SERVICE:                     *
|    *  ECSA and/or OMVS private storage.                          *
|    *  Required amount of storage will be identified when the     *
|    *  command to activate service is issued.                     *
|    *_____________________________________________________________*
|    *                                                             *
|    * STEPS TO ACTIVATE SERVICE:                                  *
|    *  Shutdown OMVS by issuing the following console command:    *
|    *   F OMVS,SHUTDOWN                                           *
|    *                                                             *
|    *  Activate service by issuing the following console command: *
|    *   F OMVS,ACTIVATE=SERVICE                                   *
|    *                                                             *
|    *   A message is displayed with a list of service items to be *
|    *   activated and the amount of system resources consumed     *
|    *   (ECSA and OMVS private storage).                          *
|    *                                                             *
|    *  The operator will be prompted with a WTOR asking to       *
|    *  confirm the activation of service.  The operator must      *
|    *  respond 'Y' to activate service.                           *
|    *                                                             *
|    *  If all service was successfully activated, message BPXM062I *
|    *  is issued:                                                 *
|    *  BPXM062I ACTIVATE=SERVICE REQUEST COMPLETED SUCCESSFULLY   *
|    *                                                             *
|    *  Restart OMVS by issuing the following console command:     *
|    *   F OMVS,RESTART                                            *
|    *                                                             *
|    *  If service was unable to be activated, one or more of the  *
|    *  following messages may be issued:                          *
|    *  BPXM059I BPXM060I BPXM064I                                 *
|    *_____________________________________________________________*
```

```
*                                                               *
* STEPS TO DE-ACTIVATE SERVICE:                                 *
*  To deactivate service, after issuing the F OMVS,SHUTDOWN     *
*  command, issue the following commands:                       *
*   F OMVS,DEACTIVATE=SERVICE                                   *
*   F OMVS,RESTART                                              *
*   No additional resources are used.  However, no resources    *
*   are freed.                                                  *
*****************************************************************).
```

z/OS UNIX System Services: Display Local AF_UNIX Sockets

In z/OS V1R7 the **DISPLAY OMVS** command was enhanced with a Sockets option that displays information about AF_UNIX Sockets and their sessions. It is used to display how AF_UNIX socket programs are performing or what sessions have been established. This display for AF_UNIX sockets is similar to the netstat display for AF_INET sockets.

Format:

```
DISPLAY OMVS,Sockets|So
```

Displays the following information about each AF_UNIX socket:

jobname
: The job name of the process that owns the socket.

id
: The inode number of the socket, in hexadecimal.

peerid
: The inode number of a connected socket's peer socket.

state
: The socket state, which is one of the following:

  LISTEN
  : A server TCP stream socket that accepts connections.

  DGRAM
  : A UDP datagram socket.

  ACP
  : An accepted stream socket.

  CONN
  : A connected stream socket.

  STRM
  : An unconnected stream socket.

readbyte
: The number of bytes read on this socket, in hexadecimal. For a server socket, this value is the number of connections that have been accepted. After 4 GB, this value wraps.

writebyte
: The number of bytes written on this socket, in hexadecimal. After 4GB, this value wraps.

socket name: *socketname*
: The name to which this socket was bound, if any.

peer name: *peersocketname*
: The name of the socket this socket is connected to, if it is connected and if the peer socket has a name.

The following is an example of the display output:

```
D OMVS,SO

BPXO060I 20.59.18 DISPLAY OMVS 661
OMVS     0010 ACTIVE          OMVS=(00,Z3)
JOBNAME     ID    PEER ID  STATE    READ   WRITTEN
```

```
-------- -------- -------- ------ -------- --------
FTPJOB   0000A3DD 00000002 DGRAM  00000000 00000000
   PEER NAME: /dev/log
WT2SR0A  00002575          CONN   00000000 00000000
TCPIP    0000000E 00000002 DGRAM  00000000 000000A6
   PEER NAME: /dev/log
OSNMPD   0000000D 0000000C ACP    00007BFA 000042FB
 SOCKET NAME: /tmp/dpi_socket
TCPIP    0000000C 0000000D CONN   000042FB 00007BFA
   PEER NAME: /tmp/dpi_socket
OSNMPD   0000000B 0000000A ACP    0000005C 0000002E
 SOCKET NAME: /tmp/dpi_socket
OMPROUTE 0000000A 0000000B CONN   0000002E 0000005C
   PEER NAME: /tmp/dpi_socket
OSNMPD   00000009          LISTEN 00000002 00000000
 SOCKET NAME: /tmp/dpi_socket
OMPROUTE 00000008 00000002 DGRAM  00000000 000090EC
   PEER NAME: /dev/log
FTPD     00000007 00000002 DGRAM  00000000 00000454
   PEER NAME: /dev/log
OSNMPD   00000006 00000002 DGRAM  00000000 00000B09
   PEER NAME: /dev/log
INETD7   00000003 00000002 DGRAM  00000000 00000262
   PEER NAME: /dev/log
SYSLOGD6 00000002          DGRAM  0000A86F 00000000
 SOCKET NAME: /dev/log
```

z/OS UNIX System Services: /dev/zero, /dev/random, dev/urandom

z/OS V1R7 support the /dev/zero, /dev/random, and /dev/urandom character special files. You can continually write to these files and the data will be accepted and discarded. These character special files are created upon IPL or OMVS shutdown/restart, if not present. They are also created, if not present, upon first reference. However, the first reference must be on the specific system, with path name starting with /dev (ie. /dev/zero, /dev/random, and /dev/urandom), or a regular file may be created. Also, referencing these with the system name, in the path name, will not create the character special file, but a regular file (for example, /SYS1/dev/zero, /SYS1/dev/random, and /SYS1/dev/urandom).

Note: Backlevel releases cannot open these devices.

When using the **mknod** command in the shell, the permissions allocated to the files will be affected by the ″umask″ setting. When using the TSO MKNOD command, the files are usually created with the correct permissions. You can use the **chmod** command to correct any permissions.

/dev/zero

/dev/zero is a character special device file that accepts and discards anything written to it and provides binary zeros for any amount read from it. The buffer passed on read() or buffers passed on readv() will be filled with binary zeros for the amount specified to be read. The Return_value for a successful read or write type operation will be equal to the amount of data that was requested to be read or written. There is no ″end of file″ for reads. The supply of zeros is inexhaustible. The /dev/zero file will be created, if necessary, when OMVS starts and will be dynamically created anytime it is referenced by its full name (ie. /dev/zero on the specific system) and it does not exist. The default permissions for /dev/zero will be 666, RW-RW-RW-. These may be changed by the chmod command or function.

The following is an example of using **mknod** in the shell to create the file on the specific system:

```
mknod /dev/zero c 4 1
chmod 666 /dev/zero
```

Note: For device major number 4, the device minor number 0 represents /dev/null and the device minor number 1 represents /dev/zero.

/dev/random and /dev/urandom

Integrated Cryptographic Service Facility (ICSF) is required with either Cryptographic Coprocessor Feature or PCI X Cryptographic Coprocessor depending on the model of the zSeries server. /dev/random and /dev/urandom are character-special device files that generate random numbers. They are opened and read from like any other file. Various applications use this output for creating security keys and other cryptographic purposes. The source of these random numbers will be the native Cryptographic hardware available on zSeries machines and this will be accessed through the Random Number Generator callable service of ICSF.

The /dev/random and /dev/urandom Character Special devices provide cryptographically secure random output generated from the hardware cryptographic feature available on the zSeries. The foundation of this random number generator is a time variant input with a very low probability of recycling. These device files require ICSF and either Cryptographic Coprocessor Feature or PCI X Cryptographic Coprocessor depending on the model of the zSeries server.

On some Unix systems, /dev/random may block waiting for naturally occurring randomness to occur and /dev/urandom is an alternative, less secure but non blocking, random number generator. On z/OS both of these devices are the same; they rely on the hardware to provide the random numbers and they will not block. The hardware is designed to produce eight-byte random numbers but on a read operation any amount of data requested will be provided and the Return_value for a successful read operation will be equal to the amount of data that was requested.

Reads may fail if ICSF or the hardware is not available or if any addresses passed are invalid. Data written to these devices is ignored without being referenced and the Return_value for a write type operation is equal to the amount of data that was being written. There is no ″end of file″ for reads; the supply of random data is inexhaustible. Reads and writes will not block. These devices are created, if necessary, when OMVS starts and are dynamically created anytime they are referenced by full name and do not exist (that is, /dev/random or /dev/urandom on the specific system). The default permissions are 666, RW-RW-RW-. These may be changed by the **chmod** command or function, or by explicitly defining the devices with **mknod**. Additionally, you must be RACF permitted to the CSFRNG profile in the CSFSERV security class or ICSF must have been started with the CHECKAUTH(NO) option.

The following are examples of using **mknod** in the shell to create the files.

```
mknod /dev/random c 4 2
chmod 666 /dev/random

mknod /dev/urandom c 4 2
chmod 666 /dev/urandom
```

Note: For device major number 4, the device minor number 0 represents /dev/null, the device minor number 1 represents /dev/zero, and the device minor number 2 is for /dev/random and /dev/urandom.

z/OS UNIX System Services: Display Information About Move or Mount Failures

The **D OMVS,MF** command enables you to display failures from prior mount or move file system commands (such as, TSO, Ishell, OMVS, and BPXPRMxx mounts). When executed, this command returns message BPXO058I, which lists previous errors. Here are three ways to use the **D OMVS,MF** command:

```
D OMVS,MF - Returns BPXO058I message, listing up to 10 prior errors
D OMVS,MF=ALL | A - Returns BPXO058I message, listing up to 50 prior errors
D OMVS,MF=PURGE | P  - Purges the saved failure information listed in BPXO058I message
```

The following are some examples of the **D OMVS,MF** command:

- No prior failures:

```
D OMVS,MF
BPXO058I 12.33.17 DISPLAY OMVS 773
OMVS     0010 ACTIVE          OMVS=(00,TP)
NO MOUNT OR MOVE FAILURES TO DISPLAY
```

- The short list of failures. This sample displays two failures; the list can hold up to 10 failures:

```
D OMVS,MF
BPXO058I 12.33.30 DISPLAY OMVS 542
OMVS     0010 ACTIVE          OMVS=(00,JC)
SHORT LIST OF FAILURES:
TIME=08.52.51  DATE=2005/09/27        MOUNT RC=0079  RSN=055B005B
NAME=fileSystemName
  TYPE=fileSystemType
  PATH=mountpoint
TIME=11.37.43  DATE=2005/09/27        MOUNT RC=0079  RSN=055B005C
NAME=fileSystemName
  TYPE=fileSystemType
  PATH=mountpoint
```

- The entire list of failures. This sample displays two failures; the list can hold up to 50 failures:

```
D OMVS,MF=ALL
BPXO058I 12.34.03 DISPLAY OMVS 361
OMVS     0010 ACTIVE          OMVS=(00,J8)
ENTIRE LIST OF FAILURES:
TIME=08.52.51  DATE=2005/09/27        MOUNT RC=0079  RSN=055B005B
  NAME=fileSystemName
  TYPE=fileSystemType
  PATH=mountpoint
TIME=11.37.43  DATE=2005/09/27        MOUNT RC=0079  RSN=055B005C
NAME=fileSystemName
TYPE=fileSystemType
  PATH=mountpoint
```

- Purging the entire list of failures:

```
D OMVS,MF=PURGE
BPXO058I 12.34.19 DISPLAY OMVS 403
OMVS     0010 ACTIVE          OMVS=(00,J8)
PURGE COMPLETE: TIME=12.34.19  DATE=2005/09/27
```

- Running the display command after purging the saved failures. Notice that there is a new line of output, LAST PURGE:, that was not present when running **D OMVS,MF** before running the **D OMVS,MF=PURGE** command for the first time.

```
BPXO058I 12.34.29 DISPLAY OMVS 192
OMVS     0010 ACTIVE          OMVS=(00,JA)
LAST PURGE: TIME=12.34.19  DATE=2005/09/27
NO MOUNT OR MOVE FAILURES TO DISPLAY
```

Note that during BPXPRMxx parmlib member processing, any mount statement that duplicates a mounted file system in both FILESYSTEM name and MOUNTPOINT is

silently ignored and is not considered an error. Therefore, it will not show up in BPXO058I. On the other hand, if you try to mount a mounted file system at the mountpoint on which it is already mounted, you will receive the following error:

```
RETURN CODE 00000079, REASON CODE 055B005C.  THE MOUNT FAILED FOR FILE SYSTEM filesystemName
```

If you run **D OMVS,MF** after this error, you will receive information similar to the following:

```
D OMVS,MF
BPXO058I 13.03.59 DISPLAY OMVS 007
OMVS     0010 ACTIVE          OMVS=(00,TP)
LAST PURGE: TIME=12.34.19  DATE=2005/09/27
SHORT LIST OF FAILURES:
TIME=13.03.40  DATE=2005/09/27        MOUNT RC=0079  RSN=055B005C
  NAME=fileSystemName
  TYPE=fileSystemType
  PATH=mountPoint
```

z/OS UNIX System Services: SETOMVS Enhancements

Enhancements introduced to the **SET OMVS** MVS System Command for z/OS V1R7 enable you to change your mount configuration from the console. Now the **SET OMVS** command executes the **ROOT**, **MOUNT**, **FILESYSTYPE**, **SUBFILESYSTYPE** and **NETWORK** commands that are contained in the specified parmlib member.

Processing of the MOUNT statements:

- Each successful MOUNT operation generates a console message.
- Any MOUNT operation that tries mounting a file system that is already mounted at the mount point on which it is already mounted, is silently ignored.
- Any other MOUNT failure causes an error message to be written to the console.

Processing of the FILESYSTYPE, SUBFILESYSTYPE and NETWORK statements is done the same way in which **SETOMVS RESET** does it.

Note that these enhancements are not an issue for migrating from an older level of z/OS. Prior releases of z/OS ″SET OMVS″ simply ignore these statements. Now, z/OS executes them by ignoring those that duplicate what is already configured. For example; if the UNIX System Services parmlib member BPXPRM00 includes the following mount statements:

1. Mount statement 1:

   ```
   MOUNT FILESYSTEM('OMVSSPN.PET1.ZFS') TYPE(ZFS) MODE(RDWR)
   MOUNTPOINT("/pet2") AUTOMOVE(Y)
   ```

2. Mount statement 2:

   ```
   MOUNT FILESYSTEM('OMVSSPN.PET2.ZFS') TYPE(ZFS) MODE(RDWR)
   MOUNTPOINT("/pet2") AUTOMOVE(Y)
   ```

3. Mount statement 3:

   ```
   MOUNT FILESYSTEM('OMVSSPN.PET2.ZFS') TYPE(ZFS) MODE(RDWR)
   MOUNTPOINT("/pet10") AUTOMOVE(Y)
   ```

We run ″SET OMVS=(00)″ on SYS1 and receive:

```
SYS1       2005200 14:25:46.53 USER1      00000200  SET OMVS=(AA)
IEE252I MEMBER BPXPRMAA FOUND IN SYS1.PARMLIB
BPXO032I THE SET OMVS COMMAND WAS SUCCESSFUL.
```

Based on the above, the following occurs:

1. The mount from Mount Statement 1 is successful:

```
BPXF013I FILE SYSTEM OMVSSPN.PET1.ZFS 398
WAS SUCCESSFULLY MOUNTED.
```

2. The mount point specified in Mount Statement 2 has another file system mounted on it (OMVSSPN.PET1.ZFS) due to Mount Statement 1:

```
BPXF236I FILE SYSTEM OMVSSPN.PET2.ZFS 661 WAS NOT MOUNTED.
THE MOUNT POINT SPECIFIED IN BPXPRM00 ALREADY HAS
FILE SYSTEM OMVSSPN.PET1.ZFS MOUNTED ON IT.
```

3. The mount point specified in Mount Statement 3 does not exist:

```
BPXF008I FILE SYSTEM OMVSSPN.PET2.ZFS 401 WAS NOT MOUNTED.
THE MOUNT POINT SPECIFIED IN BPXPRM00 DOES NOT EXIST
```

z/OS UNIX System Services: Display Mount Latch Contention Information

A new addition to the set of MVS System Commands that display the z/OS UNIX System Services status is **D OMVS,WAITERS | W**. This command is created for better identifying the reason for which a mount latch is being held and similar information for outstanding cross system messages.

Using this command, you can display the following. The display output is for the specific system on which the command was entered:

- The task that is holding the LFS Mount Latch
- The reason why the task started holding the LFS Mount Latch
- What that task is doing
- The tasks waiting for that Mount Latch and why they want it
- The tasks that are currently waiting for messages from other systems in a sysplex.

On the sender systems what the senders are waiting for and the systems they are waiting from are displayed. On the receiver systems, the messages that have arrived and have not yet been responded to are shown.

The output of this command is separated into two different sections: ″Mount Latch Activity″ and ″Outstanding Cross System Messages.″

If there is some ″Mount Latch Activity″ in the system, the related section displays the following:

- Who is holding the Mount Latch
- Who is waiting for the Mount Latch
- What the holder is doing at the moment
- How long the Mount Latch has been held
- How long each waiter has been waiting for the Mount Latch.

If there are some ″Outstanding Cross System Messages″ on the system, the related section displays the following:

- Who is waiting for a reply
- What type of message was sent
- The systems to which the message was sent
- How long the reply has been outstanding.

The following are sample **D OMVS,W** outputs:

Sample 1: If there are no Mount Latch activity or Outstanding Cross System Messages at the time, you will receive something similar to the following:

```
BPXO063I 09.54.31 DISPLAY OMVS 712
OMVS     0010 ACTIVE          OMVS=(00,JE)
MOUNT LATCH ACTIVITY: NONE
OUTSTANDING CROSS SYSTEM MESSAGES: NONE
```

Sample 2: If the system on which you run **D OMVS,W** is waiting on some replies from other systems for messages that it had sent, you will receive something similar to the following:

```
SYSTEM JB0 RESPONSE TO D OMVS,W
BPXO063I 09.54.31 DISPLAY OMVS 255
OMVS     0010 ACTIVE          OMVS=(00,JB)
MOUNT LATCH ACTIVITY: NONE
OUTSTANDING CROSS SYSTEM MESSAGES:
 SENT SYSPLEX MESSAGES:
    USER   ASID   TCB    FCODE  MEMBER   REQID     MSG TYPE     AGE
  U082001  0336 007F8080  0003   Z2     045E5B89   RDWRCall  00.00.00
```

where:

USER User id of the address space that is involved

ASID AsID of the address space that is involved

TCB Task that is involved

FCODE
Function code being sent cross system

MEMBER
The system(s) to which the message is sent

REQID
Unique request ID of this message

MSG TYPE
Function that the messages is performing

AGE How long the task has been waiting

Sample 3: If the system on which you run **D OMVS,W** has received some messages but has not responded to them, then you will see something similar to the following:

```
SYSTEM Z2 RESPONSE TO D OMVS,W
BPXO063I 09.54.31 DISPLAY OMVS 809
OMVS     0010 ACTIVE          OMVS=(00,Z2)
MOUNT LATCH ACTIVITY: NONE
OUTSTANDING CROSS SYSTEM MESSAGES:
 RECEIVED SYSPLEX MESSAGES:
                     FROM  FROM                  FROM
   ON TCB   ASID     TCB     FCODE  MEMBER   REQID     MSG TYPE     AGE
  007D2CF0 0336    007F8080  0003     JB0   045E5B89   RDWRCall   00.00.00
     IS DOING: HFS RDWRCall / Running
    FILE SYSTEM: OMVSSPN.U2.U059048.FS
```

where:

ON TCB
TCB of the Worker Task that is processing this message.

FROM ASID
AsID of the message sender.

FROM TCB
The TCB of the message sender.

FCODE
The function code to be processed.

FROM MEMBER
The sysplex member that sent this message.

REQID
Unique request ID of this message.

MSG TYPE
Function that the message is performing.

AGE How long this Working Task has been processing the message.

IS DOING
What the worker task is actually doing; that is, what is holding the worker task from responding to the message. (Shown only for Worker Tasks that appear to be hung or that are running in a different component than OMVS.)

FILE SYSTEM
The file system involved (if any).

Sample 4: You receive something similar to the following, if you had Mount Latch activity at the time of the display:

```
BPXO063I 03.33.02 DISPLAY OMVS 782
OMVS     0010 ACTIVE          OMVS=(00,JE)
MOUNT LATCH ACTIVITY:
    USER   ASID     TCB           REASON                        AGE
 HOLDER:
  OMVS     0010  008EA400     Inact Cycle                     00.06.22
     IS DOING: XPFS VfsInactCall / XSYS Message To: Z1
     FILE SYSTEM: OMVSSPN.U2.FS
 WAITER(S):
  OMVS     0010  008EA840     FileSys Sync                    00.06.17
OUTSTANDING CROSS SYSTEM MESSAGES: NONE
```

The following are displayed for both the HOLDER and the WAITERs:

USER User id of the address space that is involved

ASID AsID of the address space that is involved

TCB Task that is involved

REASON
What the user is trying to do

AGE How long the task has been waiting for the Mount Latch.

The following are displayed for the HOLDER:

IS DOING
What the holder task is doing

FILE SYSTEM
The name of the file system involved (If any).

Sample 5: Note that Sample 2 is marked as ″System JB0 Response to D OMVS,W″ and Sample 3 is marked as ″System Z2 Response to D OMVS,W″. Then notice that the FROM MEMBER field in Sample 2 shows JB0 and the MEMBER

field in Sample 1 shows Z2. Now look at the REQID fields for both samples and notice that they are the same. Sample 2 shows the message that JB0 sent to Z2 and is currently expecting a reply for it. On the other hand, Sample 3 shows that Z2 has received a message from JB0 and has not yet responded to it.

In summary, by running **D OMVS,W** across the sysplex, you can track Outstanding Sysplex Messages as well as Mount Latch Activity, just like Sample 5.

Note: This display is very useful in diagnosing mount latch contention and hangs. See ″Procedure: Diagnosing and resolving mount latch contention″ in *z/OS MVS Diagnosis: Reference* for more information.

z/OS UNIX System Services: Enhancements to Display Filesystems

Using **D OMVS,FILE | F**, you can display the list of file systems that z/OS UNIX System Services is currently using along with their status. This is not a new function but it is important to note that beginning with z/OS V1R7 this command displays mounts that are in an earlier stage of the mount sequence than it did before, as well as new status items.

D OMVS,F is a key display command that collects data during z/OS UNIX System Services problems, such as Latch Hangs. The enhancements to this command help with problem determination.

For z/OS V1R7, **D OMVS,F** displays the following status items:

- The status of each file system
- The date and time that the file system was mounted
- The latch number for the file system
- The quiesce latch number for the file system, or 0 if UNIX System Services has never quiesced the file system.

The following are two sample outputs from **D OMVS,F**. In both examples, the following is true:

MOUNTED
Specifies the date and time this file system was mounted

LATCHES
L specifies the latch number for this file system and **Q** specifies the quiesce Latch number for thie file system

Example 1:

```
TYPENAME  DEVICE ---------STATUS-----------MODE  MOUNTED    LATCHES
ZFS        178            ACTIVE           RDWR  09/26/2005 L=187
   NAME=fileSystemName                             18.56.18   Q=0
   PATH=mountPoint
   OWNER=ownerSystemName      AUTOMOVE=Y  CLIENT=N
```

Example 2:

```
TYPENAME  DEVICE ---------STATUS-----------MODE  MOUNTED    LATCHES
NFS       4511           FORCE UNMOUNT    RDWR  07/21/2005 L=184
  NAME=fileSystemName                              12.24.13   Q=1053
  PATH=mountPoint
  MOUNT PARM=mountParm
  OWNER=ownerSystemName       AUTOMOVE=Y CLIENT=N
```

z/OS UNIX System Services: ISHELL Enhancements

This section lists the ISHELL enhancements for z/OS V1R7.

New "Do not normalize the selected path to the real path" option

Use the new option "Do not normalize the selected path to the real path" to specify the use of Real (normalized) or Logical paths on the file list when using ISHELL. That is, as you navigate through directories using ISHELL, if this option is NOT selected (default), the displays expand the symbolic links in the pathnames. If you select this option, the displays show the pathnames as you enter them or select them in ISHELL.

You can select this option from the main ISHELL panel. Follow the "Options->Directory List" pull-down menu, and this option is at the very bottom, selected by default.

Here is an example to clarify what this new option does. In this example, we have:

/dir0

and it is a symbolic link to:

/dir1/dir2/dir3/dir4/dir5

In ISHELL, if you navigate to */dir0/dir6/dir7* with "Do not normalize the selected path to the real path" option NOT selected (default), your display shows the following (assuming */dir0/dir6/dir7* is empty):

```
EUID=2406   /dir1/dir2/dir3/dir4/dir5/dir6/dir7/
  Type  Perm  Filename
_ Dir    750  .
_ Dir    750  ..
```

On the other hand, if you navigate to */dir0/dir6/dir7* with "Do not normalize the selected path to the real path" option selected, your display shows the following (assuming */dir0/dir6/dir7* is empty):

```
EUID=2406   /dir0/dir6/dir7/
  Type  Filename
_ Dir   .
_ Dir   ..
```

The New "View and set attributes" Option

You can set this option to Y or /, when creating a new file or a directory. Setting that option Y or / takes you to a dialog box where you can set or change any modifiable attributes for the file you just created.

For example, to create a new file /u/user1/test, enter it at the main panel, as shown in Figure 46 on page 176:

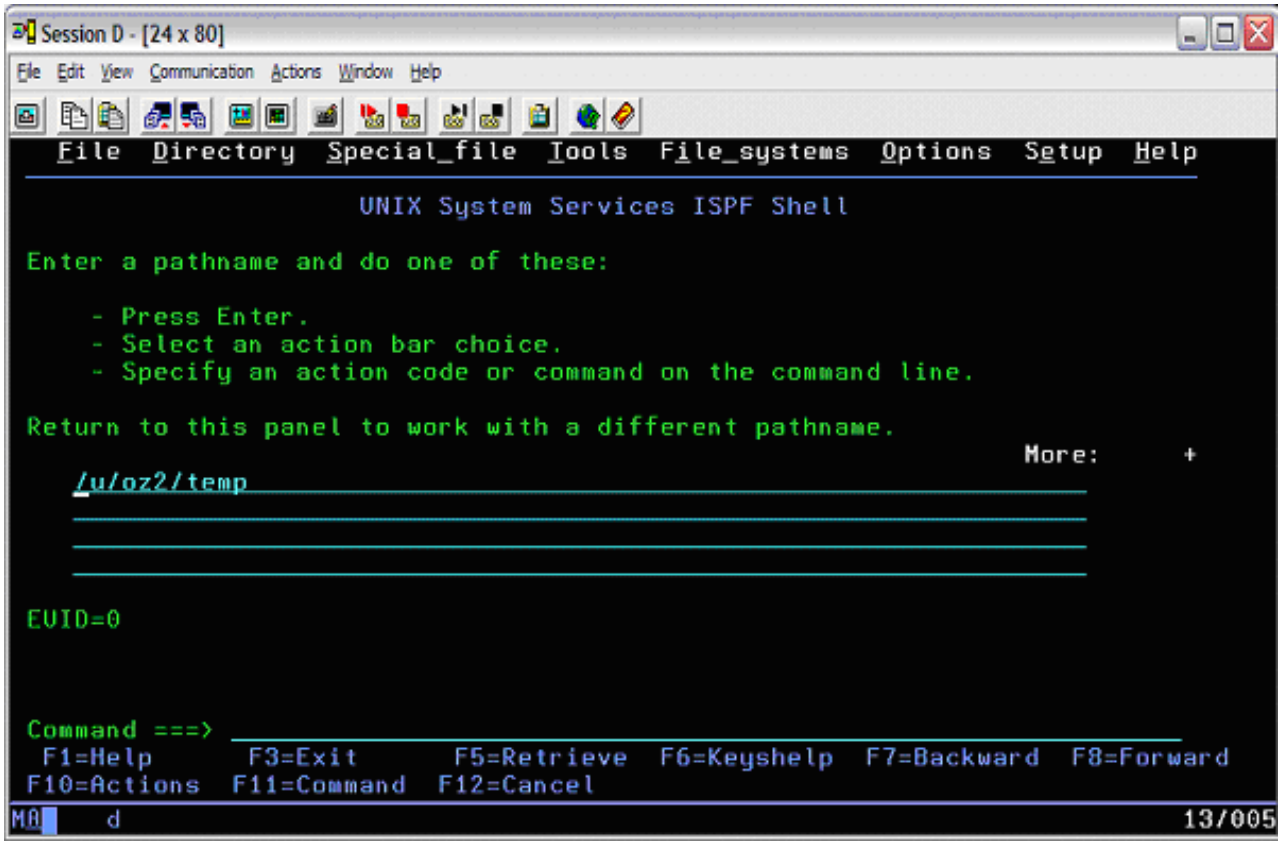


Figure 46. Entering /u/user1/test on the z/OS UNIX System Services main panel

The dialog box shown in Figure 47 on page 177 is displayed:

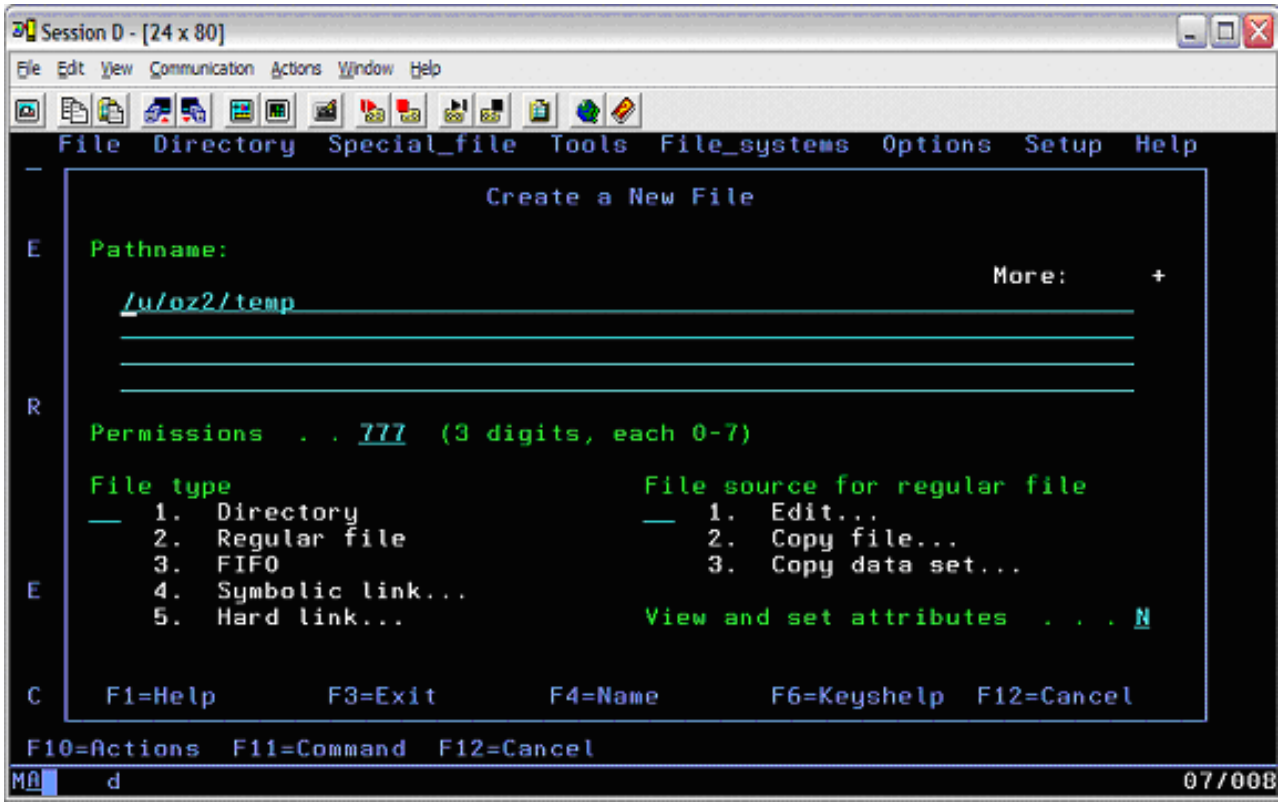


Figure 47. Dialog box for /u/user1/test

In the dialog box, the “View and set attributes” option is set to “N” by default. If you leave that option as is, pick a 2 as “File Type” and press Enter, you are presented with the panel shown in Figure 46 on page 176. On the other hand, if you set that option to “Y” or “/”, pick 2 as the “File Type” and press Enter, the Display File Attributes panel (Figure 48 on page 178) is displayed.

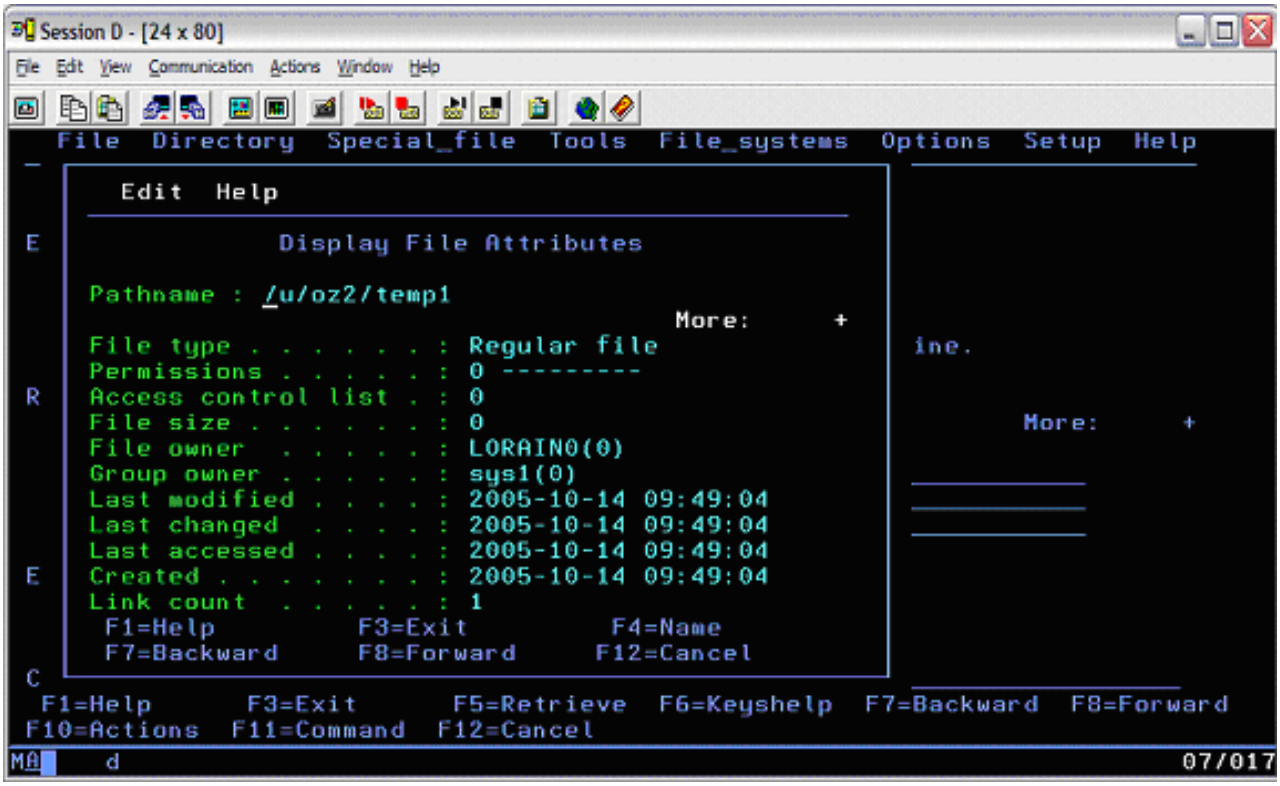


Figure 48. File attributes for /u/user1/test

In this panel we can navigate through all the modifiable options and change or set them for the file we just created.

The New REFRESH Command

When listing directories you can enter the new “refresh | refr” command to cause the display to be refreshed. You may visit the ISHELL Help panels for more details.

The New “GROUP LIST” Choice

A new choice, GROUP LIST, is added to the SETUP pull-down on the main panel. When selected it displays a list of all the groups and their GIDs in a table, as shown in Figure 49 on page 179.

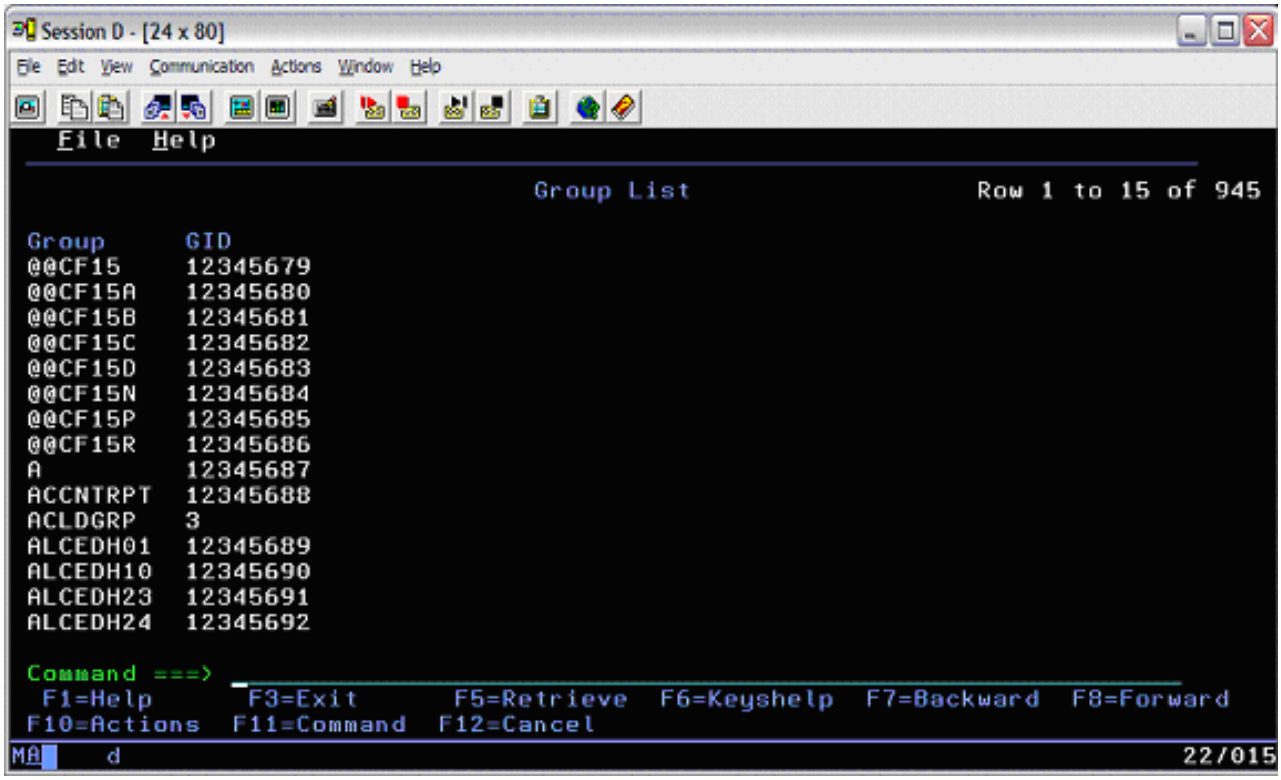


Figure 49. Groups and GIDs

By default the table is sorted by group name but you can sort it by GID. Follow the "File" pull-down and pick "Sort GID." Figure 50 on page 180 shows a Group List sorted by GID.

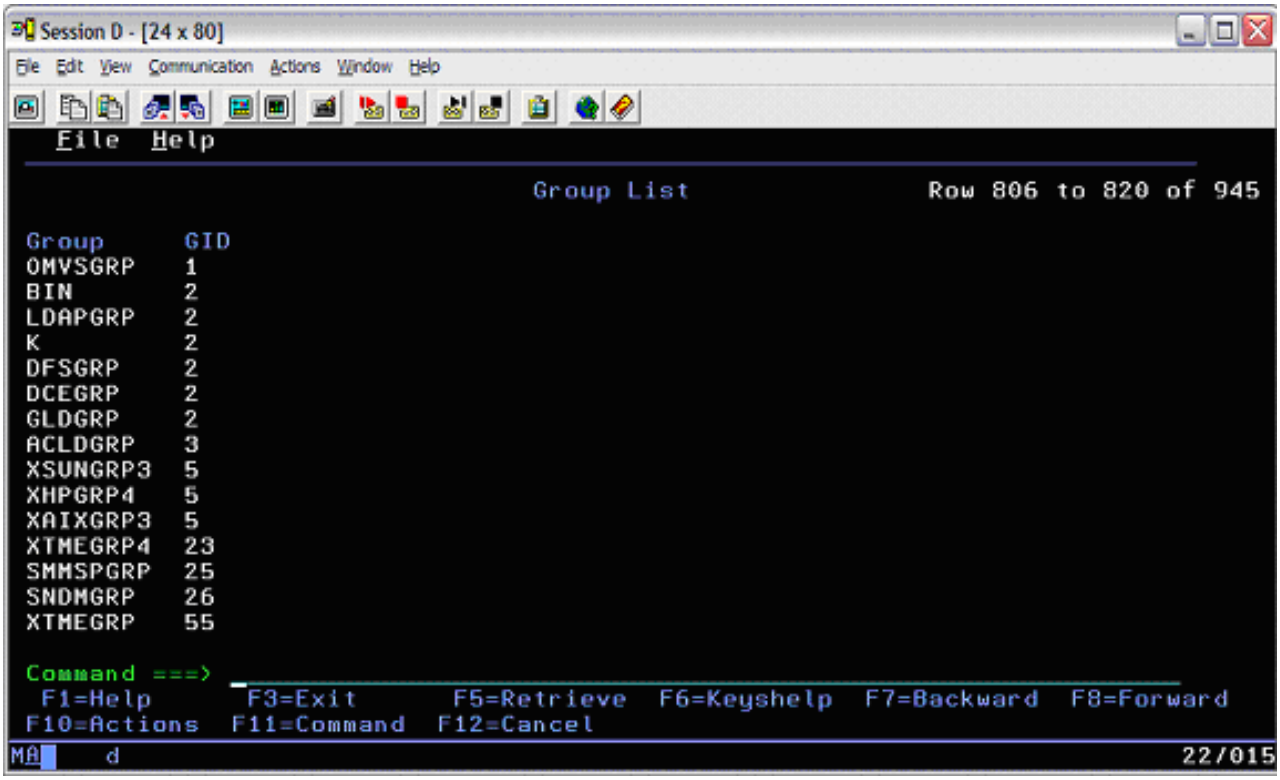


Figure 50. Sorting by GID

See the ISHELL Help panels for more details.

Keeping a List of Recently-Viewed Directories

Another ISHELL enhancement for z/OS V1R7 has the ability to keep a list of recently viewed directories, a history file.

Enabling the directory reference list can be done in either of two ways (if you try to view the reference list without first enabling it, you will receive an error message):

- From the command line, enter **REF ON**
- Using ISHELL menus: Select Options –> Advanced –> Select “Enable directory reference list”

Viewing the directory reference list can be done in either of two ways:

- From the command line, enter **REF**
- Using ISHELL menus: Select Tools –> Reference List (REF)

Disabling the directory reference list can be done in either of two ways:

- From the command line, enter **REF OFF**
- Using ISHELL menus: Select Options –> Advanced –> Deselect “Enable directory reference list”

Refreshing/Clearing the reference list:

- From the command line, enter **REF CLEAR**

Saving the reference list manually (Will be saved automatically when you leave ISHELL):

- From the command line, enter **REF SAVE**

The reference list file for user1 is saved as the following. You should not alter the contents of this file:

```
/u/user1/.ishell-reflist-USER1
```

See the ISHELL Help panels for more details.

Using the hierarchical file system (HFS)

We provided extensive coverage of our strategy for managing the z/OS UNIX hierarchical file system (HFS), including shared HFS, in our December 2001 edition. Refer to that edition for more information.

Automount enhancement for HFS to zSeries file system (zFS) migration

We tested a new automount enhancement that eases the migration from HFS to zFS file systems. Prior to the new function, you could not use a generic automount policy to automount both HFS and zFS file systems - all the file systems had to be the same type for a given automount managed mountpoint. The enhanced HFS to zFS automount migration function allows a single automount policy to mount both HFS and zFS file systems. This will help if you want to migrate your file systems over time rather than all at once, and so have a mixture of HFS and zFS file systems in your installation.

It works like this: the automount function has changed so that when you specify either HFS or ZFS as the file system type in an automount policy, the system re-checks the data set at mount time to determine what type of data set it really is, and then directs the mount to the appropriate file system type. However, to use this function, the naming conventions of the file systems for both HFS and zFS must be the same.

The example below shows a zFS policy that we implemented to mount both HFS and zFS file systems. This policy will mount both pre-existing HFS or zFS type filesystems, but only allocates new filesystems as zFS file systems. This is the recommended policy for easing the migration to zFS file systems.

```
name *
type ZFS
filesystem OMVSSPN.<uc_name>.FS
lowercase no
allocuser  space(3,2)   cyl    storclas(SMSOE)
mode rdwr
duration 30
delay 10
```

The next automount policy example will mount both pre-existing HFS or zFS file types as well, but will only allocate new file systems as HFS file systems:

```
name *
type HFS
filesystem OMVSSPN.<uc_name>.FS
lowercase no
mode rdwr
allocuser space(3,1) cyl storclas(SMSOE)
duration 30
delay 10
```

Using the zSeries file system (zFS)

We provided extensive coverage of our strategy for setting up and managing a z/OS DFS zSeries file system (zFS) in our December 2003 edition. Refer to that edition for more information.

zFS enhancements in z/OS V1R6

The following topics describe some of the new zFS functions in z/OS V1R6 which we implemented and tested.

- "zFS parmlib search"
- "zFS performance monitoring with zfsadm (query and reset counters)"
- "HANGBREAK, zFS modify console command" on page 185

zFS parmlib search

zFS implemented a new logical parmlib search capability. We tested the following options:

Using IOEPRM00: If an IOEZPRM DD statement for specifying zFS configuration parameters is not in the started proc, the zFS will look in SYS1.PARMLIB for the existence of an IOEPRM00 member. If that member is not found, then zFS uses default settings. We created member IOEPRM00 and populated it with the settings that we use in our sysplex:

```
user_cache_size=256m
debug_setting_dsn=sys1.&SYSNAME..zfs.debug(file1)
trace_dsn=sys1.&SYSNAME..zfs.trace
trace_table_size=128m
```

Specifying IOEPRMxx: Another option is to specify one or more IOEPRMxx members of parmlib to use. The members are identified in the zFS FILESYSTYPE statement of the BPXPRMxx parmlib member. The following example shows how to specify that we want to use members IOEPRM01 and IOEPRM02 for our zFS configuration settings.

```
FILEYSTYPE TYPE(ZFS) ENTRYPOINT(IOEFSCM) ASNAME(ZFS,'SUB=MSTR') PARM('PRM=(01,02)')
```

Using the SYSCLONE symbolic: Another option allows us to have a unique IOEPRMxx for each image by using the SYSCLONE symbolic. The following example illustrates how parmlib members would be selected if we were to start zFS on system Z0. Members IOEPRM97, IOEPRM98, IOEPRM99, and IOEPRMZ0 would be used. If a parmlib member is not found, the search for the configuration option will continue with the next parmlib member.

The maximum number of suffixes for IOEPRMxx that can be specified on the FILESYSTYPE statement is 32.

zFS performance monitoring with zfsadm (query and reset counters)

The **zfsadm query** command displays and resets zFS internal performance statistics counters and timers.

Format:

```
zfsadm query [-locking] [-reset] [-storage] [-usercache] [-iocounts]
             [-iobyaggregate] [-iobydasd] [-level] [-help]
```

Options:

-locking Specifies that the locking statistics report should be displayed.

-reset Specifies the report counters should be reset to zero. Should be specified with a report type.

-storage Specifies that the storage report should be displayed.

-usercache Specifies that the user cache report should be displayed.

-iocounts Specifies that the I/O count report should be displayed.

-iobyaggregate
Specifies that the I/O count by aggregate report should be displayed.

-iobydasd Specifies that the I/O count by Direct Access Storage Device (DASD) report should be displayed.

-level Prints the level of the zfsadm command. This is useful when you are diagnosing a problem. All other valid options specified with this option are ignored.

-help Prints the online help for this command. All other valid options specified with this option are ignored.

Note that the **-reset** option will reset the counters AFTER, not before, the display that is displayed when the option is used. For example, **zfsadm query -locking -reset** would display the locking statistics report, then reset the counters. Subsequent locking display will show statistics from counter reset.

Example: `zfsadm query -locking -reset`

Result:

```
Locking Statistics


Untimed sleeps:      13575   Timed Sleeps:          0   Wakeups:      13574

Total waits for locks:              22319606
Average lock wait time:             1.906 (msecs)

Total monitored sleeps:             13522
Average monitored sleep time:       5.692 (msecs)

               Top 15 Most Highly Contended Locks

  Thread     Async       Spin
   Wait      Disp.       Resol.    Pct.      Description
----------  -------   ----------  -----     -------------
 23683110       0      983063    99.583%    Log system map lock
        3   37549           6     0.151%    Volser I/O queue lock
    11852       0       20564     0.130%    Async global device lock
    10321       0         192     0.42%     Vnode-cache access lock
     2113       0        3705     0.23%     Transaction-cache complete list lock

     1134    1116        3425     0.22%     Transaction-cache main lock
     2446       0         187     0.10%     Anode bitmap allocation handle lock

     1405       0         269     0.6%      Anode fileset quota lock
     1437       0           4     0.5%      Async IO device lock
      202     425         531     0.4%      User file cache main segment lock
      829       0          81     0.3%      Anode fileset handle lock
      609       0          29     0.2%      Metadata-cache buffer lock
      352       0         169     0.2%      Anode file zero lock
      420       0          39     0.1%      Anode file notify lock
```

```
      280       0          21     0.1%      Transaction-cache active list lock
Total lock contention of all kinds:   24769331

               Top 5 Most Common Thread Sleeps

   Thread Wait             Pct.             Description
   -----------            -----            -----------
      13521              99.992%           Transaction allocation wait

          1                0.7%            OSI cache item cleanup wait

          0                0.0%            Directory Cache Buffer Wait

          0                0.0%            User file cache Page Wait

          0                0.0%            User file cache File Wait
```

Example: `zfsadm query -locking`

Result:

```
Locking Statistics
Untimed sleeps:         10   Timed Sleeps:          0   Wakeups:         10

Total waits for locks:              15898
Average lock wait time:             2.174 (msecs)

Total monitored sleeps:                10
Average monitored sleep time:       5.622 (msecs)

               Top 15 Most Highly Contended Locks

  Thread      Async    Spin
   Wait       Disp.    Resol.     Pct.    Description
----------   -------   -------   -----    --------------
     17009       0      679     99.718%  Log system map lock
         0      19        0      0.107%  Volser I/O queue lock
         7       0        7      0.78%   Async global device lock
         6       0        0      0.33%   Vnode-cache access lock
         6       0        0      0.33%   Anode bitmap allocation handle lock

         3       0        0      0.16%   Transaction-cache complete list lock
         1       0        0      0.5%    Vnode lock
         1       0        0      0.5%    Async IO device lock
         0       0        0      0.0%    Async IO set free list lock
         0       0        0      0.0%    Async IO event free list lock
         0       0        0      0.0%    LVM global lock
         0       0        0      0.0%    OSI Global process lock
         0       0        0      0.0%    Main volume syscall lock
         0       0        0      0.0%    User file cache all file lock
         0       0        0      0.0%    User file cache main segment lock

Total lock contention of all kinds:      17738

               Top 5 Most Common Thread Sleeps

Thread Wait     Pct.       Description
-----------   --------     -------------
       10      100.0%      Transaction allocation wait

        0        0.0%      OSI cache item cleanup wait

        0        0.0%      Directory Cache Buffer Wait

        0        0.0%      User file cache Page Wait

        0        0.0%     User file cache File Wait
```

Corresponding pfsctl Application Programming Interface (APIs) are also provided to retrieve these performance statistics.

- **Statistics iobyaggr Information** – The statistics iobyaggr information subcommand call contains information about the number of reads and writes and the number of bytes transferred for each aggregate.
- **Statistics iobydasd Information** – The statistics iobydasd information subcommand call contains information about the number of reads and writes and the number of bytes transferred for each DASD volume.
- **Statistics iocounts Information** – The statistics iocounts information subcommand call contains information about how often zFS performs I/O for various circumstances and how often it waits on that I/O.
- **Statistics Locking Information** – The statistics locking information subcommand call is a performance statistics operation that returns locking information.
- **Statistics Storage Information** – The statistics storage information subcommand call is a performance statistics operation that returns storage information.
- **Statistics User Cache Information** — The statistics user cache information subcommand call is a performance statistics operation that returns user cache information.

For more information on these APIs, see *z/OS Distributed File Service zSeries File System Administration*.

HANGBREAK, zFS modify console command

The following new modify console command for zFS attempts recovery for specific hang conditions: **modify procname,hangbreak**.

The **hangbreak** command causes zFS to post a failure to any requests in zFS that are waiting. This can allow the hang condition to be broken and resolved. This should only be used if you suspect that there is a hang involving zFS. The modify **zfs,query,threads** operator command is used to determine if one or more requestor threads remain in the same wait over several queries. If this command does not successfully break the hang, you need to stop or cancel zFS. If you suspect that zFS is in an infinite loop, you need to cancel zFS.

Example:

```
F ZFS,HANGBREAK
IOEZ00025I zFS kernel: MODIFY command - HANGBREAK completed successfully.
```

zFS: Migrating the Sysplex Root File System from HFS to zFS

We converted our Sysplex-Root file system from an HFS to a zFS. Note that the Sysplex-Root file system is the top-of-the-tree in the UNIX System Services file system hierarchy for sysplex. Therefore, to replace the Sysplex-ROOT file system, we had to unmount all file systems.

We took the following approach to convert our sysplex root from an HFS to a zFS:

1. Make a zFS copy of the sysplex root

   We had the following:

   ```
   HFS sysplex root: OMVSSPN.SYSPLEX.ROOT.FS size: 6 cylinders
   ```

   We created the following:

   ```
   zFS sysplex root: OMVSSPN.SYSPLEX.ROOT.ZFS size: 10 cylinders
   ```

   We created the zFS version of the sysplex root to be larger than the HFS sysplex root. The main reason is that zFS file systems are formatted differently

than HFS file systems and because we were running with ″dynamic grow″ defaulted to OFF to ensure that there was sufficient space for growth. We then mounted the zFS file system (RDWR) at /tempMountPoint.

Note: The sample ″SYS1.SAMPLIB(BPXISYZR)″ can be modified and used to perform the zFS file system creation. It also executes ″BPXISYS1″ which creates needed files. If you do not use this sample, you will have to evaluate if BPXISYS1 needs to be run.

We copied the HFS file system to the zFS file system using copytree:

```
/samples/copytree / /tempMountPoint
```

You should perform the copy when it is known that there is no activity against the file system, and it will not change, after the copy. Because we copied from a known, good sysplex-root file sytem that contains the required links and files, we did not have to run BPXISYS1.

Once copytree completed, we double checked to make sure the copy was successful and immediately unmounted the zFS from /tempMountPoint.

Note: There are other ways of copying an HFS to a zFS. This is the way we did it. Please reference ″Migrating from HFS to zSeries File Systems (zFS) in /OS V1R7" for some other ways. Also see the section, Migrating data from HFS to zFS, in z/OS Distributed File Service zFS Administration.

2. Edit the ROOT statement in the BPXPRMxx member with the new sysplex root name, and change the type to ZFS. We used member BPXPRM00 in SYS1.PARMLIB:

   ```
   ROOT FILESYSTEM('OMVSSPN.SYSPLEX.ROOT.FS') TYPE(HFS)
     MODE(RDWR)
   ```

   with

   ```
   ROOT FILESYSTEM('OMVSSPN.SYSPLEX.ROOT.ZFS') TYPE(ZFS)
     MODE(RDWR)
   ```

   Note: The HFS and zFS file system types in mount statements and command operands are now generic file system types that can mean either HFS or zFS.

3. Bring down all systems in the sysplex but one. You can do this before the copy, also.
4. Unmount all the file systems, after taking down all subsystems and such that were using file systems.

   We ran the **f bpxoinit,filesys=unmountall** modify command to unmount all file systems.

   We ran the **d omvs,f** display command. It should display something similar to this:

   ```
   RESPONSE=SYS1
    BPXO045I 17.44.31 DISPLAY OMVS 592
    OMVS     0010 ACTIVE          OMVS=(00,SYS1)
    TYPENAME   DEVICE ----------STATUS----------- MODE  MOUNTED    LATCHES
    BPXFTCLN 73741826 ACTIVE                          RDWR  07/21/2005      L=11
      NAME=SYSROOT                                  17.43.20    Q=0
      PATH=/
      OWNER= AUTOMOVE=Y CLIENT=N
   ```

5. Mount the file systems specified in the BPXPRMxx member (this includes the ROOT file system). We used member BPXPRM00 in SYS1.PARMLIB for ROOT identification.

   ```
   SET OMVS=(00)
   BPXO032I THE SET OMVS COMMAND WAS SUCCESSFUL.
   ```

6. Test the system. We did the following:
   - Started an OMVS session and did such tasks as creating files and navigating the session
   - Checked the system log for error messages
   - Ran **d omvs,f** to see if all mounts specified in BPXPRMxx were mounted successfully.
7. Once you have confirmed that all looks good, IPL the rest of the systems in the sysplex, checking each system as it enters the sysplex.

zFS: Improved Mount Performance (Fast-Mount)

Starting in z/OS V1R7, zFS has improved the performance of mounting zFS type file systems. This required a change in the structure and on-disk format of the zFS aggregate. The new structure is referred to as version 1.4. The prior structure was referred to as version 1.3.

New zFS aggregates created in z/OS V1R7 are in version 1.4 format. Existing aggregates are converted to the version 1.4 format automatically (from the version 1.3 format) upon the first read-write (R/W) mount in z/OS V1R7. Since this occurs in addition to the normal mount processing, the first R/W mount of existing aggregates takes as long as they did with previous formats. Subsequent mounts benefit from the new format and mount more quickly.

During the conversion, you may get messages similar to the following:

```
IOEZ00500I Converting aggr_name for fast mount processing
IOEZ00518I Converting filesystem filesystem_name to allow for fast mount
```

Migration/Coexistence Notes

Toleration APAR OA11573 must be installed on prior releases before IPLing z/OS V1R7. Prior releases will then be able to correctly access zFS aggregates with the new version 1.4 structure. Conversion will not take place on prior releases.

If you choose to have zFS aggregates in the version 1.3 format in a mixed z/OS level sysplex, you should mount the version 1.3 aggregates NOAUTOMOVE. Or, you could choose to AUTOMOVE(EXCLUDE) all z/OS V1R7 systems. This prevents movement to a z/OS V1R7 system, where the aggregate is automatically converted to a version 1.4 aggregate upon first R/W mount.

In cases where a version 1.4 aggregate needs to be used on a system that does not have the toleration APAR OA11573 applied, the aggregate must be converted back to version 1.3.

The zFS IOEAGSLV (salvager) utility for z/OS V1R7 has been modified to accept a new option (-converttov3) that can be used to convert a version 1.4 zFS aggregate back to a version 1.3 zFS aggregate. The new syntax is the following:

```
ioeagslv -aggregate name [-recoveronly]
[{-converttov3 | -verifyonly | -salvageonly}] [-verbose] [-level] [-help]
```

The following is a sample job:

```
//USERIDA  JOB ,'Salvage',
// CLASS=A,MSGCLASS=X,MSGLEVEL=(1,1)
//STEPLIB  DD DSN=hlq.MIGLIB,DISP=OLD
//SALVAGE  EXEC PGM=IOEAGSLV,REGION=0M,
// PARM=('-aggregate aggr.name -converttov3')
//SYSPRINT DD SYSOUT=H
//STDOUT   DD SYSOUT=H
```

```
//STDERR   DD SYSOUT=H
//SYSUDUMP DD SYSOUT=H
//CEEDUMP  DD SYSOUT=H
//*
```

Notes:

1. When -convertov3 is specified, the aggregate is recovered (that is, the log is replayed) whether or not -recoveronly is specified.
2. If a conversion is interrupted, it must be run again.

zFS: Migrating from HFS to zFS in z/OS V1R7

This section provides notes on using the BPXWH2Z tool and the z/OS V1R7 level of the pax command.

Using the BPXWH2Z Tool

BPXWH2Z is an ISPF based tool that migrates HFS file systems to zFS file systems. It lets you alter space allocation, placement, SMS classes and data set names. You can invoke the BPXWH2Z tool from the ISPF COMMAND panel.

In summary, you can do the following:

- Migrate HFS file systems (both mounted and unmounted) to zFS file systems. If the HFS being migrated is mounted, the tool automatically unmounts it and then mounts the new zFS file system on its current mount point.
- Define zFS aggregates by default to be approximately the same size as the HFS. The new allocation size can also be increased or decreased.
- Have the migration run in TSO foreground or UNIX background.

See the ″Migrate from HFS file systems to zFS file systems″ section in *z/OS Migration* for more information.

Using the z/OS V1R7 Level of the pax Command

The z/OS V1R7 version of the **pax** command can also be used for migrating a file system from HFS to zFS, as follows:

- Manually create a zFS
- Mount the zFS and the HFS
- Use **pax** to copy the HFS to a zFS.

Example: If you want to copy the HFS to a zFS and you have OMVSSPN.MYHFS.HFS and OMVSSPN.MYZFS.ZFS, you can mount them both at /HFSmountPoint and /ZFSmountPoint, respectively. Then you can run **pax** to copy the HFS into the zFS, as follows:

```
pax -rw -X -E /HFSmountPoint /ZFSmountPoint
```

See *z/OS UNIX System Services Command Reference*, SA22-7802 to learn more about the pax command and its options.

zFS: Unquiesce Console Modify Command

In cases where a zFS aggregate must be quiesced (for example, during backup), it may happen that the job that quiesced the aggregate may fail. If this occurs, the aggregate is unavailable to any application, since it remains quiesced. z/OS V1R7 provides an operator command to allow the operator to unquiesce the aggregate, thus allowing applications to access the aggregate.

The modify zFS unquiesce command must be issued from the owning system of the filesystem.

Format:

```
MODIFY ZFS,UNQUIESCE,aggregate_name
```

Note: The **zfsadm unquiesce** command (**zfsadm unquiesce -aggrname** *name*) can be used from any system in the shared filesystem sysplex.

The following is an example of the use of the unquiesce console command:

From the ″D OMVS,F″ console display, or the ″zfsadm lsaggr″ command, we see that this filesystem is owned by Z0. Note that the indication of the zFS filesystem quiesce is from the zfsadm commands.

```
D OMVS,F
...
ZFS            17 ACTIVE                      RDWR  10/12/2005  L=24
  NAME=OMVSSPN.PET3.ZFS.FS                          20.33.29    Q=938
  PATH=/pet3
  AGGREGATE NAME=OMVSSPN.PET3.ZFS.FS
  OWNER=Z0       AUTOMOVE=Y CLIENT=Y
...

zfsadm lsaggr
...
OMVSSPN.PET3.ZFS.FS                              Z0        R/W QUIESCE
...

zfsadm aggrinfo -aggregate omvsspn.pet3.zfs.fs
MVSSPN.PET3.ZFS.FS (R/W COMP QUIESCED): 561 K free out of total 720
```

From system TPN, which is not the owning system, if we issue the following, we get Return code 129 and Reason code EF176775. This indicated that the unquiesce console command has to be entered from the owning system.

```
MODIFY ZFS,UNQUIESCE,OMVSSPN.PET3.ZFS.FS

IOEZ00425E UNQUIESCE FAILURE: rc = 129 rsn = EF176775
IOEZ00024E zFS kernel: MODIFY command - UNQUIESCE,OMVSSPN.PET3.ZFS.FS failed.
```

From Z0, which is the owning system, the unquiesce is successful.

```
R0,Z0,MODIFY ZFS,UNQUIESCE,OMVSSPN.PET3.ZFS.FS

IOEZ00025I zFS kernel: MODIFY command - UNQUIESCE,OMVSSPN.PET3.ZFS.FS completed successfully.
```

Issuing the su command and changing TSO identity

The following scenario describes a problem we encountered when issuing the `su` command from a z/OS UNIX System Services session, started from TSO, which did not change the TSO identity.

- We logged into TSO as a NON-superuser.
- We started an OMVS session.
- We wanted to edit a file with `oedit` that was owned by a superuser.
- We used the `su` command to switch the user identity to a superuser.
- We were not able to save the file after editing it.

After further investigation we found that if you use the OMVS interface when running a shell created by `su`, any attempt to run a TSO command results in the

command running in your TSO address space. The command runs under your TSO identity, not the identity specified by `su`, unless the TSO command changes the effective UNIX identity.

`oedit` passes the effective UID of its process to the TSO session. If the EUID does not match the EUID of the TSO process, the `oedit` TSO command will attempt to set the effective UID of the TSO process to that of the shell command prior to loading the file.

One way to use `oedit` as a superuser using the `su` command is by making sure that the non-superuser id you are using is permitted to the `BPX.SUPERUSER` RACF facility class.

Being permitted to this facility class will not make that user a superuser but it will give that id the required permissions to become one. This can be used as a temporary solution to this problem, when one is required.

For more information, please see the z/OS Unix System Services documentation and DOC APAR OA10650.

Removing additional diagnostic data collection from OMVS CTRACE LOCK processing

We noticed increased CPU utilization and performance degradation running z/OS V1R6 with OMVS CTRACE options set at ALL or any set of options that include LOCK. This was caused by calls to query latch ownership activity when a dubbed z/OS UNIX System Services task terminates to collect additional diagnostic information. This utilization was especially noticeable when running with OMVS Heavy-weight threads, which are prevalent, for example, in Java workloads.

Due to the effect this has on the system when using the LOCK CTRACE option, the additional diagnostic data collection calls were removed from z/OS V1R6 by APAR OA10735 (PTF UA16780).

Additional collection of diagnostic latch information may be considered in future releases by other means.

Chapter 13. Using the IBM HTTP Server

This chapter describes our experiences with IBM HTTP Server V5.3.

For the most current debugging and tuning hints and tips for all supported releases of IBM HTTP Server and IBM WebSphere Application Server, see the *WebSphere Troubleshooter* (www.ibm.com/software/webservers/appserv/troubleshooter.html).

Using gskkyman support for storing a PKCS #7 file with a chain of certificates

In z/OS V1R6, the System SSL component changed the processing of the gskkyman utility to generate and manage certificates. We tested the new enhancements, which are covered in *z/OS Cryptographic Service System Secure Sockets Layer Programming*. In this section, we'll describe one small issue we encountered in using the new gskkyman support for storing certificates and their chains in a PKCS #7 file.

To test the gskkyman support for storing certificates and their chains in a PKCS #7 file, we created a certificate authority file containing the entire chain, and exported it to a PKCS #7 file with extension .p7b. So far, so good, but when we downloaded the file to our browser, we received the following message:

```
This is an invalid Security Certificate file
```

It turned out that we needed to update our HTTP server configuration file before we could download the file. We added the following AddType line:

```
AddType  .p7b      application/x-x509-ca-ra-cert-chain    ebcdic  1.0
```

After adding this directive, we restarted the HTTP Server and exported the Certificate Authority to a PKCS #7 file with an extension of .p7b. Then, we were able to download the .p7b file to our browser.

Chapter 14. Using LDAP Server

LDAP Server is a component of z/OS Security Server which uses the Lightweight Directory Access Protocol (LDAP) standard, an open industry protocol for accessing information in a directory.

This chapter contains the following sections:

Overview of our LDAP configuration

We have a multiplatform LDAP configuration and we use both replication and referral. Figure 51 shows a high-level view of our LDAP multiplatform configuration:

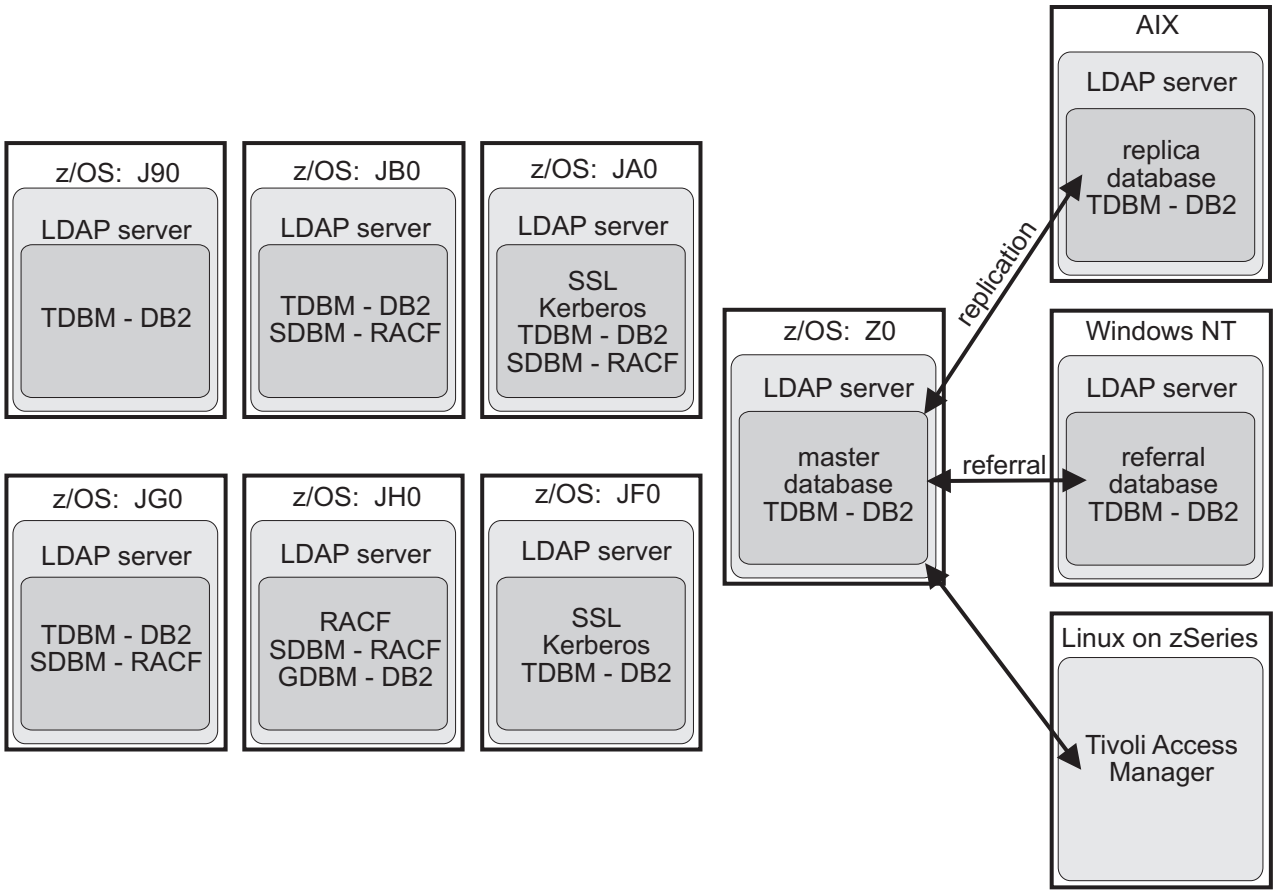


Figure 51. Overview of our LDAP configuration

Our LDAP environment includes the following features:

- **Master LDAP server:** Our master server on z/OS system Z0 has a DB2 backend database, TDBM.

- **Secure LDAP servers:** We have two LDAP servers in our sysplex (on systems JA0 and JF0) that are set up for SSL secure transactions and Kerberos authentication. The servers have a TDBM backend and listen on port 636.
- **LDAP server for our RACF backend:** We have an LDAP server with an SDBM backend that connects to the RACF directory for our sysplex.
- **LDAP referral from Windows NT to z/OS:** We manage an LDAP server on Windows NT using a Web-based management tool at:

  `http://NT_server_IP_address/ldap/index.html`

  This LDAP server has a TDBM backend and has a general referral in its configuration file that points to our master LDAP server on z/OS. This allows a user to issue an **ldapsearch** command from the Windows NT LDAP server for an entry that is not found in that directory but that might be found in the directory on the master server on z/OS. The **ldapsearch** command returns all matching entries from both directories.
- **LDAP referral from z/OS to Windows NT:** We maintain an LDAP server referral database on Windows NT using the Directory Management Tool for Windows. This server is set up to have referral processing enabled between the master LDAP server on z/OS and the LDAP server on Windows NT.
- **LDAP replica server on AIX:** We manage an LDAP replica server on AIX using a Web-based management tool at:

  `http://AIX_server_IP_address/ldap/index.html`

  This LDAP server has a TDBM backend and was configured through the Web-based management tool to be a replica of the master LDAP server on z/OS.
- **Tivoli Access Manager running on Linux on zSeries:** We set up Tivoli Access Manager on a SUSE Linux image running on zSeries to enable cross-platform testing between Linux and z/OS. Tivoli Access Manager uses the z/OS LDAP Server as a backend to store user ID information that is used to authorize access for users of Tivoli Access Manager. We perform our testing by running shell scripts on Linux that create a workload to stress the master LDAP server on z/OS.

Setting up the LDAP server for RACF change logging

During our z/OS V1R5 testing, we set up and configured support for change logging in LDAP Server. This new function is delivered in Security Server LDAP APAR OA03857 and applies to z/OS V1R3 and higher.

Change logging provides the following functions:

- Provides a log of changes made to user profiles in RACF, including password changes
- Allows a client to search the log of changes
- Allows retrieval of an enveloped version of a RACF password

Log entries are stored in a new type of backend called GDBM.

Change logging also requires that the SDBM backend be configured, that LDAP Program Callable (PC) support be enabled. Support for the exploitation of this new function by RACF is provided by RACF APAR OA03853 and SAF APAR OA03854. For details and a link to the updated documentation on the Web, see LDAP APAR OA03857.

This section describes our experiences setting up and configuring change logging in our environment.

Activating change notification in RACF

We did the following to enable RACF to provide notification of changes for logging in the LDAP change log:

1. Define the RACFEVNT class profile named NOTIFY.LDAP.USER:

   ```
   RDEFINE RACFEVNT NOTIFY.LDAP.USER
   ```

   A generic profile can also be used.

2. Activated the RACFEVNT class:

   ```
   SETROPTS CLASSACT(RACFEVNT)
   ```

For more information, see the documentation in RACF APAR OA03853.

Setting up the GDBM backend for the LDAP server

Note: You cannot use the LDAP configuration utility, ldapcnf, to configure the GDBM backend. For more information, see the documentation in LDAP APAR OA03857.

At a minimum, the GDBM backend section of the LDAP configuration file requires the following:

```
database GDBM GLDBGDBM [name]
dbuserid dbowner
servername string
```

Other options are also available to specify such things as the maximum age of a change log entry, the maximum number of entries that the change log can contain, and whether change logging is on or off (default is on).

Also, Program Callable (PC) support must be enabled in the global section of the configuration file, as follows:

```
listen ldap://:pc
```

We already had PC support enabled in our configuration file.

We did the following to set up the GDBM backend:

1. Loaded the change log schema into the LDAP server from the ChangeLog.ldif file:

   ```
   ldapmodify -h ip_addr -D "cn=LDAPxxxxx" -w pw -f /path/etc/ldap/ChangeLog.ldif
   ```

2. Added the following GDBM configuration options to the slapd.conf configuration file. (Although SDBM was already set up on this server, we have included those options here as well).

   ```
   #  GDBM-specific CONFIGURATION SETTINGS
   # ---------------------------------------------------------------------
   # ---------------------------------------------------------------------
   database gdbm GLDBGDBM
   servername USIBMT6PETDB2
   dbuserid GLDSRV
   ```

```
dsnaoini GLD.CNFOUT.JB0(DSNAOINI)
attroverflowsize 500
#########################################################################
# sdbm database definitions
#########################################################################
database sdbm GLDBSDBM
suffix "sysplex=UTCPLXJ8,o=IBM,c=US"
```

3. Started the LDAP server:

   START LDAP*xx*

   Result: We viewed the SLAPDOUT output to verify that the server startup was successful and that change logging was enabled. SLAPDOUT contained the following:

```
******************************** TOP OF DATA *********************************
GLD0022I z/OS Version 1 Release 4 Security Server LDAP Server
 Starting slapd.
GLD0010I Reading configuration file /etc/ldap/slapd.conf.
GLD3135I Grant/Deny ACL support is enabled below suffixes: "CN=CHANGELOG".
GLD0244I Change logging is enabled
         Logging started status (0 = off, 1 = on): 1
         Limit in seconds on age of change log entries (0 = no limit): 0
         Limit on the number of change log entries (0 = no limit): 0
         Current number of change log entries: 0
         First change number in use: 0
         Last change number in use: 0
GLD0163I Backend capability listing follows:
GLD0166I Backend type: sdbm, Backend ID: SDBM BACKEND
GLD0207I SDBM BACKEND manages the following suffixes:
GLD0208I Backend suffix: SYSPLEX=UTCPLXJ8
GLD0209I End of suffixes managed by SDBM BACKEND.
GLD0165I Capability: LDAP_Backend_ID     Value: SDBM BACKEND
GLD0165I Capability: LDAP_Backend_BldDateTime     Value: 2003-10-21-17.46.55.000
GLD0165I Capability: LDAP_Backend_APARLevel     Value: OA03857
GLD0165I Capability: LDAP_Backend_Release     Value: R 4.0
GLD0165I Capability: LDAP_Backend_Version     Value: V 1.0
GLD0165I Capability: LDAP_Backend_Dialect     Value: DIALECT 1.0
GLD0165I Capability: LDAP_Backend_BerDecoding     Value: STRING
GLD0165I Capability: LDAP_Backend_ExtGroupSearch     Value: YES
GLD0165I Capability: LDAP_Backend_krbIdentityMap     Value: YES
GLD0165I Capability: supportedControl     Value: 2.16.840.1.113730.3.4.2
GLD0165I Capability: supportedControl     Value: 1.3.18.0.2.10.2
GLD0167I End of capability listing for Backend type: sdbm, Backend ID: SDBM BACKEND
GLD0166I Backend type: gdbm, Backend ID: GDBM BACKEND
GLD0207I GDBM BACKEND manages the following suffixes:
GLD0208I Backend suffix: CN=CHANGELOG
GLD0209I End of suffixes managed by GDBM BACKEND.
GLD0165I Capability: LDAP_Backend_ID     Value: GDBM BACKEND
GLD0165I Capability: LDAP_Backend_BldDateTime     Value: 2003-10-21-17.47.40.000000
GLD0165I Capability: LDAP_Backend_APARLevel     Value: OA03857
GLD0165I Capability: LDAP_Backend_Release     Value: R 4.0
GLD0165I Capability: LDAP_Backend_Version     Value: V 1.0
GLD0165I Capability: LDAP_Backend_Dialect     Value: DIALECT 1.0
GLD0165I Capability: LDAP_Backend_BerDecoding     Value: BINARY
GLD0165I Capability: LDAP_Backend_ExtGroupSearch     Value: NO
GLD0165I Capability: LDAP_Backend_krbIdentityMap     Value: NO
GLD0165I Capability: supportedControl     Value: 2.16.840.1.113730.3.4.2
GLD0167I End of capability listing for Backend type: gdbm, Backend ID: GDBM BACKEND
GLD0164I Backend capability listing ended.
GLD0002I Configuration file successfully read.
GLD0189I Nonsecure communication is active for IP: INADDR_ANY, nonsecure port: 389
GLD0202I Program Call communication is active.
GLD0122I Slapd is ready for requests.
******************************** BOTTOM OF DATA ********************************
```

The LDAP server GDBM backend was successfully set up and enabled for change logging.

Testing the change logging function and the GDBM database

With change logging active, we made several changes to a RACF user ID and then tested functions to search the GDBM database, set the maximum number of change log entries, search the GDBM database anonymously, and delete change log entries.

Searching the GDBM database

Before adding any change log entries, we issued the following command to verify that the GDBM database could properly be searched:

```
ldapsearch -h ip_addr -D "racfid=XXXXX,profiletype=user,sysplex=UTCPLXJ8,o=IBM,c=US"
     -w pw -b "cn=changelog" "objectclass=*"
```

Result: The search displayed the following output:

```
cn=changelog
objectclass=top
objectclass=container
cn=changelog
```

Since there were no change log entries in the database yet, the search returned only the base entry of the database, as expected.

Testing the maximum number of change log entries

We did the following to test the option to limit the maximum number of change log entries:

1. Added the changeLogMaxEntries option to the slapd.conf file and specified a value of 1000, as shown:

   ```
   #  GDBM-specific CONFIGURATION SETTINGS
   # ---------------------------------------------------------------------
   # ---------------------------------------------------------------------
   database gdbm GLDBGDBM
   servername USIBMT6PETDB2
   dbuserid GLDSRV
   dsnaoini GLD.CNFOUT.JB0(DSNAOINI)
   changeLogging on
   changeLogMaxEntries 1000
   changeLogMaxAge 86400
   attroverflowsize 500
   ```

2. Made eight changes to a RACF user ID, USER01, which creates eight change log entries (a total of nine, including the cn=changelog root entry) in the GDBM backend.

3. Searched the database to verify that the change log entries were present:

   ```
   ldapsearch -h ip_addr -D "racfid=XXXXX,profiletype=user,sysplex=UTCPLXJ8,o=IBM,c=US"
        -w pw -b "cn=changelog" "objectclass=*"
   ```

   Result: The search displayed the following output:

   ```
   cn=changelog
   objectclass=top
   objectclass=container
   cn=changelog

   CHANGENUMBER=401,CN=CHANGELOG
   objectclass=CHANGELOGENTRY
   ```

```
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=401
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144917.638873Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=402,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=402
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144921.623237Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=403,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=403
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144925.306248Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=404,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=404
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144929.050827Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=405,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=405
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144933.085019Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=406,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
```

```
changenumber=406
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144938.965894Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=407,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=407
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144942.378976Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=408,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=408
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144945.559614Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US
```

---

4. Changed the value of the changeLogMaxEntries option in the slapd.conf file from 1000 to 5, as shown:

```
#  GDBM-specific CONFIGURATION SETTINGS
# ---------------------------------------------------------------------
# ---------------------------------------------------------------------
database gdbm GLDBGDBM
servername USIBMT6PETDB2
dbuserid GLDSRV
dsnaoini GLD.CNFOUT.JB0(DSNAOINI)
changeLogging on
changeLogMaxEntries 5
changeLogMaxAge 86400
attroverflowsize 500
```

---

5. Recycled the LDAP server.

---

6. Issued the LDAP search again:

```
ldapsearch -h ip_addr -D "racfid=XXXXX,profiletype=user,sysplex=UTCPLXJ8,o=IBM,c=US"
     -w pw -b "cn=changelog" "objectclass=*"
```

Result: The search displayed the following output:

```
cn=changelog
objectclass=top
objectclass=container
cn=changelog

CHANGENUMBER=405,CN=CHANGELOG
```

```
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=405
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144933.085019Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=406,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=406
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144938.965894Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=407,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=407
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144942.378976Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=408,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=408
targetdn=RACFID=USER01,PROFILETYPE=USER,SYSPLEX=
UTCPLXJ8,O=IBM,C=US
changetime=20040127144945.559614Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETY
PE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US
```

Note that change log entries 401 through 404 have been deleted. There were now a total of five entries (including the cn=changelog root entry) in the database, as specified by the changeLogMaxEntries value.

The option to limit the maximum number of change log entries worked successfully.

Searching the GDBM database anonymously

We did the following to enable and test the ability to anonymously search the GDBM backend:

1. Performed an anonymous search to make sure this feature was not already enabled:

   ```
   ldapsearch -h ip_addr -b "cn=changelog" "objectclass=*"
   ```

Result: The search displayed no output and simply returned to the command line.

---

2. Performed an administrative search to make sure the database could properly be searched:

```
ldapsearch -h ip_addr -D "racfid=XXXXX,profiletype=user,sysplex=UTCPLXJ8,o=IBM,c=US"
     -w pw -b "cn=changelog" "objectclass=*"
```

Result: The search displayed the following output:

```
cn=changelog
objectclass=top
objectclass=container
cn=changelog

CHANGENUMBER=501,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=501
targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
changetime=20040203154225.041549Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=502,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=502
targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
changetime=20040203154229.595015Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=503,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=503
targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
changetime=20040203154237.589303Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=504,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=504
targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
changetime=20040203154242.123712Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US
```

---

3. Created a file, cl.ldif, with the following contents to modify the ACL to allow anonymous searches:

```
1  dn: cn=changelog
2  changetype: modify
3  replace: aclentry
4  aclentry:cn=Anybody:normal:rsc:sensitive:rsc:critical:rsc:system:rsc
```

---

4. Loaded the new information from the cl.ldif file into the database:

   ```
   ldapmodify -h ip_addr -D "racfid=XXXXX,profiletype=user,sysplex=UTCPLXJ8,o=IBM,c=US"
        -w pw -f cl.ldif
   ```

   Result: The changes were successfully loaded.

---

5. Performed an anonymous search again:

   ```
   ldapsearch -h ip_addr -b "cn=changelog" "objectclass=*"
   ```

   Result: This time, the search displayed the database contents:

```
cn=changelog
objectclass=top
objectclass=container
cn=changelog

CHANGENUMBER=501,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=501
targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
changetime=20040203154225.041549Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=502,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=502
targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
changetime=20040203154229.595015Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=503,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=503
targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
changetime=20040203154237.589303Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US

CHANGENUMBER=504,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=504
targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
changetime=20040203154242.123712Z
changetype=MODIFY
ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
=US
```

Anonymous searches of the database worked successfully.

Deleting change log entries

We did the following to test the ability to delete unwanted change log entries from the database:

1. Performed a search for a specific change log entry:

   ```
   ldapsearch -h ip_addr -b "changenumber=604, cn=changelog" "objectclass=*"
   ```

   Result: The search displayed the following:

   ```
   CHANGENUMBER=604,CN=CHANGELOG
   objectclass=CHANGELOGENTRY
   objectclass=IBM-CHANGELOG
   objectclass=TOP
   changenumber=604
   targetdn=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C=US
   changetime=20040209151933.319305Z
   changetype=MODIFY
   ibm-changeinitiatorsname=RACFID=XXXXX,PROFILETYPE=USER,SYSPLEX=UTCPLXJ8,O=IBM,C
   =US
   ```

---

2. Issued the following command to delete the specific change log entry:

   ```
   ldapdelete -h ip_addr -D "racfid=XXXXX,profiletype=user,sysplex=UTCPLXJ8,o=IBM,c=US"
        -w pw "changenumber=604, cn=changelog"
   ```

   Result: The command completed successfully.

---

3. Searched again for the specific change log entry to verify that it was gone:

   ```
   ldapsearch -h ip_addr -b "changenumber=604, cn=changelog" "objectclass=*"
   ```

   Result: The search displayed the following:

   ```
   ldap_search: No such object
   ldap_search: matched: cn=changelog
   ldap_search: additional info: R004026 Entry changenumber=604, cn=changelog not
   found in the database. (tdbm_search.c|1.74.3.2|841)
   ```

The change log entry was successfully deleted from the database.

Using the z/OS LDAP client with the Windows 2000 Active Directory service

We had a request from our colleagues in z/OS LDAP development to test the z/OS LDAP client with the Microsoft Windows 2000 Active Directory service using a Kerberos authentication bind. This was to help validate a fix they were working on involving the use of Kerberos authentication to bind to IBM Directory Server. In order to do this, we first wanted to ensure that we could perform a search using a simple LDAP bind between the z/OS LDAP client and Active Directory.

We did not need to do anything special to set up or enable this process. We already had access to a Windows 2000 server that had Active Directory enabled and had data loaded. The hardest part was determining the format of the Active Directory distinguished name. Fortunately, we were able to get some advice from a colleague who has some experience with Active Directory. We were eventually able to successfully perform a search from z/OS against the Active Directory, as shown in the following example:

Example: We issued the following **ldapsearch** command (as a single line) from the z/OS UNIX shell command line against the Windows 2000 Active Directory:

```
ldapsearch -h win2k_ip_addr
   -D "CN=Sue Marcotte,CN=Users,DC=kerberos,DC=xxx,DC=yyy,DC=ibm,DC=com" -w password
   -b "CN=Sue Marcotte,CN=Users,DC=kerberos,DC=xxx,DC=yyy,DC=ibm,DC=com" "objectclass=*" name
```

Result: As expected, we received the following response:

```
CN=Sue Marcotte,CN=Users,DC=kerberos,DC=xxx,DC=yyy,DC=ibm,DC=com
name=Sue Marcotte
```

Using LDAP with Kerberos authentication

We have implemented a new LDAP workload that exploits binding with Kerberos authentication. (Our December 2002 edition describes how we enabled the z/OS LDAP Server for Kerberos authentication.) This workload has uncovered a couple of problems that we would like to note.

We used the following documentation to help us investigate and diagnose these problems:

- *z/OS Integrated Security Services LDAP Client Programming*, SC24-5924
- *z/OS Integrated Security Services LDAP Server Administration and Use*, SC24-5923
- *z/OS Integrated Security Services Network Authentication Service Administration*, SC24-5926

Problems we experienced with our workload

The following are the problems that we experienced with our LDAP workload using Kerberos authentication:

Abend 0C6 in LDAP Server

We experienced an abend 0C6 in LDAP Server under the following conditions:

- LDAP Server successfully started but failed to configure a TDBM backend. (There is an SDBM backend.)
- An **ldapsearch** command to the TDBM backend is issued to the server using a Kerberos authentication bind.

This caused LDAP Server to generate a CEEDUMP and fail with an abend 0C6. Below is a portion of the traceback that helped to identify the error.

```
Traceback:
  DSA Addr  Program Unit  PU Addr   PU Offset  Entry         E Addr    E  Offset   Statement  Load Mod  Service  Status
  26EE74B8  CEEHDSP       26955430  +00003F42  CEEHDSP       26955430  +00003F42              CEEPLPKA  D1515    Call
  26EE69C8                27CF9D68  +2870A3DB  addAltDN(_Connection*,_strbuf*,_Backend*)
                                                           27CF9D68  +2870A3DB              GLDNM003           Exception
  26EE68A8                27CF9378  +000002D0  storeBindInfo(_Connection*,_Operation*)
                                                           27CF9378  +000002D0              GLDNM003           Call
  26EE6788                27CF8548  +00000612  krbBind(_Connection*,_Operation*,berval*)
                                                           27CF8548  +00000612              GLDNM003           Call
  26EE66A0                2686AB68  +0000015A  SaslBindGssapi::doBindPart1(_strbuf*)
                                                           2686AB68  +0000015A              GLDNM005           Call
  26EE6550                2680A430  +000010A2  do_bind(_Connection*,_Operation*)
                                                           2680A430  +000010A2              GLDNM005           Call
  26EE63D8                26838550  +00000F38  process_request
                                                           26838550  +00000F38              GLDNM005           Call
  26EE62A0                2683F908  +0000086E  caMReceiveCB(void*,void*,int,int)
                                                           2683F908  +0000086E              GLDNM005           Call
  26EE61A8                26849E00  +0000020E  caSslAsyncBerGetNextCB(sockbuf*)
                                                           26849E00  +0000020E              GLDNM005           Call
  26EE60E8                05F50398  +00000164  asyncBerGetNext
                                                           05F50398  +00000164              GLDNMC03           Call
  26EE6008                05F513E0  +00000086  asyncBerGetNextCB(sockbuf*)
                                                           05F513E0  +00000086              GLDNMC03           Call
  26EE5F30                05F50D48  +00000136  async_get_tag(sockbuf*,unsigned long*,void(*)(sockbuf*))
```

```
                                                  05F50D48  +00000136              GLDNMC03           Call
  26EE5E68                05F51308  +0000005E  async_get_tagCB(sockbuf*)
                                                  05F51308  +0000005E              GLDNMC03           Call
  26EE5D80                05F50A38  +0000026C  async_BerRead(sockbuf*,char*,long,long*,void(*)(sockbuf*))
                                                  05F50A38  +0000026C              GLDNMC03           Call
  26EE5CB8                05F51220  +00000072  async_BerRead_filbufCB(sockbuf*)
                                                  05F51220  +00000072              GLDNMC03           Call
  26EE5BF0                05F51118  +0000008A  async_ber_filbufCB(sockbuf*,int)
                                                  05F51118  +0000008A              GLDNMC03           Call
  26EE5AF0                2684A6A0  +00000174  caSslLowerReceiveCB(void*,void*,int,int)
                                                  2684A6A0  +00000174              GLDNM005           Call
  26EE59E8                26856468  +000003D8  caInetReceiveCB
                                                  26856468  +000003D8              GLDNM005           Call
  26EE5930                26AC8CD8  +0000001A  @@GETFN       26AC8C30  +000000C2              CEEEV003           Call
  26EE57F0                05FEE3F0  +000009A4  async_service_thread
                                                  05FEE3F0  +000009A4              GLDNM035           Call
  26EE5718                05FE34A8  +0000022E  osi_thread_first
                                                  05FE34A8  +0000022E              GLDNM035           Call
  7F599E78  CEEOPCMM      0000E4D0  +00000914  CEEOPCMM      0000E4D0  +00000914              CEEBINIT  D1515    Call

 Condition Information for Active Routines
   Condition Information for  (DSA address 26EE69C8)
     CIB Address: 26EE7DF8
     Current Condition:
       CEE0198S The termination of a thread was signaled due to an unhandled condition.
     Original Condition:
       CEE3206S The system detected a specification exception (System Completion Code=0C6).
     Location:
       Program Unit:  Entry: addAltDN(_Connection*,_strbuf*,_Backend*)
       Statement:     Offset: +2870A3DB
```

APAR OA07015 addresses this problem.

Abend 0C4 in gss_release_buffer in z/OS LDAP client

We experienced an intermittent problem in which the z/OS LDAP client, while binding to the z/OS LDAP server using Kerberos authentication, generated a CEEDUMP with an exception in gss_release_buffer and failed with an abend 0C4. The CEEDUMP file appeared in the HFS under the directory from which the client was running.

Below is a portion of the traceback that helped to identify the error.

```
Traceback:
  DSA Addr  Program Unit  PU Addr   PU Offset  Entry         E Addr    E  Offset   Statement  Load Mod  Service  Status
  29D63140                29E41900  +00000234  eim_snap_dump
                                                  29E41900  +00000234          77  *PATHNAM  HIT7708  Call
  29D63028                29E41C28  +000006A6  eim_exc_handler
                                                  29E41C28  +000006A6         294  *PATHNAM  HIT7708  Call
  29D62F70                29A51838  +0000001A  @@GETFN       29A51790  +000000C2              CEEEV003           Call
  29D5FE30  CEEHDSP       298EBA50  +000024D8  CEEHDSP       298EBA50  +000024D8              CEEPLPKA  D1515    Call
  29D5F3C0                078001C0  +0000016A  gss_release_buffer
                                                  078001C0  +0000016A              EUVFKDLL           Exception
  29D5F2E8                08F96798  +000000B6  ldap_gss_release_buffer(gss_buffer_desc_struct*)
                                                  08F96798  +000000B6              GLDNMC03           Call
  29D5F1A0                08EF0858  +00000550  ldap_krb5_authenticate(ldap*,berval*,_LDAPControl**,_LDAPCon
                                                  08EF0858  +00000550              GLDNMC01           Call
  29D5EE68                08EEFB50  +00000AA6  ldap_sasl_bind_krb5_s_direct
                                                  08EEFB50  +00000AA6              GLDNMC01           Call
  29D5EDA0                08EC6AB8  +00000118  ldap_sasl_bind_s_direct
                                                  08EC6AB8  +00000118              GLDNMC01           Call
  29D5ECA8                08EC58E0  +00000326  ldap_sasl_bind_s
                                                  08EC58E0  +00000326              GLDNMC01           Call
  29D5EBA0                29E03EF8  +000000E2  eimHandleInt::kerberosBind(ldap*,unsigned long*,eimErr*)
                                                  29E03EF8  +000000E2        2936  *PATHNAM  HIT7708  Call
  29D5E9F8                29E01498  +000005A0  eimHandleInt::connect2(eimLdapInfo*,EimConnectInfo*,eimClean
                                                  29E01498  +000005A0        2435  *PATHNAM  HIT7708  Call
  29D5E8A8                29E03248  +000002A8  eimHandleInt::setMaster2(char*,int,eimErr*)
                                                  29E03248  +000002A8        2072  *PATHNAM  HIT7708  Call
  29D5E7C8                29E03130  +0000008C  eimHandleInt::connectToMaster(EimConnectInfo*,eimErr*)
                                                  29E03130  +0000008C        1433  *PATHNAM  HIT7708  Call
  29D5E6F8                29E39430  +00000082  qsy_eimConnectToMaster(eimHandleInt*,EimConnectInfo*,eimErr*
                                                  29E39430  +00000082         714  *PATHNAM  HIT7708  Call
  29D5E530                29E281C8  +00000410  eimConnectToMaster
                                                  29E281C8  +00000410        3050  *PATHNAM  HIT7708  Call
  29D5E368                29809840  +00000D28  connectEIM    29809840  +00000D28         924  *PATHNAM  HIT7708  Call
```

```
  29D5E210               2980D1C0  +000002FC  main          2980D1C0  +000002FC         184  *PATHNAM  HIT7708  Call
  29D5E0F8               29C2A146  +000000B4  EDCZMINV      29C2A146  +000000B4              CEEEV003           Call
  29D5E030  CEEBBEXT     298BBAA0  +000001A6  CEEBBEXT      298BBAA0  +000001A6              CEEPLPKA  D1515    Call

Condition Information for Active Routines
  Condition Information for  (DSA address 29D5F3C0)
    CIB Address: 29D60770
    Current Condition:
      CEE3204S The system detected a protection exception (System Completion Code=0C4).
    Original Condition:
      CEE3204S The system detected a protection exception (System Completion Code=0C4).
    Location:
      Program Unit:  Entry: gss_release_buffer
      Statement:     Offset: +0000016A
    Machine State:
      ILC..... 0004    Interruption Code..... 0004
      PSW..... 078D1400 8780032E
      GPR0..... 29D99CB0  GPR1..... 29D5F458  GPR2..... 29D99CB0  GPR3..... 078001FA
      GPR4..... 0000E748  GPR5..... 00000000  GPR6..... 29D99D00  GPR7..... 00000000
      GPR8..... 29D5F3BC  GPR9..... 29D8E010  GPR10.... 29E6B130  GPR11.... 29D8A840
      GPR12.... 2983B7A8  GPR13.... 29D5F3C0  GPR14.... 8780032A  GPR15.... 0003032A
```

APAR OA07090 addresses this problem.

Setting up SSL client and server authentication between z/OS LDAP V1R6 server/client and Sun ONE Directory Server 5.2 server/client

We set up SSL Client and Server authentication between the Sun ONE Directory Server 5.2 and z/OS LDAP Server/Client V1R6, when we were evaluating the Sun ONE Directory Server 5.2.

This topic describes how to setup:

- SSL Server Authentication between a Sun ONE Directory Server 5.2 and a z/OS LDAP V1R6 Client
- SSL Server Authentication between a z/OS V1R6 LDAP Server and a Sun ONE Directory Server 5.2 Client
- SSL Server and Client authentication between a Sun ONE Directory Server 5.2 and a z/OS LDAP V1R6 Client
- SSL Server and Client authentication between a z/OS V1R6 LDAP Server and a Sun ONE Directory Server 5.2 Client

Assumptions:

- You have a z/OS LDAP v1r6 LDAP Server setup. Populated with entries and accepting NON-secure communications.
- You have a Sun ONE Directory Server 5.2 setup on a Sun Solaris 9.0 operating system. Populated with entries and accepting NON-secure communications.

Since we are in a test environment, we chose to use z/OS's `gskkyman` utility to setup our own Certificate Authority (CA).

In order to act as a CA, a certificate key database and a CA certificate were created following these instructions:

- Create a CA Certificate Key Database and a CA certificate:
  - Start z/OS's `gskkyman` utility from an OMVS shell (`gskkyman`)
  - Follow the instructions on the screen to create a new key database. For example, `myCA.kdb`.
  - Once the certificate key database is created you will be at the "*Key Management Menu*"
  - Pick option 6, "*Create a Self-signed Certificate*"

- For this example we picked option 1, "*CA Certificate with 1024-bit RSA Key*", you may choose to pick any of the CA certificates listed.
- We filled out the rest of the information requested as follows:
  - Enter label (press ENTER to return to menu): `myCAcert`
  - Enter subject name for certificate
  - Common name (required): `My CA`
  - Organizational unit (optional): `myUnit`
  - Organization (required): `myOrg`
  - City/Locality (optional): `Pok`
  - State/Province (optional): `NY`
  - Country/Region (2 characters - required): `US`
  - Enter number of days certificate will be valid (default 365): `<enter>`
- Enter 1 to specify subject alternate names or 0 to continue: `0`
- You should see:
  - Certificate created.
  - Press ENTER to continue.
- Once you hit enter you will be back at the "*Key Management Menu*". Pick option 1, "*Manage Keys and Certificates*"
- Pick `myCAcert` from the list of the certificates, and then pick option 3, "*Set Key as Default"*. Next, pick option 6, "*Export Certificate To a File*"
- We picked "`Base64 ASN.1 DER`" as the Export File Format for this example and hit enter
- Export File Name: `myCAcert`

Now we have a CA certificate and a CA certificate key database. We will be using them for signing certificate requests from our servers and clients, therefore act as our own CA.

In the following examples, whenever a CA certificate is needed we will use `myCAcert` and whenever the CA certificate key database is needed we will use `myCA.kdb`. In a production environment, unless you are acting as your own CA, you would want to send the certificate requests that you create for your servers and clients to the CA in order to get them signed.

Also, remember that the following are examples only. Not all possible scenarios are considered, only basic setups are explained. Make sure to review the Sun ONE Directory Server 5.2 and z/OS LDAP V1R6 documentation for details, especially when setting up in a production environment.

1. SSL Server Authentication between a Sun ONE Directory Server 5.2 and a z/OS LDAP V1R6 Client:
   a. Enable Sun ONE Directory Server 5.2 for SSL Communications:
      - Transfer `myCAcert` over to the Solaris system hosting the Sun ONE Directory Server 5.2 and install it, using the Sun ONE Directory Server 5.2 Administration document.
      - Using the Sun ONE Directory Server 5.2 Administration document, create a certificate request for the directory server. The Common Name field in the request should be the name of your server (for example: the IP address).

- Get the certificate request signed by your CA. For this example, since we are acting as our own CA, transfer the request to the z/OS system where myCA.kdb is located.
- Sign the certificate request using gskkyman. For example:

  ```
  gskkyman -g -x 365 -cr sunServer.req -ct sunServerCert –k /etc/ldap/myCA.kdb
  ```

- sunServerCert is now created. Transfer it back to the Sun system, and install the server certificate.

b. Create a certificate key database for the z/OS LDAP client and install the CA certificate myCAcert in that database:
   - Start gskkyman on z/OS
   - Follow the instructions to create a new key database

     For this example: zOSclient.kdb
   - Pick option 7, "*Import a Certificate*"
   - Enter the certificate file name: myCAcert
   - Label it as you wish, we labeled it as myCAcert
   - Hit enter and the certificate is imported
   - From the "*Key Management Menu*" pick option 2, "*Manage Certificates*" then pick myCAcert. Next pick option 2 "*Set Certificate Trust Status*" to make sure that this CA certificate is trusted.

c. Next, we tested our setup. We did this by running an ldapsearch command, from z/OS against the Sun ONE Directory Server, with the following options:

   ```
   ldapsearch –h <host name> -p <secure port> -Z -K <client kdb> -P <client key database
   password> -b <search string> <filter>
   ```

   For example:

   ```
   ldapsearch –h solarisBox -p 636 -Z -K /u/test/keys/zOSclient.kdb -P secret
   -b "cn=John Doe, o=Your Company, c=US" objectclass=*
   ```

   Note: You might not receive the search results you are expecting or any error messages. That means that the bind was successful but you don't have access to see the information you requested. This depends on how your server is setup. On the other hand binding with the administrator DN should give you results.

   ```
   ldapsearch –h solarisBox -p 636 –D "cn=LDAP Administrator" -w secret -Z
   -K /u/test/keys/zOSclient.kdb -P secret -b "cn=John Doe, o=Your Company, c=US"
   objectclass=*
   ```

2. SSL Server Authentication between a z/OS V1R6 LDAP Server and a Sun ONE Directory Server 5.2 Client

   Note: Sun ONE Directory Server 5.2 provides you with a tool called certutil. See Server Administration document for more information on this tool.

   a. Create a certificate key database for Sun's LDAP client, using certutil. For example:

      ```
      certutil -N -d /export/home/test/keys/ -P client-
      ```

      Look up how to use certutil for detailed instructions and all the available options.

      This command will create two key databases:

      ```
      client-cert7.db
      client-key3.db
      ```

   b. Transfer the CA certificate myCAcert, which we created, to the Solaris system. Install the CA certificate to the client key database, for example:

      ```
      certutil -A -n myCAcert -t "TC,," -a -d /export/home/test/keys -P client- -I
      /export/home/test/keys/myCAcert
      ```

c. Create a certificate key database, import the CA certificate into it and create a new certificate request for the z/OS LDAP server using gskkyman:
   - Start gskkyman.
   - Create a new key database using the instructions. For example: z0Sserver.kdb
   - Pick option 7, "*Import a Certificate*".
   - Import myCAcert (the CA certificate we created earlier).
   - Pick option 4, "*Create New Certificate Request*"
   - Follow the instructions to create a new certificate request for your z/OS LDAP server. For this example I used the following values:

```
Enter certificate type (press ENTER to return to menu): 1
Enter request file name (press ENTER to return to menu): z0Sserver.req
Enter label (press ENTER to return to menu): z0SserverCert
Enter subject name for certificate
Common name (required): cn=<server's IP goes here>
Organizational unit (optional): myOu
  Organization (required): myOrg
  City/Locality (optional): Pok
  State/Province (optional): NY
  Country/Region (2 characters - required): US
```

   Note:
   The "Common name" value above must be in that format: cn=server name or IP.

d. Exit out of gskkyman. Now you must sign the certificate request using gskkyman and the CA certificate we created earlier:

```
gskkyman -g -x 365 -cr z0Sserver.req -ct z0SserverCert –k /u/test/keys/myCA.kdb
```

   Now you have a certificate for your server named z0SserverCert.

e. Install the certificate into your server key database. Start gskkyman, open z0Sserver.kdb, pick option 5, "*Receive requested certificate or a renewal certificate*", enter filename when requested to, z0SserverCert and hit enter.

f. Enable z/OS V1R6 LDAP Server for SSL communications following the instructions in "Integrated Security Services LDAP Server Administration and Use" document, use z0Sserver.kdb as your server's certificate key database.

g. Next, we tested our setup. We did this by running an ldapsearch command, from the Sun Solaris system against the z/OS LDAP server, with the following options:

```
ldapsearch -h <host> -p <secure port> -P <client's cert7 db>
-b <search string> <filter>
```

   For example:

```
ldapsearch –h z0Saddress –p 636 –P /export/home/test/keys/client-cert7.db
–b "cn=John Doe,o=Your Company,c=US" objectclass=*
```

3. SSL Server and Client authentication between a Sun ONE Directory Server 5.2 and a z/OS LDAP V1R6 Client

   a. Make sure you have SSL Server Authentication setup between the Sun ONE Directory Server and z/OS LDAP Client. If not, follow the instructions in 1 on page 207.

   b. Now you should have:

```
Client key database on z/OS system:  z0Sclient.kdb
Server key database on Sun Solaris system: <server-name>-cert7.db and
      <server-name<-key3.db
Both databases should contain a copy of: myCAcert CA certificate
```

c. Next, we created a client certificate (for z/OS LDAP Client) request and signed it by way of the CA certificate we created earlier. In this example we created a client certificate for "cn=John Doe,o=Your Company,c=US" entry in the Sun ONE directory server.
   - Start gskkyman
   - Open z0Sclient.kdb
   - Pick option 4, "*Create New Certificate Request*"
   - Follow the instructions to create a new certificate request for "cn=John Doe,o=Your Company,c=US". For this example we used the following values:

```
Enter certificate type (press ENTER to return to menu): 1
Enter request file name (press ENTER to return to menu): JohnDoe.req
Enter label (press ENTER to return to menu): JohnDoeCert
Enter subject name for certificate
Common name (required): John Doe
Organizational unit (optional):
  Organization (required): Your Company
  City/Locality (optional):
  State/Province (optional):
  Country/Region (2 characters - required): US
```

   Once the certificate request is created, sign the request:

```
gskkyman -g -x 365 -cr JohnDoe.req -ct JohnDoeCert –k /u/test/keys/myCA.kdb
```

   Now you have a certificate named JohnDoeCert.

d. Import the client certificate JohnDoeCert into your client key database z0Sclient.kdb:
   - Start gskkyman
   - Open z0Sclient.kdb using the instructions:
   - Pick option 7, "*Import a Certificate*"
   - Import JohnDoeCert

e. Next, we setup the Sun ONE Directory Server mappings so that John Doe can bind to the server using his client certificate, from z/OS.
   - Locate certmap.conf on your Sun Solaris system
   - We didn't edit the default mapping scheme but created a new one; something like this:

```
certmap myCA            cn=My CA, ou=MyUnit, o=MyOrg, l=Pok, st=NY, c=US
myCA:DNComps            o, c
myCA:FilterComps        cn
myCA:verifycert         off
```

   For more information on mappings see Sun ONE Directory Server 5.2 documentation.

f. Make changes to the access control to test our setup:

   Please note that the actions below were taken just to test this setup easily. To better understand how to manage access controls make sure to see: *"Sun ONE Directory Server 5.2 Administration Guide: Ch 6- Managing Access Control"*.

   "Depending on the ACIs defined for the directory, for certain operations, you need to *bind* to the directory. *Binding* means logging in or authenticating yourself to the directory by providing a bind DN and password, or, if using SSL, a certificate. The credentials provided in the bind operation, and the circumstances of the bind determine whether access to the directory is allowed or denied."

From the console, you can set this permission by doing the following:

1) On the Directory tab, right click the o=Your Company,c=US node in the left navigation tree, and choose Set Access Permissions from the pop-up menu to display the Access Control Manager.
2) Click New to display the Access Control Editor.
3) On the Users/Groups tab, in the ACI name field, type "John Doe Bound - Read, Search, Compare". Click add and find John Doe to add it to the list of users granted access permission.
4) On the Rights tab, tick the checkboxes for read, compare, and search rights. Make sure the other checkboxes are clear.
5) On the Targets tab, click This Entry to display the o=Your Company,c=US suffix in the target directory entry field. In the attribute table, locate the userPassword attribute and clear the corresponding checkbox. All other checkboxes should be ticked.

   Note: This task is made easier if you click the Name header to organize the list of attributes alphabetically.
6) Click OK in the Access Control Editor window.

g. Next, we tested our setup:

```
ldapsearch -h sunServer -p 636 -Z -S EXTERNAL -N JohnDoeCert -K
/u/test/keys/client.kdb -P secret -b "cn=John Doe,o=Your Company,c=US" objectclass=*
```

4. SSL Server and Client authentication between a z/OS V1R6 LDAP Server and a Sun ONE Directory Server 5.2 Client

   a. Make sure you have SSL Server Authentication setup between the z/OS LDAP Server and Sun LDAP Client. If not, follow the instructions in 2 on page 208.

   b. Now you should have:

```
Client key databases on Sun Solaris system: client-cert7.db and client-key3.db
Server key database on z/OS system:  zOSserver.kdb
Both databases should contain a copy of: myCAcert CA certificate
```

   c. Next, we created a client certificate request (for Sun LDAP Client) and signed it by way of the CA certificate we created earlier:

   This example created a client certificate request called JohnDoe.req for the entry "cn=John Doe,o=Your Company,c=US" in directory /export/home/test/keys, and the request is associated with client- set of certificate key databases.

```
certutil -R -s "cn=John Doe,o=Your Company,c=US" -a -o JohnDoe.req
-d /export/home/test/keys -P client-
```

   Once the certificate request is created, transfer the request to z/OS. Sign the request:

```
gskkyman -g -x 365 -cr JohnDoe.req -ct JohnDoeCert –k /u/test/keys/myCA.kdb
```

   We now have a certificate named JohnDoeCert, and transferred it back to our Sun Solaris system.

   d. Install the client certificate JohnDoeCert into your client key database client-cert7.db:

```
certutil -A -n "JohnDoeCert" -t "u,," -a -i /export/home/test/keys/JohnDoeCert -d
/export/home/test/keys/ -P client-
```

   e. Next, we tested our setup.

   Caution: Do not use the -D and -w options with client authentication, as the bind operation will use the authentication credentials specified with --D and -w instead of the certificate credentials desired. For example;

```
ldapsearch -h x.xx.xx.xxx  -p 636 -Z -P /export/home/test/keys/client-cert7.db -N
JohnDoeCert -K /export/home/test/keys/client-key3.db -W secret -b "cn=John Doe,
o=Your Company,c=US" "objectclass=*"
```

Setting up SSL client and server authentication between z/OS LDAP V1R6 server/client and IBM Tivoli Directory Server 5.2 server/client

This topic describes how to setup:

- SSL Server Authentication between an IBM Tivoli Directory Server 5.2 and a z/OS LDAP V1R6 Client
- SSL Server Authentication between a z/OS V1R6 LDAP Server and an IBM Tivoli Directory Server 5.2 Client
- SSL Server and Client authentication between an IBM Tivoli Directory Server 5.2 and a z/OS LDAP V1R6 Client
- SSL Server and Client authentication between a z/OS V1R6 LDAP Server and an IBM Tivoli Directory Server 5.2 Client

Assumptions:

- You have a z/OS LDAP V1R6 LDAP Server setup. Populated with entries and accepting NON-secure communications.
- You have an IBM Tivoli Directory Server 5.2 setup on a SUSE Sles 8, for Linux on zSeries, operating system. Populated with entries and accepting NON-secure communications.

Since we are in a test environment, we chose to use z/OS's `gskkyman` utility to setup our own Certificate Authority (CA).

In order to act as a CA, a certificate key database and a CA certificate were created following these instructions:

- Create a CA Certificate Key Database and a CA certificate:
  - Start z/OS's `gskkyman` utility from an OMVS shell (`gskkyman`)
  - Follow the instructions on the screen to create a new key database. For example, `myCA.kdb`.
  - Once the certificate key database is created you will be at the "*Key Management Menu*"
  - Pick option 6, "*Create a Self-signed Certificate*"
  - For this example we picked option 1, "*CA Certificate with 1024-bit RSA Key*", you may choose to pick any of the CA certificates listed.
  - We filled out the rest of the information requested as follows:
    - Enter label (press ENTER to return to menu): `myCAcert`
    - Enter subject name for certificate
    - Common name (required): `My CA`
    - Organizational unit (optional): `myUnit`
    - Organization (required): `myOrg`
    - City/Locality (optional): `Pok`
    - State/Province (optional): `NY`
    - Country/Region (2 characters - required): `US`
    - Enter number of days certificate will be valid (default 365): `<enter>`
  - Enter 1 to specify subject alternate names or 0 to continue: `0`
  - You should see:

- Certificate created.
- Press ENTER to continue.

– Once you hit enter you will be back at the "*Key Management Menu*". Pick option 1, "*Manage Keys and Certificates*"
– Pick `myCAcert` from the list of the certificates, and then pick option 3, "*Set Key as Default*". Next, pick option 6, "*Export Certificate To a File*"
– We picked "`Base64 ASN.1 DER`" as the Export File Format for this example and hit enter
– Export File Name: `myCAcert`

Now we have a CA certificate and a CA certificate key database. We will be using them for signing certificate requests from our servers and clients, therefore act as our own CA.

In the following examples, whenever a CA certificate is needed we will use `myCAcert` and whenever the CA certificate key database is needed we will use `myCA.kdb`. In a production environment, unless you are acting as your own CA, you would want to send the certificate requests that you create for your servers and clients to the CA in order to get them signed.

Also, remember that the following are examples only. Not all possible scenarios are considered, only basic setups are explained. Make sure to review the IBM Tivoli Directory Server 5.2 and z/OS LDAP V1R6 documentation for details, especially when setting up in a production environment.

1. SSL Server Authentication between an IBM Tivoli Directory Server 5.2 and a z/OS LDAP V1R6 Client:
   a. Enable IBM Tivoli Directory Server 5.2 for SSL Communications:
      - Create a key database using `GSKit` key management software that came with the IBM Tivoli Directory Server
      - Transfer `myCAcert` over to the Linux on zSeries system hosting the ITDS and install it to the server's key database, using the ITDS 5.2 Administration document.
      - Using the ITDS 5.2 Administration document, create a certificate request for the directory server. The Common Name field in the request should be the name of your server (for example: the IP address).
      - Get the certificate request signed by your CA. For this example, since we are acting as our own CA, transfer the request to the z/OS system where `myCA.kdb` is located.
      - Sign the certificate request using `gskkyman`. For example:

        ```
        gskkyman -g -x 365 -cr itdsServer.req -ct itdsServerCert –k /etc/ldap/myCA.kdb
        ```

      - **itdsServerCert** is now created. Transfer it back to the Linux on zSeries system, and install the server certificate.
   b. Create a certificate key database for the z/OS LDAP client and install the CA certificate `myCAcert` in that database:
      - Start `gskkyman` on z/OS
      - Follow the instructions to create a new key database

        For this example: `zOSclient.kdb`
      - Pick option 7, "*Import a Certificate*"
      - Enter the certificate file name: `myCAcert`
      - Label it as you wish, we labeled it as `myCAcert`
      - Hit `enter` and the certificate is imported

- From the "*Key Management Menu*" pick option 2, "*Manage Certificates*" then pick myCAcert. Next pick option 2 "*Set Certificate Trust Status*" to make sure that this CA certificate is trusted.

c. Next, we tested our setup. We did this by running an ldapsearch command, from z/OS against the IBM Tivoli Directory Server 5.2, with the following options:

```
ldaldapsearch –h <host name> -p <secure port> -Z -K <client kdb> -P <client key database
password> -b <search string> <filter>
```

For example:

```
ldapsearch –h idsBox -p 636 -Z -K /u/test/keys/zOSclient.kdb -P secret -b "cn=John Doe,
o=Your Company, c=US" objectclass=*
```

2. SSL Server Authentication between a z/OS V1R6 LDAP Server and an IBM Tivoli Directory Server 5.2 Client

a. Create a certificate key database for IBM Tivoli Directory Server 5.2 client, using GSKit.

b. Transfer the CA certificate myCAcert, which we created, to the Linux on zSeries system. Install the CA certificate to the client key database using GSKit.

c. Create a certificate key database, import the CA certificate into it and create a new certificate request for the z/OS LDAP server using gskkyman:

- Start gskkyman.
- Create a new key database using the instructions. For example: z0Sserver.kdb
- Pick option 7, "*Import a Certificate*".
- Import myCAcert (the CA certificate we created earlier).
- Pick option 4, "*Create New Certificate Request*"
- Follow the instructions to create a new certificate request for your z/OS LDAP server. For this example we used the following values:

```
Enter certificate type (press ENTER to return to menu): 1
Enter request file name (press ENTER to return to menu): z0Sserver.req
Enter label (press ENTER to return to menu): z0SserverCert
Enter subject name for certificate
Common name (required): cn=<server's IP goes here>
Organizational unit (optional): myOu
  Organization (required): myOrg
  City/Locality (optional): Pok
  State/Province (optional): NY
  Country/Region (2 characters - required): US
```

Note:
The "Common name" value above must be in that format: cn=server name or IP.

d. Exit out of gskkyman. Now you must sign the certificate request using gskkyman and the CA certificate we created earlier:

```
gskkyman -g -x 365 -cr z0Sserver.req -ct z0SserverCert –k /u/test/keys/myCA.kdb
```

Now you have a certificate for your server named z0SserverCert.

e. Install the certificate into your server key database. Start gskkyman, open z0Sserver.kdb, pick option 5, "*Receive requested certificate or a renewal certificate*", enter filename when requested to, z0SserverCert and hit enter.

f. Enable z/OS V1R6 LDAP Server for SSL communications following the instructions in "Integrated Security Services LDAP Server Administration and Use" document, use z0Sserver.kdb as your server's certificate key database.

g. Next, we tested our setup. We did this by running an `ldapsearch` command, from the Linux on zSeries system against the z/OS LDAP server, with the following options:

```
ldapsearch -h <host> -p <secure port> -P <client's key db>
-b <search string> <filter>
```

For example:

```
ldapsearch –h zOSaddress –p 636 –P /home/test/keys/itdsClient.kdb –b "cn=John  Doe,
o=Your Company,c=US" objectclass=*
```

3. SSL Server and Client authentication between an IBM Tivoli Directory Server 5.2 and a z/OS LDAP V1R6 Client
   a. Make sure you have SSL Server Authentication setup between the IBM Tivoli Directory Server 5.2 and z/OS LDAP Client. If not, follow the instructions in 1 on page 213.
   b. Now you should have:

```
Client key database on z/OS system:  zOSclient.kdb
Server key database on the zLinux system: zLinuxServer.kdb (for example)"
Both databases should contain a copy of: myCAcert CA certificate
```

   c. Next, we created a client certificate (for z/OS LDAP Client) request and signed it by way of the CA certificate we created earlier. In this example we created a client certificate for "`cn=John Doe,o=Your Company,c=US`" entry in the IBM Tivoli Directory Server.
      - Start `gskkyman`
      - Open `zOSclient.kdb`
      - Pick option 4, "*Create New Certificate Request*"
      - Follow the instructions to create a new certificate request for "`cn=John Doe,o=Your Company,c=US`". For this example we used the following values:

```
Enter certificate type (press ENTER to return to menu): 1
Enter request file name (press ENTER to return to menu): JohnDoe.req
Enter label (press ENTER to return to menu): JohnDoeCert
Enter subject name for certificate
Common name (required): John Doe
Organizational unit (optional):
  Organization (required): Your Company
  City/Locality (optional):
  State/Province (optional):
  Country/Region (2 characters - required): US
```

      Once the certificate request is created, sign the request:

```
gskkyman -g -x 365 -cr JohnDoe.req -ct JohnDoeCert –k /u/test/keys/myCA.kdb
```

      Now you have a certificate named `JohnDoeCert`.
   d. Import the client certificate `JohnDoeCert` into your client key database `zOSclient.kdb`:
      - Start `gskkyman`
      - Open `zOSclient.kdb` using the instructions:
      - Pick option 7, "*Import a Certificate*"
      - Import `JohnDoeCert`
   e. Next, we tested our setup:

```
ldapsearch -h itdsServer -p 636 -Z -S EXTERNAL -N JohnDoeCert -K
/u/test/keys/client.kdb -P secret -b "cn=John Doe,o=Your Company,c=US" objectclass=*
```

4. SSL Server and Client authentication between a z/OS V1R6 LDAP Server and a IBM Tivoli Directory Server 5.2 Client
   a. Make sure you have SSL Server Authentication setup between the z/OS LDAP Server and IBM Tivoli Directory Server 5.2. If not, follow the instructions in 2 on page 214.

b. Now you should have:

```
Client key databases on Linux on zSeries system: itdsClient.kdb
Server key database on z/OS system:  z0Sserver.kdb
Both databases should contain a copy of: myCAcert CA certificate
```

c. Next, we created a client certificate request (for ITDS LDAP Client) using GSKit.

This example uses a client certificate request called JohnDoe.req for the entry "cn=John Doe,o=Your Company,c=US".

Once the certificate request is created, transfer the request to z/OS. Sign the request:gskkyman -g -x 365 -cr **JohnDoe.req** -ct **JohnDoeCert** –k /u/test/keys/**myCA.kdb**

We now had a certificate named JohnDoeCert, and transferred it back to our Linux on zSeries system.

d. Install the client certificate JohnDoeCert into your client key database itdsClient.kdb using GSKit.

e. Next, we tested our setup.

Caution: Do not use the -D and -w options with client authentication, as the bind operation will use the authentication credentials specified with --D and -w instead of the certificate credentials desired. For example, using the certificate, certificate key database names ... etc from the example above:

```
ldapsearch -h z0Saddress -p 636 -Z –K /home/test/keys/itdsClient.kdb -N
JohnDoeCert  -P secret -b "cn=John Doe, o=Your Company,c=US" "objectclass=*"
```

LDAP Server enhancements in z/OS V1R6

The following topics describe some of the new LDAP Server functions in z/OS V1R6 that we implemented and tested.

- "LDAP migration to z/OS V1R6"
- "Setting up a peer-to-peer replication network between an IBM Tivoli Directory Server 5.2 and a z/OS LDAP Server" on page 217
- "Using DB2 restart/recovery function" on page 223
- "Using alias support" on page 225
- "Using the enhanced LDAP configurgation utility (LDAPCNF)" on page 226
- "Using change logging with TDBM" on page 227

LDAP migration to z/OS V1R6

Accessing SYS1.SIEALNKE: All Integrated Security Server products are now placing their load modules in SYS1.SIEANLKE instead of maintaining their own load module data set. This is a new data set for the Integrated Security Server products. We used *z/OS Integrated Security Services LDAP Server Administration and Use* and *z/OS Migration* to migrate to this new level and use this new data set.

Prior to starting any LDAP servers, verify that the SYS1.SIEALNKE data set is in the LNKLST concatenation. If it is not in link list, then you must use STEPLIB to locate the data set. When SYS1.SIEALNKE is not in the LNKLST concatenation, the LDAP server will not start and the following error is seen in the JES log.

```
IEF403I  LDAPSRV - STARTED - TIME=10.17.38
CSV003I  REQUESTED MODULE GLDSLAPD NOT FOUND
CSV028I  ABEND806-04  JOBNAME=LDAPSRV  STEPNAME=LDAPSRV
IEA995I  SYMPTOM DUMP OUTPUT
SYSTEM COMPLETION CODE=806  REASON CODE=00000004
```

Using enhanced dynamic, nested, or expanded static group data: In order to use the enhanced support for static, dynamic, and nested groups of users, your DB_Version level must be 3.0 or higher. When we first brought up our z/OS V1R6 LDAP server, our DB_Version was below the required level. We received the following message from the LDAP server:

```
GLD3148I Dynamic, nested, or expanded static group data is present in the TDBM backend but ignored since the DB_VERSION is not 3.0 or greater below suffixes: suffixes
```

To resolve this problem, you must update the DB_Version level from SPUFI (SQL Processor Using File Input) with the following statement

```
UPDATE dbuserid.DIR_MISC SET DB_VERSION='3.0'
```

dbuserid is the z/OS user ID that will be the owner of the DB2 tables, a value assigned during initial LDAP backend setup. For example if you defined the *dbuserid* as LDAPSRV when you set up the backend, the SPUFI DB_Version update statement would be:

```
UPDATE LDAPSRV.DIR_MISC SET DB_VERSION='3.0'
```

Once you have updated the DB_Version level to 3.0 or higher, you can use the enhanced dynamic, nested, or static group data. See *z/OS Integrated Security Services LDAP Server Administration and Use* for more information.

Setting up a peer-to-peer replication network between an IBM Tivoli Directory Server 5.2 and a z/OS LDAP Server

The procedures documented here are intended to give an LDAP administrator a set of instructions on how to set up a peer-to-peer replication network between two IBM directory servers, IBM Tivoli Directory Server 5.2 and z/OS LDAP Server on z/OS V1R6.

The procedures assume that you have installed and can use the Web Administration Tool for the IBM Tivoli Directory Server. See the *IBM Tivoli Directory Server Version 5.2 Installation Guide* for information about installing the Web Administration Tool. Another assumption is that you have decided which suffix to replicate and that the entries under that suffix are loaded in both directories.

There are two configuration options presented here. For each option, the procedure starts by creating a master/slave replication network and then promoting that to a peer-to-peer replication network.

Configuration Option 1

This option shows you how to setup a master/slave replication network with IBM Tivoli Directory Server 5.2 as the MASTER and z/OS LDAP Server on z/OS V1R6 as the SLAVE.

PART 1 consists of the following steps:

Creating the Master Server: The servers must be running to perform this task.

This task designates an entry as the root of an independently replicated subtree and creates an **ibm-replicasubentry** representing this server as the single master for the subtree. To create a replicated subtree, you must designate the subtree that you want the server to replicate.

1. Use the Web Administration Tool to log on to the master server.
2. Expand the Replication management category in the navigation area of the Web Administration Tool and click **Manage topology**.

3. Click **Add subtree**.
4. Enter the DN of the subtree that you want to replicate or click **Browse** to expand the entries to select the entry that is to be the root of the subtree.

   Note: If you are not using a suffix, there are other requirements. See *IBM Tivoli Directory Server Version 5.2 Administration Guide*.
5. The master server referral URL is displayed in the form of an LDAP URL. For example,

   ```
   ldap://<myservername>.<mylocation>.<mycompany>.com
   ```

   Note: The master server referral URL is optional. It is used only:
   - If the server contains (or will contain) any read-only subtrees.
   - To define a referral URL that is returned for updates to any read-only subtree on the server.
6. Click **OK**.
7. The new server is displayed on the Manage topology panel under the heading **Replicated subtrees**.

Creating Credentials: Credentials identify the method and required information, such as a DN and password, which the supplier uses in binding to the consumer.

1. If you have not already done so, use the Web Administration Tool to log on to the master server.
2. Expand the Replication management category in the navigation area of the Web Administration Tool and click **Manage credentials**.
3. Select **cn=replication,cn=IBMpolicies** to store the credentials from the list of subtrees.
4. Click **Add**.
5. Enter the name for the credentials you are creating. For example, **mycreds,** cn= is already filled in the field for you.
6. Select **Simple bind** as the type of authentication and click **Next**.
   - Enter the DN that the server uses to bind to the replica. For example, cn=any.

     Note: This DN cannot be the same as your server administration DN.
   - Enter the password the server uses when it binds to the replica. For example, secret.
   - Enter the password again to confirm that here are no typographical errors.
   - If you want, enter a brief description of the credentials
   - Click **Finish**.

     Note: You might want to record the credential's bind DN and password for future reference. You will need this password when you create the replica agreement.

Creating a replica server: The servers must be running to perform this task.

1. If you have not already done so, use the Web Administration Tool to log on to the master server.
2. Expand the Replication management category in the navigation area of the Web Administration Tool and click **Manage topology**.
3. Select the subtree that you want to replicate and click **Show topology**.

4. Click the arrow next to the **Replication topology** selection to expand the list of supplier servers.
5. Select the supplier server and click **Add replica**.
6. On the **Server** tab of the **Add replica** window:
   - Enter the host name of the replica server. Do not change the default non-SSL port (389).
   - Leave the **Enable SSL** check box unchecked.
   - Enter the replica name or leave this field blank to use the host name.
   - Enter the replica ID If the server on which you are creating the replica is running, click **Get replica ID** to automatically fill this field. For a replica, which is a z/OS LDAP server, this section will be filled as **UNKNOWN**. Enter a description of the replica server.
7. Click the **Additional** tab.
   - Specify the credentials that the replica uses to communicate with the master:
     – Click **Select**.
     – Click the radio button next to **cn=replication,cn=IBM policies**.
     – Click **Show credentials**.
     – Expand the list of credentials and select **mycreds**.
     – Click **OK**.

     See “Creating Credentials” on page 218 for additional information on agreement credentials.
   - Keep the **Specify a replication schedule or enter DN (optional)** set to **None**. This sets the default as immediate replication.
   - Do not deselect any capabilities.
   - Click **OK** to create the replica. A message is displayed noting that additional actions must be taken.
   - Click **OK**.
8. Next, the supplier information must be added to the replica. Open the **slapd.conf** configuration file of the z/OS LDAP server. Find the TDBM backend definitions and add the following configuration file options under the **suffix** that is to be replicated: **masterserver, masterserverdn, masterserverpw**.

   Example:

   ```
   masterserver ldap://<MasterServerIP>:<MasterServerPort>/
   masterserverdn cn=any
   masterserverpw password
   ```

   For masterserverdn and masterserverpw use the credentials you created in “Creating Credentials” on page 218.

   Restart the replica.

Starting replication: The replica is in a suspended state and no replication is occurring. After you have finished setting up your replication topology, on the master you must:

1. If you have not already done so, use the Web Administration Tool to log on to the master server.
2. Expand the **Replication management** category in the navigation area of the Web Administration Tool and click **Manage queues**.
3. Select the new replica.
4. Click **Suspend/resume** to start receiving replication updates for that server.

Master/slave replication setup is complete.

PART 2, in which you promote the master/slave replication network to a peer-to-peer replication network, consists of the following steps:

Changing the master to a peer: Refer to the **current** master as peer1 and the **current** replica as peer2. To define peer2 to peer1, we add peer2's definition to peer1's configuation file **ibmslapd.conf**.

For example:

```
dn: cn=Master Server,cn=Configuration
cn: Master Server
ibm-slapdMasterDN: cn=peer
ibm-slapdMasterPW: secret
objectclass: ibm-slapdReplication
objectclass: top
```

Promoting the replica to a peer: Stop peer2.

Open the **slapd.conf** configuration file for peer2 and delete **masterserver**, **masterserverDN**, and **masterserverPW** configuration file options.

Restart peer2.

Next, define peer1 to peer2. Create an LDIF file as in the example below and add it to peer2's directory, using the **ldapadd** utility.

For example:

```
dn: cn=myReplica,o=Your Company,c=US
objectclass: top
objectclass: replicaObject
cn: myReplica
replicaHost: <ip address>
replicaBindDn: cn=peer
replicaCredentials: secret
```

Stop peer2.

Open peer2's **slapd.conf** configuration file, find the TDBM backend definitions and add **peerserverDN peerserverPW** configuration file options under the **suffix** that is being replicated.

Example:

```
peerServerDN cn=peer
peerServerPW secret
```

Starting peer-to-peer replication: Restart servers peer1 and peer2. Peer-to-peer replication network setup between an IBM Tivoli Directory Server 5.2 and a z/OS LDAP Server on z/OS V1R6 is complete.

Configuration Option 2

This option shows you how to setup a master/slave replication network with z/OS LDAP Server on z/OS V1R6 as the MASTER and IBM Tivoli Directory Server 5.2 as the SLAVE.

PART 1 consists of the following steps:

Setting up IBM Tivoli Directory Server 5.2 as the Slave: Before setting up IBM Tivoli Directory Server 5.2 as the slave, we set it up as the master.

Follow the instructions in "Configuration Option 1" on page 217 up until 8 on page 219 to set up IBM Tivoli Directory Server 5.2 as the master and z/OS LDAP Server on z/OS V1R6 as the slave.

Next, delete the replication agreement that was just built between the master and the slave. That action leaves behind some information in the IBM Tivoli Directory Server that we will use later on.

1. Use the Web Administration Tool to log on to the master server.
2. Expand the **Replication management** category in the navigation area of the Web Administration Tool and click **Manage topology**.
3. Select the subtree that you picked to replicate earlier and click **Show topology**.
4. Click the arrow next to the **Replication topology** selection to expand the list of all the servers within the replication network. Keep doing this until both servers are listed.
5. Delete the replica server from the topology. (It is the bottom one in the list.)

Follow the directions below to look into the IBM Tivoli Directory Server 5.2 under ″ibm-replicaGroup=default,<subtreedn>″. You should find an ibm-replicaSubEntry object with the attribute ibm-replicationServerIsMaster=TRUE. Change this attribute value to FALSE.

1. Use the Web Administration Tool to log on to the master server.
2. Expand the **Directory management** category in the navigation area of the Web Administration Tool and click **Manage entries**.
3. Select the subtree that is being replicated and then click **Find**.
4. Pick **ibm-replicaSubEntry** objectclass from the **Find Entries with Following Objectclasses** drop down menu and click **OK**.
5. Click **Edit Attributes**.
6. Pick **FALSE** under **ibm-replicationServerIsMaster** section.
7. Click **OK**, **OK**, and **CANCEL** to go back to the **Manage entries** window.

Next, we need to define the new master server, z/OS V1R6 LDAP Server, to its replica, IBM Tivoli Directory Server 5.2. We do this by adding a description of the master to IBM Tivoli Directory Server's **ibmslapd.conf** configuration file. Use the description below as an example:

```
dn: cn=Master Server,cn=Configuration
cn: Master Server
ibm-slapdMasterDN: cn=peer
ibm-slapdMasterPW: secret
ibm-slapdMasterReferral: ldap://<MasterServerIP>:<MasterServerPort>/
objectclass: ibm-slapdReplication
objectclass: ibm-slapdConfigEntry
objectclass: top
```

Finally, go back to the Web Administration Tool and click on **Replication Management**, then click on **Manage Topology**. Pick the subtree that is being replicated and click on **Edit Subtree**. Change the current referral address to the master server's (z/OS V1R6 LDAP Server) address and click **OK**.

Setting up z/OS V1R6 LDAP Server as the Master: Now, define the replica to its master. Create an LDIF file similar to the example below, which includes a replicaObject representing the replica server. Then, add the LDIF file to the master's directory, using the **ldapadd** utility.

```
dn: cn=myReplica,o=Your Company,c=US
objectclass: top
objectclass: replicaObject
cn: myReplica
replicaHost: <ip address>
replicaBindDn: cn=peer
relicaCredentials: secret
```

Starting replication: Restart both servers.

The master/slave replication between an IBM Tivoli Directory Server 5.2 and a z/OS LDAP Server on z/OS V1R6 is complete.

PART 2, in which we promote the master/slave replication network to a peer-to-peer replication network, consists of the following steps:

Changing the master to a peer: Stop the master server.

Open the **slapd.conf** configuration file. Find the TDBM backend definitions. Add **peerServerDN** and **peerServerPW** configuration file options under the **suffix** that is to be replicated.

Example:

```
peerServerDN cn=peer
peerServerPW secret
```

Changing the replica to a peer:

1. Use the Web Administration Tool to log on to the master server.
2. Expand the Replication management category in the navigation area of the Web Administration Tool and click **Manage topology**.
3. Select the subtree that you want to replicate and click **Edit subtree**.
4. Scroll right and click on **Make server a master**. A message will pop up. Click **OK**, click **OK** on the next screen.
5. Click **Show topology**.
6. Click the arrow next to the **Replication topology** selection to expand the list of supplier servers. Select the supplier server and click **Add replica**.
7. On the **Server** tab of the **Add replica** window:
   - Enter the host name of the replica server. Do not change the default non-SSL port (389).
   - Leave the **Enable SSL** check box unchecked.
   - Enter the replica name or leave this field blank to use the host name.
   - Enter the replica ID If the server on which you are creating the replica is running, click **Get replica ID** to automatically fill this field. For a replica, which is a z/OS LDAP server, this section will be filled as **UNKNOWN**. Enter a description of the replica server.
8. Click the **Additional** tab.
   - Specify the credentials that the replica uses to communicate with the master:
     – Click **Select**.
     – Click the radio button next to **cn=replication,cn=IBM policies**.

  - Click **Show credentials**.
  - Expand the list of credentials and select **mycreds**.
  - Click **OK**.

  See “Creating Credentials” on page 218 for additional information on agreement credentials.
- Keep the **Specify a replication schedule or enter DN (optional)** set to **None**. This sets the default as immediate replication.
- Do not deselect any capabilities.
- Click **OK** to create the replica. A message is displayed noting that additional actions must be taken.
- Click **OK**.

Starting peer-to-peer replication: Restart IBM Tivoli Directory Server 5.2 and then restart z/OS LDAP Server.

Peer-to-peer replication network is complete.

Reference information

We used the following documentation to set up these procedures:

- *z/OS Integrated Security Services LDAP Server Administration and Use*
- *A Simplified Approach to IBM Tivoli Directory Server V5.2 Replication*
- *IBM Tivoli Directory Server Administration Guide*

Using DB2 restart/recovery function

DB2 Restart/Recovery is a new feature for the z/OS V1R6 LDAP server that allows a TDBM and/or GDBM configured LDAP server to remain up and running even if DB2 shuts down. Then, once DB2 is restored, the LDAP server can function as normal. In the past, you had to restart the LDAP server in order to reconnect to DB2 once the connection was lost.

We used the following setup and tested DB2 restart/recovery:

1. Installed the fix for APAR PQ87724, which is required for this function.

2. Updated the slapd.conf file as follows:

```
# ------------------------------------------------------------------
database tdbm GLDBTDBM
suffix "o=xxx"
suffix "o=xxx"
servername xxxxxxxxx
dbuserid xxxxxx
databasename xxxxxx
dsnaoini GLD.CNFOUT.xx(DSNAOINI)
attroverflowsize 500
pwEncryption  none
schemaReplaceByValue on
extendedgroupsearching on
db2terminate restore

#  GDBM-specific CONFIGURATION SETTINGS
# ------------------------------------------------------------------
# ------------------------------------------------------------------
database gdbm GLDBGDBM
servername xxxxxxxxx
dbuserid xxxxxx
dsnaoini GLD.CNFOUT.xxx(DSNAOINI)
```

```
changeLogging on
changeLogMaxEntries 1000
changeLogMaxAge 86400
attroverflowsize 500
schemaReplaceByValue on
db2terminate restore
```

Note that db2terminate restore is the default, so that if you do not specify a value, you'll get restore. If you specify db2terminate terminate, the LDAP server will shut down when DB2 shuts down.

---

3. We tested DB2 restart/recovery function by bringing DB2 down and up again, and verifying that LDAP stayed up throughout:
   - After we brought DB2 down, the system issued the following LDAP server message:

     ```
     GLD0252E DB2 termination detected, database access unavailable.
     ```

     To verify that DB2 was down, we issued an ldapsearch command:

     ```
     ldapsearch -h <hostname> -b "o=IBM" "objectclass=*"
     ```

     The system returned a message saying that no such object was present, verifying that DB2 was down.
   - We brought DB2 up again, and received the following LDAP server message:

     ```
     GLD0253I DB2 restart detected, database access available.
     ```

     Again, we issued the ldapsearch command, this time to verify that DB2 was up:

     ```
     ldapsearch -h <hostname> -b "o=IBM" "objectclass=*"
     ```

     The system displayed the output for the search query.

Migrating to DB2 V8

When we migrated to DB2 V8 we encountered the following problems with LDAP.

Module DSNAOCLI was not found in an authorized library

The LDAP server would not start. The following message was seen in the servers JES log.

```
CEE3518S The module DSNAOCLI was not found in an authorized library.
         From entry point DBXAllocEnv at compile unit offset +000000D0 at
         entry offset +000000D0 at address 277556A0.
CSV042I REQUESTED MODULE DSNAOCLI NOT ACCESSED. THE MODULE IS NOT PROGRAM CONTROLLED.
ICH422I THE ENVIRONMENT CANNOT BECOME UNCONTROLLED.
BPXP014I ENVIRONMENT MUST REMAIN CONTROLLED FOR SERVER (BPX.SERVER) PROCESSING.
```

DSNAOCLI is a DB2 module that is in dataset DB2.DB2810.SDSNLOAD. To resolve the above problem we program controlled the dataset with the following commands.

```
ralter program * addmem('DB2.DB2810.SDSNLOAD'/******/NOPADCHK)
SETROPTS WHEN(PROGRAM) REFRESH
```

Plans needed to be rebound using SQLERROR(CONTINUE)

After program controlling the dataset the server started but the TDBM backend failed to configure. We encountered the following errors:

```
GLD0154E Error code -1 from odbc string:  "SQLConnect " USIBMT6PETDB2 .
GLD0155E ODBC error, SQL data is:  native return code=-805, SQL state=51002,
 SQL message={DB2 FOR OS/390}{ODBC DRIVER}
 DSNT408I SQLCODE = -805, ERROR:  DBRM OR PACKAGE NAME USIBMT6PETDB2..DSNCLIC1.-
          177B362318910800D NOT FOUND IN PLAN DSNACJA. REASON 03
```

There were problems binding the plan that the DB2 System Programmers had to resolve. The problem was the plans needed to be rebound using SQLERROR(CONTINUE) as per holddata for PTF UQ87683.

Once these were resolved and the Plan was bound LDAP worked successfully.

Using alias support

Alias support provides a means for a TDBM directory entry to point to another entry in the same TDBM directory. If a distinguished name encountered during a search operation with dereferencing contains an alias, the alias is replaced by the value it points to and search continues using the new distinguished name. This support is designed to allow a user to make directory information available even if the entry is moved. It allows the user to point to a well-known name that would always lead to the entry.

We did the following to setup and test alias support:

1. Created an ldif file to exercise alias support. New file **alias.ldif** contains the following:

   ```
   dn: cn=js, o=IBM
   objectclass:person
   objectclass:aliasObject
   sn: Smith
   aliasedobjectname: cn=Joe Smith, ou=My Team, ou=Test Team, o=IBM
   ```

---

2. Next we loaded the alias.ldif file into the TDBM database with the following ldapmodify command:

   ```
   ldapmodify - h <hostname> -D "cn=LDAP Administrator" -w xxxxx -f /sysname/etc/ldap/alias.ldif
   ```

---

3. To make sure that alias.ldif was properly loaded, we issued the following ldapsearch command:

   ```
   ldapsearch - h <hostname> -b "o=js, o=IBM" "objectclass=*"
   ```

   This command displayed the following output, showing the new alias entry, which showed that alias.ldif was loaded properly:

   ```
   dn: cn=js, o=IBM
   objectclass:person
   objectclass:aliasObject
   sn: Smith
   aliasedobjectname: cn =Joe Smith, ou=My Team, ou=Test Team, o=IBM
   ```

---

4. We tested alias support by issuing the following ldapsearch command with new parameter **-a always** that specifies that aliases are always dereferenced:

   ```
   ldapsearch -h <hostname> -a always -b "cn=js, o=IBM" "objectclass=*
   ```

   This command displays the actual entry that the alias represents:

   ```
   cn=Joe Smith, ou=My Team, ou=Test Team, o=IBM
   ```

See *z/OS Integrated Security Services LDAP Client Programming* for information on the -a *deref* parameter.

Using the enhanced LDAP configurgation utility (LDAPCNF)

The LDAP configuration utility, ldapcnf, has been enhanced so that configuring TDBM is no longer required and to support configuring the change log. We tested the enhanced LDAPCNF utility using information from *z/OS Integrated Security Services LDAP Server Administration and Use*. We did the following to setup and test ldapcnf::

1. Created a new LDAP server for testing ldapcnf by doing the following:
   - Copied the following files from **/usr/lpp/ldap/etc** to **/sysname/etc/ldap**:

     ldap.profile
     ldap.slapd.profile
     ldap.db2.profile
     ldap.racf.profile
     slapd.conf
   - Next, we updated the profile files specific to our new LDAP server. We made the following changes to profile files:
     - **ldap.profile** and **ldap.slapd.profile**- We made system specific changes, see *z/OS Integrated Security Services LDAP Server Administration and Use* for information.
     - **ldap.db2.profile** - We enabled the LDAP server for TDBM and GDBM. You can choose to configure one or both.
     - **ldap.racf.profile** - We made system specific changes, see z/OS Integrated Security Services LDAP Server Administration and Use for information..

---

2. Started the LDAP configuration utility, ldapcnf, using the following command:

   ```
   ldapcnf -i ldap.profile
   ```

   The ldapcnf utility ran successfully with a return code of 0 and the utility created the following:
   - JCL jobs
   - SLAPDCNF (LDAP server configuration file)
   - SLAPDENV (LDAP server environment variable file)
   - PROG member needed for APF authorization
   - Procedure needed to start the LDAP server
   - DSNAOINI configuration file for DB2 CLI
   - SPUFI DB2 SQL Statements for TDBM and GDBM

---

3. Next we copied the LDAP started task procedure to the procedure library for our new LDAP server and copied the PROGxx member to the target system's PARMLIB.

---

4. We then submitted the APF member and DBCLI member following JCL jobs. Our DB2 administrators submitted the DBSPUFI members for TDBM and GDBM using the DB2 SPUFI tool.

---

5. Finally, we started up the LDAP server as follows:

```
s user_id
```

We received the following message:

```
GLD0122I Slapd is ready for requests.
```

The LDAP Server was running with both TDBM and GDBM configured successfully. We successfully ran a variety of LDAP commands to test this server.

Using change logging with TDBM

For the z/OS V1R6 LDAP server, change logging has been enabled for changes made to entries in the TDBM backend. When a change is made to an entry in the TDBM backend, a record of the change will be created and stored in the GDBM backend.

To set up and test TDBM change logging, we did the following:

1. Because this support includes a new backend section (GDBM) in the configuration file, we first enabled the GDBM back end for the LDAP server in the configuration file:

```
#  GDBM-specific CONFIGURATION SETTINGS
 # ------------------------------------------------------------------------
 # ------------------------------------------------------------------------
 database gdbm GLDBGDBM
 servername xxxxxxx
 dbuserid xxxxxx
 #databasename xxxxxx
 dsnaoini GLD.CNFOUT.xxx(DSNAOINI)
 changeLogging on
 changeLogMaxEntries 1000
 changeLogMaxAge 86400
 attroverflowsize 500
 schemaReplaceByValue on
```

Once the GDBM backend is configured, the change logging support is automatically enabled for the corresponding TDBM back end. Note that **changeLogging on** is the default setting.

---

2. After this setup step, the slapd.conf file looks as follows (the bold sections show requirements for change logging):

```
# * This file is the LDAP Server configuration file for z/OS.
 # ************************************************************/
 #global section

 timelimit       3600
 sizelimit       500

 adminDN "cn=LDAP Administrator"
 adminPW xxxxxx


 listen ldap://:389
 listen ldap://:pc
 #  TDBM-specific CONFIGURATION SETTINGS
 # ------------------------------------------------------------------------
 # ------------------------------------------------------------------------
 changeLogging on
 database tdbm GLDBTDBM
```

```
suffix "o=IBM"
suffix "o=Your Company"
servername xxxxxxxxxx
dbuserid xxxxxx
databasename xxxxxxx
dsnaoini GLD.CNFOUT.xx(DSNAOINI)
attroverflowsize 500
pwEncryption  none
schemaReplaceByValue on
extendedgroupsearching on
#  GDBM-specific CONFIGURATION SETTINGS
# ------------------------------------------------------------------------
# ------------------------------------------------------------------------
database gdbm GLDBGDBM
servername xxxxxxxxxx
dbuserid xxxxxx
dsnaoini GLD.CNFOUT.xx(DSNAOINI)
changeLogging on
changeLogMaxEntries 1000
changeLogMaxAge 86400
attroverflowsize 500
schemaReplaceByValue on
#########################################################################
# sdbm database definitions
#########################################################################
database sdbm GLDBSDBM
suffix "sysplex=xxxxxxxx,O=IBM,C=US"
```

---

3. Finally, we restarted the LDAP server. SLAPDOUT displays the following, showing that ChangeLogging is enabled:

```
GLD0244I Change logging is enabled
         Logging started status (0 = off, 1 = on): 1
         Limit in seconds on age of change log entries (0 = no limit): 86400
         Limit on the number of change log entries (0 = no limit): 1000
         Current number of change log entries: 0
         First change number in use: 0
         Last change number in use: 0
GLD3151I The backend containing the following suffix is participating in change logging: 'CN=CHANGELOG'.
GLD3151I The backend containing the following suffix is participating in change logging: 'o=IBM'.
GLD0202I Program Call communication is active.
GLD0122I Slapd is ready for requests.
```

---

4. Now we're ready to start testing the TDBM change logging. First, we created an ldif file, test.ldif, that would make a change to an entry in the TDBM backend:

```
dn: cn=John Doe, ou=My Team, ou=Test Team, o=IBM
changetype:modify
replace:x
title:ICSF
```

---

5. We then issued the following ldapmodify command to make the changes in the ldif file:

```
ldapmodify -h <hostname> -D "cn=LDAP Administrator" -w xxxxx -f test.ldif
```

The modifications were made successfully.

---

6. I then issued an ldapsearch against the change log to verify that a record was created for the change:

```
ldapsearch -h <hostname> -b "cn=changelog" "objectclass=*"
```

The following output was displayed, showing that TDBM change logging was working successfully:

```
cn=changelog
objectclass=top
objectclass=container
cn=changelog

CHANGENUMBER=1201,CN=CHANGELOG
objectclass=CHANGELOGENTRY
objectclass=IBM-CHANGELOG
objectclass=TOP
changenumber=1201
targetdn=cn=John Doe, ou=My Team, ou=Test Team, o=IBM

changetime=20040701185439.759260Z
changetype=MODIFY
changes=replace:title
title: ICSF
-
add:ibm-entryuuid
ibm-entryuuid: B95FA000-5DEF-10E4-B0B9-40208401B52A
-
ibm-changeinitiatorsname=CN=LDAP ADMINISTRATOR
```

TDBM change logging works successfully.

Chapter 15. Using Kerberos (Network Authentication Service)

Setting up a Kerberos peer trust relationship between z/OS and Windows 2000

We had a request from our colleagues in z/OS LDAP development to test the z/OS LDAP client with the Microsoft Windows 2000 Active Directory service using a Kerberos authentication bind. This was to help validate a fix they were working on involving the use of Kerberos authentication to bind to IBM Directory Server.

We needed to create a Kerberos realm that included Kerberos servers on z/OS and a Windows platform. Another test team had already enabled a Windows 2000 server for Kerberos authentication and we already had a Kerberos server running on z/OS. We now needed to create a peer trust relationship between these two Kerberos servers.

Since the Windows 2000 server was set up by another test team, we don't have a lot of details to share. However, we intend to continue our testing with Kerberos peer relationships and transitive trust relationships on other platforms and from other suppliers. We'll have more to say about how to enable such scenarios at that time. For now, we will focus on what we did from the z/OS perspective to set up the peer trust relationship and how we validated our setup.

We used the following documentation to help us set up the z/OS portion of the peer trust relationship:

- *z/OS Integrated Security Services Network Authentication Service Administration*, SC24-5926
- *z/OS Integrated Security Services LDAP Client Programming*, SC24-5924
- *z/OS Security Server RACF Command Language Reference*, SA22-7687

Enabling the peer trust relationship on z/OS

There are two main areas that need to be configured to enable the peer trust relationship for Kerberos authentication from the z/OS perspective: the krb5.conf configuration file and RACF. We configured these accordingly, as described below, to define a new Kerberos realm. (For more information, see the appendix containing sample Kerberos configurations in *z/OS Integrated Security Services Network Authentication Service Administration*.)

Defining the Windows 2000 realm to the Kerberos server on z/OS

We did the following to update the /etc/skrb/krb5.conf configuration file:

1. Under the [Realms] section, we defined the Windows 2000 server as follows:

```
KERBEROS.XXX.YYY.IBM.COM = {
   kdc = kerb2000.kerberos.xxx.yyy.ibm.com:88
   kpasswd_server = kerb2000.kerberos.xxx.yyy.ibm.com:464
}
```

---

2. Under the [domain_realm] section, we defined the Windows 2000 server as follows:

```
.kerberos.xxx.yyy.ibm.com = KERBEROS.XXX.YYY.IBM.COM
```

Defining the cross-realm certification in RACF

We issued the following RACF commands to define the cross-realm certification:

```
RDEFINE REALM /.../KERBEROS.XXX.YYY.IBM.COM/krbtgt/XXX.YYY.IBM.COM KERB(PASSWORD(win2k_pw))

RDEFINE REALM /.../XXX.YYY.IBM.COM/krbtgt/KERBEROS.XXX.YYY.IBM.COM  KERB(PASSWORD(zos_pw))
```

Testing the peer trust relationship

Since the intention for this scenario was to test the z/OS LDAP client, we used the z/OS LDAP client and the Windows 2000 Active Directory service to validate the newly created Kerberos realm and the peer trust relationship.

We did the following to test the peer trust relationship (all commands are issued from the z/OS UNIX shell):

1. We issued the **kinit** command to obtain Kerberos credentials. Because we were trying to obtain credentials from the Windows 2000 server, we issued the **kinit** command using a Windows 2000 Kerberos principal.

   Example: `kinit SAM@KERBEROS.XXX.YYY.IBM.COM`

   Result: `EUVF06017R Enter password:`

   If everything is set up correctly and you enter the correct password, you will simply return to the command prompt when the **kinit** command successfully completes.

   However, if there is a problem with the setup and you are unable to access the Windows 2000 server, you would see the following error message:

   ```
   EUVF06014E Unable to obtain initial credentials.
              Status 0x96c73a9a - Unable to locate security server.
   ```

   Our **kinit** command was successful and we returned to the command prompt.

---

2. We used the **klist** command to verify that we had the expected credentials.

   Example: `klist`

   Result: We received the following response, as expected:

   ```
   Ticket cache: FILE:/var/skrb/creds/krbcred_0a3ae270
   Default principal: SAM@KERBEROS.XXX.YYY.IBM.COM

   Server: krbtgt/KERBEROS.XXX.YYY.IBM.COM@KERBEROS.XXX.YYY.IBM.COM
     Valid 2004/05/13-13:21:23 to 2004/05/13-23:21:23
   ```

At this point, we were confident that we had established communication between z/OS and the Kerberos server running on Windows 2000. We could now use other applications that require binding with Kerberos authentication. In this scenario, we used the z/OS LDAP client to search the Windows 2000 Active Directory, as described in the following steps.

3. We issued the **ldapsearch** command to search the Windows 2000 Active Directory.

   Example: We entered the following command as a single line from the z/OS UNIX command prompt:

   ```
   ldapsearch -h ip_address_of_win2k_server -V 3 -S GSSAPI -s base
      -b "CN=Users,DC=kerberos,DC=xxx,DC=yyy,DC=ibm,DC=com" "objectclass=*"
   ```

   Result: We received the following response, as expected:

```
CN=Users,DC=kerberos,DC=xxx,DC=yyy,DC=ibm,DC=com
cn=Users
description=Default container for upgraded user accounts
instanceType=4
isCriticalSystemObject=TRUE
distinguishedName=CN=Users,DC=kerberos,DC=xxx,DC=yyy,DC=ibm,DC=com
objectCategory=CN=Container,CN=Schema,CN=Configuration,DC=kerberos,DC=xxx,DC=yyy,DC=ibm,DC=com
objectClass=top
objectClass=container
objectGUID=NOT Printable
name=Users
showInAdvancedViewOnly=FALSE
systemFlags=-1946157056
uSNChanged=1314
uSNCreated=1314
whenChanged=20030506135552.0Z
whenCreated=20030506135552.0Z
```

To validate the peer trust relationship between the Kerberos server on z/OS and the Kerberos server on Windows 2000, we needed to clear out our existing Kerberos credentials (that we had obtained using a Windows 2000 Kerberos principal), obtain new Kerberos credentials using a z/OS Kerberos principal, and then rerun the **ldapsearch** command.

4. We issued the following command to clear out any existing Kerberos credentials:

   ```
   kdestroy
   ```

   ---

5. We issued the **kinit** command to obtain new Kerberos credentials using a z/OS Kerberos principal.

   Example: `kinit LDAP/zOS.ibm.com`

   ---

6. We reissued the same **ldapsearch** command as before to search the Windows 2000 Active Directory.

   Example: We entered the following command as a single line from the z/OS UNIX command prompt:

   ```
   ldapsearch -h ip_address_of_win2k_server -V 3 -S GSSAPI -s base
      -b "CN=Users,DC=kerberos,DC=xxx,DC=yyy,DC=ibm,DC=com" "objectclass=*"
   ```

   Result: As expected, the response was identical to the one received before.

Network Authentication Service (NAS) enhancements in z/OS V1R6

All Integrated Security Server products are now placing their load modules in SYS1.SIEALNKE instead of maintaining their own load module data set. This is a new data set for the Integrated Security Server products.

We used *z/OS Integrated Security Services Network Authentication Service Administration* and *z/OS Migration* when migrating to this new level and using this new data set.

Accessing SYS1.SIEALNKE

Prior to starting any NAS servers, verify that the SYS1.SIEALNKE data set is link list. If it is not in link list, then you must use STEPLIB to locate the data set.

When SYS1.SIEALNKE is not in link list, the NAS server will not start and the following error is seen in the JES log.

```
IEF403I  SKRBKDC - STARTED - TIME=20.41.45
CSV003I  REQUESTED MODULE EUVFSKDC NOT FOUND
CSV028I  ABEND806-04  JOBNAME=SDRBKDC  STEPNAME=SKRBKDC
IEA995I  SYMPTOM DUMP OUTPUT
SYSTEM COMPLETION CODE=806  REASON CODE=00000004
```

FTP with Kerberos

Our goal was to use an FTP client on Linux (on an Intel® box), obtaining the Kerberos credentials from a z/OS Kerberos server and then FTP into a z/OS FTP server using those credentials. This document will identify the steps taken to implement this solution.

Where to find more information

During our testing, we used documentation from several sources, listed below.

- *z/OS Communications Server: IP Configuration Guide*, ″Chapter 11. Transferring files using FTP″ section titled ″Steps for customizing the FTP server for Kerberos″
- *z/OS Security Server RACF Command Language Reference*
- *Communications Server for z/OS V1R2 TCP/IP Implementation Guide Volume 7: Security SG24-6840-00* , section 11.1.3 ″FTP using Kerberos″.

FTP server enablement for Kerberos

The following sections describe how we set up our FTP server enablement for Kerberos.

Assigning service principals

Initially it was thought that both an FTP and a host service principal were required. After further investigation and testing it was determined that the host service principal is not needed. We needed to create the ftp service principal against a RACF id. Although any id could be used we decided that to keep it simple we would assign the service principal to an id with the same name.

Adding the FTP service principal:

- Add the RACF userid FTP on our systems. (There was already a RACF userid FTP on our systems.) If the FTP RACF userid did not already exist, the following command would be used to create it:

  ```
  adduser FTP NOPASSWORD DFLTGRP(SYS1) omvs(autouid home('/u/ftp') prog('/bin/sh'))
  ```

- Add the Kerberos principal once the FTP RACF userid is created. We used the following command:

  ```
  ALTUSER FTP PASSWORD(ftp) NOEXPIRED KERB(KERBNAME(ftp/<hostname>))
  ```

- Remove password protection from the FTP id, if desired. Because a password was not desired to be assigned to the FTP id the following command was issued to remove it:

  ```
  ALTUSER FTP NOPASSWORD
  ```

- Ensure that the Kerberos segment was added by using the following command to display the id:

  ```
  LU FTP NORACF KERB
  ```

  The following is the result:

  ```
  USER=FTP

  KERB INFORMATION
  ```

```
---------------
KERBNAME= ftp/<hostname>
KEY VERSION= 001
KEY ENCRYPTION TYPE= DES DES3 DESD
```

The ftp.data file for the FTP Server

The ftp.data file resides in the /etc directory.

Note: The file name default is the same for both the FTP server and client. What designates which one to use is the location of the file. The default location of the server's file is in `/etc`. Both the name of the file and the location can be changed. The changed name or location must then be in the FTPD startup proc. In our installation we have changed the name of this file to `ftps.data` (we added the `s` for server copy) to help us distinguish it from the client copy. The client file location is in the clients 'home' directory.

At a minimum the following must be enabled in the file to enable the FTP server for Kerberos:

```
EXTENSIONS        AUTH_GSSAPI
```

This is all that we added to the ftp.data file thus accepting the defaults for the remaining Kerberos specific variables.

Adding the keytab file

We added a keytab file on z/OS for the FTP service principal.

- Locate the keytab file in the `/etc/skrb` directory:

  ```
  cd /etc/skrb
  ```

- Use the `list` command to show what is currently in the keytab file:

  ```
  keytab list
  ```

  The following will be returned if nothing is currently in the keytab file:

  ```
  Key table: /etc/skrb/krb5.keytab
  ```

- Add the FTP service principal with the following command:

  ```
  keytab add ftp/<hostname>
  ```

- Enter the principals' password.

  You will be prompted for the principals' password. For this example that password is FTP and it must be entered in uppercase. This password was assigned via the RACF `ALTUSER` command when the FTP principal was created.

- Issue the keytab list again.

  The following is what should be displayed when the FTP service principal is present.

  ```
   Key table: /etc/skrb/krb5.keytab

  Principal: ftp/<hostname>@<realm>
    Key version: 1
    Key type: 56-bit DES
    Entry timestamp: 2005/02/04-16:21:10

  Principal: ftp/<hostname>@<realm>
    Key version: 1
    Key type: 56-bit DES using key derivation
    Entry timestamp: 2005/02/04-16:21:10

  Principal: ftp/<hostname>@<realm>
    Key version: 1
    Key type: 168-bit DES using key derivation
    Entry timestamp: 2005/02/04-16:21:10
  ```

Running without a keytab file

An alternative to running with a keytab file is to associate the FTP Kerberos principal to the id under which the FTP started task runs. If the id under which FTP runs happens to be named FTP then the examples above for creating the FTP Kerberos principal would be fine. Otherwise let's say the id which the FTP started task runs under is named FTPD. Issue the following command to create the FTP Kerberos principal and have it associated to that id.

```
ALTUSER FTPD PASSWORD(ftpd) NOEXPIRED KERB(KERBNAME(ftp/<hostname>))
```

In this setup the KRB5_SERVER_KEYTAB environment variable must be set. This can be specified directly in the FTP startup proc as listed below:

```
//FTPD   EXEC PGM=&MODULE,REGION=4096K,TIME=NOLIMIT,
//      PARM=('POSIX(ON) ALL31(ON)',
//        'ENVAR("KRB5_SERVER_KEYTAB=1")/&PARMS')
```

The other alternative to specifying the environment variable directly in the startup proc would be to specify a file where the environment variables are listed:

```
//FTPD   EXEC PGM=&MODULE,REGION=4096K,TIME=NOLIMIT,
//      PARM=('POSIX(ON) ALL31(ON)',
//        'ENVAR("_CEE_ENVFILE=/etc/ftp.envvars")/&PARMS')
```

Then within the /etc/ftp.envvars file add the following:

```
KRB5_SERVER_KEYTAB=1
```

Configuring a Linux workstation for Kerberos

The following software was used when we configured our Linux workstation for Kerberos.

- SUSE 9.2 Linux workstation
- MIT Kerberos Client

We created a new z/OS userid kerbftp1 to be used with the Linux workstation and eventual workload. We used the following RACF commands for this:

```
adduser kerbftp1 NOPASSWORD DFLTGRP(SYS1) omvs(autouid home('/u/kerbftp1') prog('/bin/sh'))
ALTUSER kerbftp1 PASSWORD(ftp) NOEXPIRED KERB(KERBNAME(kerbftp1))
```

The following was needed for the Linux workstation Kerberos configuration. The data can be found in the Kerberos configuration file /etc/skrb/krb5.conf

Default Realm
: This value is found under the [libdefaults] section as default_realm

Default Domain
: This value is found under the [domain_realm] section. It is the left hand side of the equation default.domain = default.realm

KDC Server Address
: This value is found under the [realms] section as kdc = ip.address:port under the Default Realm designation.

Creating the ftp.data file for the z/OS client ftp user

We created an ftp.data file in the users home directory. (/u/JOE)

Add at a minimum the following to the ftp.data file:

```
SECURE_MECHANISM GSSAPI
```

Testing FTP with Kerberos

We used the following commands to test the setup from the z client perspective.

First the Kerberos credentials are required.

Issue the kinit command:

```
kinit kerbftp1
```

You will be prompted for the password. Enter FTP Then issue the FTP command:

```
 ftp <hostname>
```

You should see the following:

```
Using /u/JOE/ftp.data for local site configuration parameters.
IBM FTP CS V1R6
FTP: using TCPIP
Connecting to: <hostname> <ipaddress> port: <portnumber>.
220-FTPD1 IBM FTP CS V1R6 at <hostname>, 21:51:51 on 2005-02-04.
220 Connection will close if idle for more than 5 minutes.
>>> AUTH GSSAPI
334 Using authentication mechanism GSSAPI
>>> ADAT
235 ADAT=YGgGCSqGSIb3EgECAgIAb1kwV6ADAgEFoQMCAQ+iSzBJoAMCAQGiQgRAjucQzxlYf
d1fLzoc7CSk1SZCL87moSzVQ+fxlCJ9Z5nu0fRpRP9K0DnxmPENQZj7WsFA/nEL4Gpbw+CI8X/kxw==
Authentication negotiation succeeded
NAME (<hostname>:USER):
JOE
>>> USER JOE
331 Send password please.
PASSWORD:

>>> PASS
230 JOE is logged on.  Working directory is "JOE.".
Command:
quit
>>> QUIT
221 Quit command received. Goodbye.
```

Problems encountered

Following are some of the problems we encountered:

1. The need for either the keytab file or association of the Kerberos principal to the FTP started task id is not defined in *z/OS Communications Server: IP Configuration Guide*.
2. There is no information on the requirement or how to create the FTP service principal in *z/OS Communications Server: IP Configuration Guide*.
3. The requirement to specify a user id and password on the FTP transaction should not happen.

The first two documentation problems will be resolved in the z/OS V1R7 level of the books. The third problem has been defined to be working as designed. A requirement has been opened and accepted to be resolved in a future release.

Working with Kerberos principals in RACF

The following RACF commands will allow you to know what Kerberos principals currently exist and to what RACF userids they are associated to.

We used *z/OS Security Server RACF Command Language Reference* for these commands.

SEARCH CLASS(KERBLINK)
The SEARCH command provides a nice consolidated list of the existing principals. All of the Kerberos principals on the system are listed.

RLIST KERBLINK * NORACF
The RLIST KERBLINK command shows the principals as well but not as nicely condensed.

RLIST KERBLINK *
If the NORACF parameter is not specified, the RACF info will be displayed. In the RACF info the APPLDATA field is displayed. The APPLDATA field lists the RACF id that the principal is associated to. Knowing what id a principal is associated to is valuable when needing to update the principal, such as changing the password. Any changes to the principal are made against the id the principal is associated to.

RLIST KERBLINK <princpal-name>
The <princpal-name> command will show the principal specified and the APPLDATA field. However, the command is not case sensitive. It will only work for principals that are ALL upper case. If any character in the principal name is lower case the command will return the following.

```
<princpal-name> NOT FOUND
```

The command will be enabled for mixed case principals in a future release of z/OS.

Chapter 16. Using the IBM WebSphere Business Integration family of products

The IBM WebSphere MQ (formerly MQSeries) family of products forms part of the newly re-branded WebSphere Business Integration portfolio of products. These products are designed to help an enterprise accelerate the transformation into an on demand business.

This chapter discusses the following topics:

Using WebSphere MQ shared queues and coupling facility structures

Using Websphere MQ, programs can talk to each other across a network of unlike components, including processors, operating systems, subsystems, and communication protocols, using a simple and consistent application programming interface.

We currently run WebSphere MQ for z/OS Version 5.3.1. We originally discussed our implementation of shared queues in our December 2002 edition. We continue that discussion by focusing on the usage and behavior of the coupling facility structures that support shared queues.

We used information from the following sources to set up and test our shared queues:

- *WebSphere MQ for z/OS System Administration Guide*, SC34-6053, for information about recovery from DB2, RRS, and CF failures. This document is available from the WebSphere Business Integration library at www.ibm.com/software/integration/websphere/library/.
- *WebSphere MQ in a z/OS Parallel Sysplex Environment*, SG24-6864, available from IBM Redbooks at www.ibm.com/redbooks/
- *WebSphere MQ Queue Sharing Group in a Parallel Sysplex Environment*, REDP-3636, available from IBM Redbooks at www.ibm.com/redbooks/

Our queue sharing group configuration

We currently have two queue sharing groups: one with three members and another with seven members. The smaller queue sharing group is for testing new applications or configurations before migrating them to our production systems. The queue sharing groups each connect to different DB2 data sharing groups. This discussion will focus on the seven-member production queue sharing group. All of the queue managers in the group run WebSphere MQ for z/OS Version 5.3.1.

Our coupling facility structure configuration

We defined our MQ coupling facility structures to use two coupling facilities (CF2 and CF3) as defined in the preflist in the structure definitions. (See "Coupling facility details" on page 9 for details about our coupling facilities.)

The following is the structure definition for our CSQ_ADMIN structure:

```
STRUCTURE NAME(MQGPCSQ_ADMIN)
          INITSIZE(18668)
          MINSIZE(15000)
          DUPLEX(ENABLED)
          SIZE(18668)
          ALLOWAUTOALT(YES)
          PREFLIST(CF3,CF2)
          REBUILDPERCENT(1)
          FULLTHRESHOLD(85)
```

We also have the following four message structures defined to support different workloads:

- MSGQ1 — for the batch stress workload
- CICS — for the CICS bridge application
- EDSW — for the IMS bridge application
- WMQI — for the WebSphere MQ Integrator retail application

The following is the structure definition for the message structure that supports the MQ-CICS bridge workload:

```
STRUCTURE NAME(MQGPCICS)
          INITSIZE(10240)
          DUPLEX(ENABLED)
          SIZE(20480)
          ALLOWAUTOALT(YES)
          PREFLIST(CF2,CF3)
          REBUILDPERCENT(1)
          FULLTHRESHOLD(85)
```

The other three message structures are defined similarly, except for the sizes. All of the structures are enabled for duplexing.

We chose to create multiple message structures in order to separate them by application. That way, if there is a problem with a structure, it will not impact the other applications. However, this is not necessarily the recommended approach from a performance perspective. See the Redbook Paper *WebSphere MQ Queue Sharing Group in a Parallel Sysplex Environment* for more information.

The CICS, EDSW, WMQI, and MSGQ1 structures are recoverable and are backed up daily.

Testing the recovery behavior of the queue managers and coupling facility structures

We conducted the following types of test scenarios during our z/OS release testing:

- CF structure errors
- CF structure duplexing and moving structures between coupling facilities
- CF-to-CF link failures
- MQ CF structure recovery

During these tests, we monitored the behavior of the MQ queue managers as well as the behavior of applications that use shared queues.

Queue manager behavior during testing

We observed the following behavior during our test scenarios:

CF structure errors: With the MQ CICS bridge workload running, we used a local tool to inject errors into the coupling facility structures. When we injected an error

into the MQ administrative structure, the structure moved to the alternate coupling facility, based on the preflist, as expected. Throughout the test, the CICS bridge workload continued to run without any errors.

CF structure rebuild on the alternate coupling facility: With system-managed CF structure duplexing active and a shared queue workload running, we issued the SETXCF STOP,REBUILD command to cause XCF to move the MQ structures to the alternate coupling facility. The queue manager produced no errors and the application continued without any interruption.

MQ structure recovery: During our normal coupling facility testing, the MQ CICS structure went into a failed state for valid reasons. This afforded us the opportunity to test MQ structure recovery. We issued the RECOVER CFSTRUCT command and the structure recovered with no errors.

We also tested recovering into an empty structure. We first issued the SETXCF FORCE command to clear the structure, followed by the RECOVER CFSTRUCT(CICS) TYPE(PURGE) command. Again, the structure recovered with no errors.

Suggested MQ maintenance

During the course of our WebSphere MQ 5.3.1 testing we applied maintenance up to PUT0508.

Additional experiences and observations

MQ abends during coupling facility failures: Although coupling facility failures are extremely rare under normal operations, we induce many failures in our environment in the course of our testing. When coupling facility failures occur which have an impact on WebSphere MQ, such problems generally manifest themselves as MQ dumps with abend reason codes that start with 00C51*nnn*. Many of these are actually coupling facility problems or conditions that result in MQ having a problem and are not necessarily MQ problems in their own right. When such abends occur, we suggest that you analyze the system log for any IXC or IXL messages that might indicate a problem with a coupling facility.

Intra-group queuing: We have all members of the queue sharing group set up for intra-group queueing. This was done by altering the queue manager to enable intra-group queuing. SDSF makes use of the SYSTEM.QSG.TRANSMIT shared queue for transmitting data between SDSF servers instead of the cluster queues. It continues to use the cluster queues and channels for members not in the queue sharing group. Currently all systems in our sysplex have the SDSF MQ function enabled so job output for one system can be viewed from any other system in the sysplex.

Effects of DB2 and RRS failures on MQ: We also tested how MQ reacts when DB2 or RRS become unavailable. The following are some of our observations:

- APAR PQ77558 fixes a problem with MQ V5.3.1 when RRS is cancelled while the queue manager is running.
- When DB2 or RRS become unavailable, the queue manager issues an error message to report its loss of connectivity with DB2 and which subsystem is down. An example of such a message is:

  ```
  CSQ5003A !MQJA0 CSQ5CONN Connection to DB2 using DB1G pending, no active DB2
  ```

  When DB2 becomes available again, MQ issues a message to report that it is again connected to DB2. For example:

```
CSQ5001I !MQJA0 CSQ5CONN Connected to DB2 DBD1
```

- MQ abend reason codes that indicate a DB2 failure start with 00F5*nnnn*.

Notes about MQ coupling facility structure sizes:

- All of our MQ coupling facility structures are defined to allow automatic alter (by specifying ALLOWAUTOALT(YES) in the structure definitions in the CFRM policy), whereby XCF can dynamically change the size of a structure, as necessary. This is beneficial because it allows XCF to automatically increase the size of a message structure as needed to hold more messages.
- When we first defined the CSQ_ADMIN structure, we made it 10000K bytes in size. Our original sizing was based on the guidelines in *WebSphere MQ for z/OS Concepts and Planning Guide*, GC34-6051. However, we have since migrated to a higher CFCC level and increased the number of queue managers in the queue sharing group, which increases the size requirement for the CSQ_ADMIN structure. As a result, the queue manager recently failed to start because the CSQ_ADMIN structure was too small and issued the following message:

  ```
  CSQE022E !MQJA0 Structure CSQ_ADMIN unusable, size is too small
  ```

  We used the SETXCF START,ALTER command to increase the size of the structure. The following is an example of the command we issued:

  ```
  SETXCF START,ALTER,STRNAME=MQGPCSQ_ADMIN,SIZE=16000
  ```

  Accordingly, we also increased the value of INITSIZE() and MINSIZE() for CSQ_ADMIN in the CFRM policy from 10000 to 15000 to accommodate the increase in usage.

Improving availability with our MQCICS workload

Our MQCICS workload is a java application that places a message on the CICS Bridge request queue containing the name of a CICS transaction and required parameters. The request queue is being monitored by a CICS region. After the request has been processed, the CICS region puts a message on the specified reply queue. Currently there are two workload environments that we run this application in. We improved availability in the second workload environment found in “Three systems with WebSphere MQ-CICS bridge monitor task handling the requests” on page 243.

One WebSphere MQ-CICS bridge monitor running on one system handling the requests

In our first workload environment, we have two systems running the request applications to a Web front end being hosted by a WebSphere Application Server server. The queue where the requests are going to is being monitored by one WebSphere MQ-CICS bridge monitor task on a third system. The three systems gain access to the request and reply queue through our shared queue system environment. Figure 52 on page 243 demonstrates the message flow.

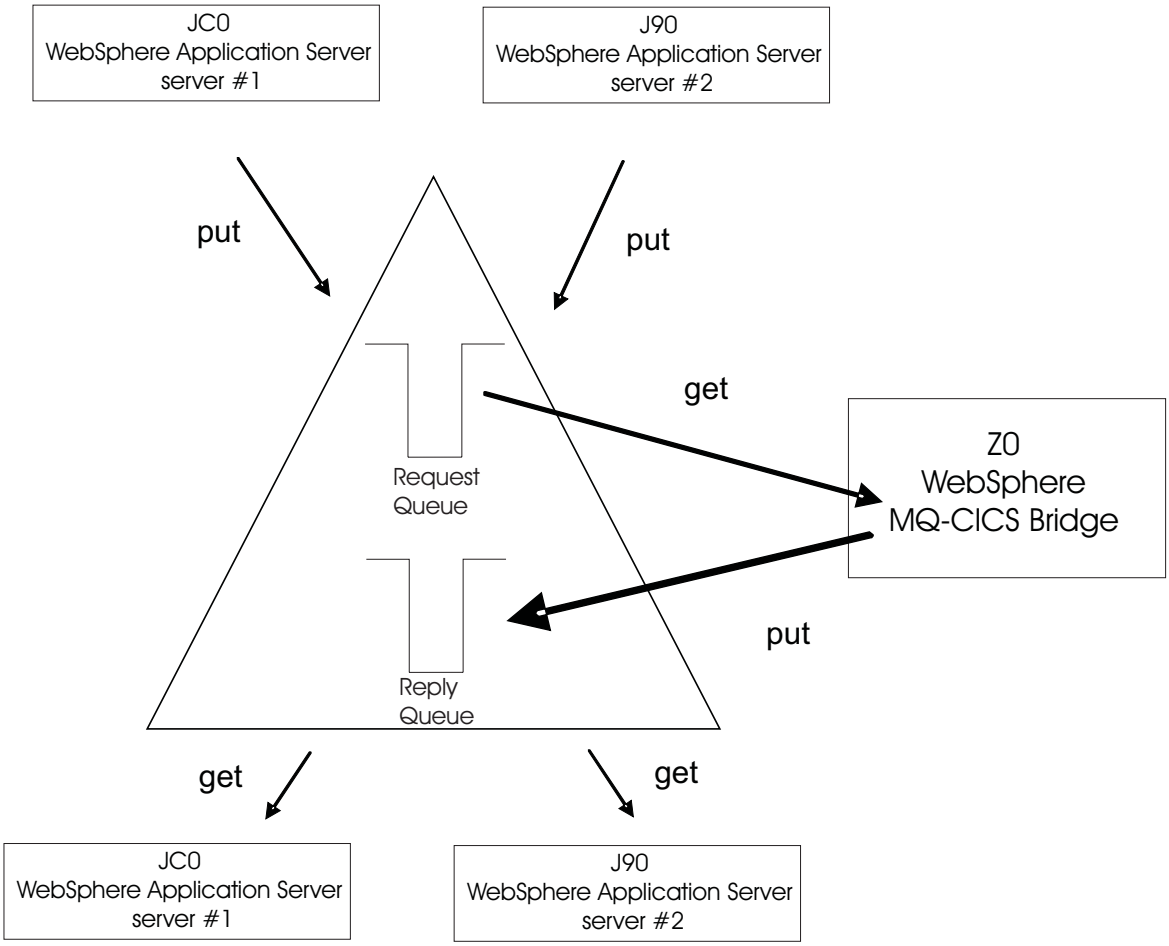


Figure 52. One WebSphere MQ-CICS bridge monitor running on one system. handling the requests

Three systems with WebSphere MQ-CICS bridge monitor task handling the requests

Our second workload environment shown in Figure 53 on page 244 increases availability by having three systems with WebSphere MQ-CICS bridge monitor task handling the requests. In this environment the clients are TPNS users on a fourth system. The customization section for the WebSphere MQ-CICS Bridge on the WebSphere for Z/OS MQ System Setup Guide Version 5 Release 3.1 says that each bridge monitor task must have its own request queue. Therefore, we made the request queue clustered with each system that has a bridge monitor task have its own local copy. The clients distribute the request messages among the three systems using a round robin fashion. Since there is no need for the reply queue to be used by only one application, it is a shared queue among the four systems.

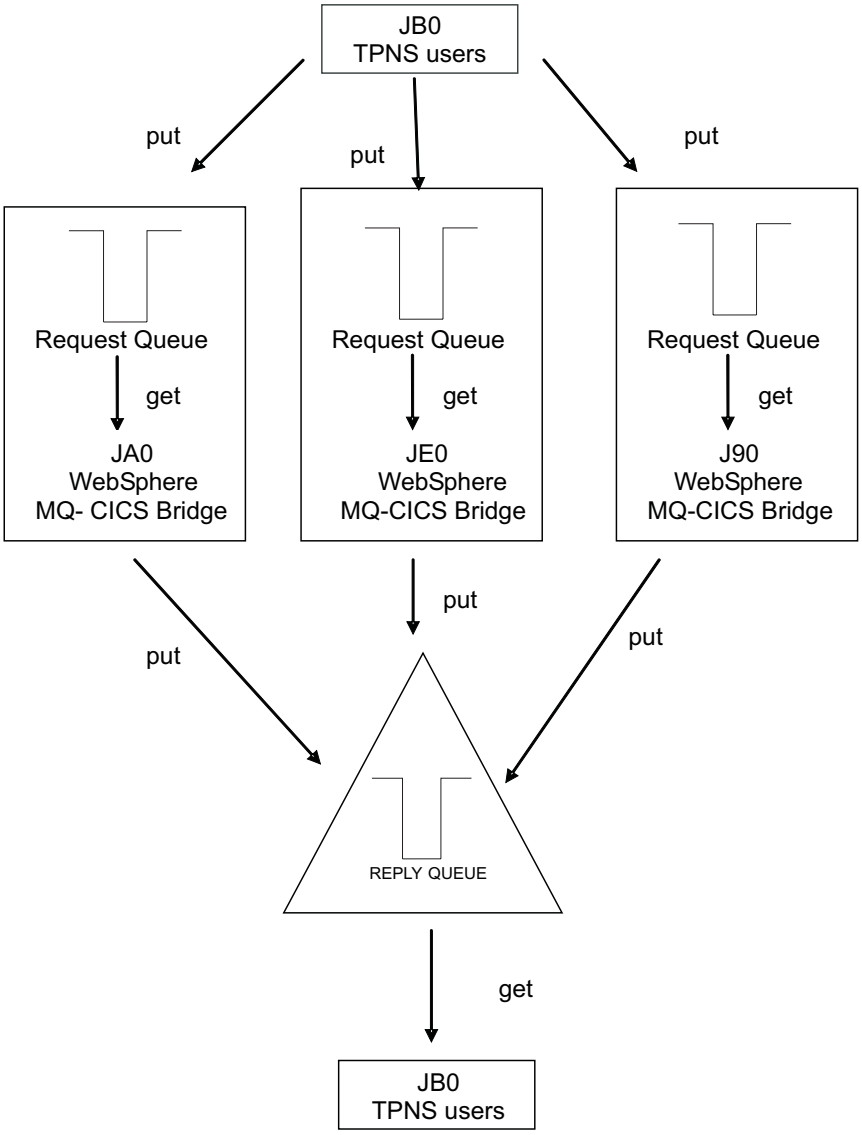


Figure 53. Three systems with WebSphere MQ-CICS bridge monitor task handling the requests.

Implementing WebSphere MQ shared channels in a distributed-queuing management environment

We implemented shared channels within the larger of our two queue sharing groups to bolster our distributed-queuing management (DQM) environment. Previously, we have had a DQM workload that exercised distributed messaging using MQ channels that provided an environment to test channel functionality such as SSL, as well as more general testing such as load stress. For z/OS V1R5, we modified the underlying DQM environment to utilize both shared inbound and shared outbound channels without having to change the workload application. We are now able to handle higher amounts of inbound messages from remote MQ clients and, at the same time. provide transparent failover redundancy for those inbound messages.

Our MQ ″clients″ are in fact full MQ servers on distributed platforms such as Linux and Windows 2000.

Our shared channel configuration

The following sections describe the configuration of our shared inbound and outbound channels. We used information in *WebSphere MQ Intercommunication*, SC34-6059, to plan our configuration.

Shared inbound channels

We decided to implement the shared channel environment on our sysplex using TCP/IP services because our distributed DQM clients are mainly TCP/IP clients. All queue managers in the queue sharing group were configured to start group listeners on the same TCP port (1415), as described in the MQ intercommunication guide.

Example: The following is an example of the command to start group listeners on TCP port 1415:

```
START LISTENER INDISP(GROUP) PORT(1415)
```

The MQ intercommunication guide describes how the group listener port maps to a generic interface that allows the queue sharing group to be seen as a single network entity. For our DQM environment, we configure the Sysplex Distributor service of z/OS Communications Server to serve as the TCP/IP generic interface. This is a slight departure from the intercommunication guide, which utilizes DNS/WLM to provide the TCP/IP generic interface. VTAM generic resources is another available service that can provide the generic interface for channels defined using LU6.2 connections.

Example: The following is an example of our Sysplex Distributor definition for TCP port 1415:

```
VIPADYNAMIC
VIPADEFINE MOVEABLE IMMED 255.255.255.0  192.168.32.30
VIPADISTRIBUTE DEFINE 192.168.32.30 PORT 1415
DESTIP 192.168.49.31 192.168.49.32 192.168.49.33 192.168.49.34 92.168.49.36 192.168.49.38
ENDVIPADYNAMIC
```

We added this definition to the TCP/IP profile of one of our queue sharing groups (in this case 192.168.49.32), but it can be added to any TCP/IP host within the sysplex in which the queue sharing group resides. The IP addresses listed for DESTIP are the XCF addresses of the queue managers in our queue sharing group. The remote client can then specify 192.168.32.30 (or, correspondingly, the host name MQGP, which maps to that IP address in our DNS server for our 192.168.*xx.xx* LAN) on its sender channel, which then causes the receiver channel start to be load-balanced using the WLM mechanisms of Sysplex Distributor.

Example: The following is an example of our definitions for the remote sender channel and the local receiver channel:

```
DEFINE  CHANNEL(DQMLNXP.TO.DQMMQGP) +
  REPLACE +
  CHLTYPE(SDR) +
  XMITQ(DQMMQGP.XMIT.QUEUE) +
  TRPTYPE(TCP) +
  DISCINT(15) +
  CONNAME('MQGP(1415)')

DEFINE  CHANNEL(DQMLNXP.TO.DQMMQGP) +
  REPLACE +
  CHLTYPE(RCVR) +
  QSGDISP(GROUP) +
  TRPTYPE(TCP)
```

Note that QSGDISP(GROUP) specifies that a copy of this channel is defined on each queue manager in the queue sharing group. This allows the inbound channel start request to be serviced by any queue manager in the queue sharing group. At this point, messages can be placed on application queues that are either shared or local to the queue manager (as long as they are defined on each queue manager in the queue sharing group, specifying QSGDISP(GROUP) in the definitions).

Shared outbound channels

The MQ intercommunication guide states that an outbound channel is a shared channel if it moves messages from a shared transmission queue. Thus, we defined a shared transmission queue for our outbound channels, along with an outbound sender channel with a QSGDISP of GROUP. This enables the queue managers in the queue sharing group to perform load-balanced start requests for this channel.

Example: The following is our definition for the shared transmission queue:

```
DEFINE  QLOCAL(DQMLNXP.XMIT.QUEUE) +
  REPLACE +
  QSGDISP(SHARED) +
  CFSTRUCT(MSGQ1)
  TRIGGER +
  TRIGDATA(DQMMQGP.TO.DQMLNXP) +
  INITQ(SYSTEM.CHANNEL.INITQ) +
  USAGE(XMITQ)  +
  STGCLASS(DQMSTG)
```

Example: The following are our definitions for the local sender channel and the remote receiver channel:

```
DEFINE CHANNEL(DQMMQGP.TO.DQMLNXP) +
  REPLACE +
  CHLTYPE(SDR) +
  XMITQ(DQMLNXP.XMIT.QUEUE) +
  QSGDISP(GROUP) +
  TRPTYPE(TCP) +
  DISCINT(15) +
  CONNAME(remote_client_host_name)

DEFINE CHANNEL(DQMMQGP.TO.DQMLNXP) +
  REPLACE +
  CHLTYPE(RCVR) +
  TRPTYPE(TCP)
```

Testing shared channel recovery

Based on the information in the MQ intercommunication guide, as well as information in the IBM Redbook, *WebSphere MQ in a z/OS Parallel Sysplex Environment*, SG24-6864, we tested several scenarios for shared channel recovery. For each scenario, we varied the DISCINT parameter of the channels in order to strike a balance between manual channel status observation and load-balanced channel starts. For our particular workload and environment, we set it to 60 seconds.

By observing the WLM goals for the Sysplex Distributor (using the NETSTAT VDPT command), we were able to ascertain the queue manager on which the inbound channel likely would start. In all of our tests, our sysplex workload mix caused queue manager CSQC on system JC0 to be favored as the destination of the Sysplex Distributor.

The following are the shared channel recovery scenarios that we tested, along with our experiences and observations:

Testing channel initiator failure

Action: Cancel the CHINIT address space.

Expected Results: The channel initiator fails, but the associated queue manager remains active. The queue manager monitors the failure and initiates recovery processing.

Actual Results: From a NETSTAT VDPT display, we observed that system JC0 had a WLM goal of 13 and JB0 had a goal of 12. All other queue manager systems had lower WLM goals. Thus, we expected the channel to start on JC0 (queue manager CSQC) and recover to JB0 (queue manager CSQB) when CSQCCHIN was cancelled.

With our DQM workload running over a shared inbound channel from our remote Linux host (queue manager LNXP) to the CSQC member of our MQGP queue sharing group, we canceled CSQCCHIN. The application continued to run successfully after the channel restarted on CSQB (as it had the highest WLM goal in the queue sharing group). After we restarted CSQCCHIN, when the channel timed out on CSQB, the next set of messages caused the channel to restart on CSQC.

The following messages appeared on the queue manager where CSQCCHIN was canceled:

```
CSQ3201E !MQJC0 ABNORMAL EOT IN PROGRESS FOR USER=
        CONNECTION-ID=CSQCCHIN THREAD-XREF=
CSQM052I !MQJC0 CSQMPCRT Shared channel recovery
        completed for CSQC, 1 channels found, 0 FIXSHARED, 1 recovered
```

Testing queue manager failure

Action: Cancel the MSTR address space.

Expected Results: The queue manager fails (failing the associated channel initiator). Other queue managers in the queue sharing group monitor the event and initiate peer recovery.

Actual Results: With our DQM workload running from our remote Linux host (queue manager LNXP) to the CSQC member of our MQGP queue sharing group, we canceled CSQCMSTR. The channel restarted on queue manager CSQB and the application continued to run successfully. After CSQCMSTR had completely restarted and channel DQMLNXP.TO.DQMMQGP timed out to CSQB, the next set of messages caused the channel to restart on CSQC (CSQCCHIN was restarted when CSQCMSTR restarted).

Testing DB2 failure

Action: Cancel the DB2 subsystem.

Expected Results: Channel state information is stored in DB2, so a loss of connectivity to DB2 becomes a failure when a channel state change occurs. Running channels can continue running without access to these resources. On a failed access to DB2, the channel enters the retry state.

Actual Results: During normal operations, we lost the connection to the DB2 subsystem from queue manager CSQA (which is also a member of our MQGP queue sharing group). Subsequent attempts to display, start, or stop shared channels failed with the following error message:

```
CSQM294I – CSQA CSQMDRTS CANNOT GET INFORMATION FROM DB2
```

We then had to wait until the connection to DB2 was re-established in order to change the state of any shared channels. This corresponds to results discussed in *WebSphere MQ in a z/OS Parallel Sysplex Environment*.

Using WebSphere Business Integration Message Broker

WebSphere Business Integration Message Broker is the latest version of the product formerly known as WebSphere MQ Integrator. This section continues the discussion of our experiences with WebSphere MQ Integrator V2.1 from our December 2003 edition and includes our experiences migrating to WebSphere Business Integration Message Broker V5.0.

Note: To simplify the discussion, we'll refer to WebSphere Business Integration Message Broker as WBIMB, and WebSphere MQ Integrator as WMQI. However, these abbreviations are not officially sanctioned by IBM, so you should not use them to try to locate information or for product ordering, for instance.

Testing WMQI V2.1 on DB2 V8

We brought up one of our WMQI V2.1 brokers (CSQ1BRK) on DB2 V8 just to see if this would work. To do this, we first deleted the broker and it's broker database on DB2 V7, and then recreated the broker using DB2 V8 for the broker and application databases. We also tested the scenario where the broker database is on DB2 V8 and the application databases is on DB2 V7 and had no problems. We tested using a variant of the Retail WMQI application that we described in our December 2003 edition.

Setting the _BPXK_MDUMP environment variable to write broker core dumps to MVS data sets

By default, broker core dumps are written to the home directory of the owner of the broker's started task in z/OS UNIX, with each dump in a separate file with a unique identifier. For example, in our sysplex, the started task owner for all brokers is MQSTEST, so the dumps are written to MQSTEST's home directory in the z/OS UNIX file system (/u/mqstest).

The problem is that these dumps are often quite large and can quickly fill up the HFS if it is not carefully monitored. Also, since we have four brokers running on different systems in the sysplex, with each broker using MQSTEST as the started task owner, it can often be difficult to determine which broker created which core dump.

We solved these problems by customizing our brokers to write core dumps to MVS data sets instead of to the started task owner's home directory. We specified a different data set for each broker's core dumps. To do this, we added the environment variable _BPXK_MDUMP to the ENVFILE file and also to the mqsicompcif file (both of which reside in the broker's component directory in the

z/OS UNIX file system) so that if the broker is re-customized in the future, this change will not be lost. It is important to remember that the broker may have to be restarted to pick up changes to the ENVFILE.

We did the following to define the _BPXK_MDUMP environment variable and prepare the target MVS data sets to receive the broker core dumps:

1. We defined the _BPXK_MDUMP environment variable in the ENVFILE file to specify the name of the MVS data set to receive broker core dumps.

   Example: We added the following line to the end of the ENVFILE file on system Z2 to cause broker core dumps on that system to be written to the MVS data set WMQI.COREDUMP.Z2:

   ```
   _BPXK_MDUMP=WMQI.COREDUMP.Z2
   ```

---

2. Similarly, we also defined the _BPXK_MDUMP environment variable in the mqsicompcif file, between the (ENVIRONMENTBEGIN) and (ENVIRONMENTEND) tags.

   Example: We added the following to the mqsicompcif file on system Z2:

   ```
   (ENVIRONMENTBEGIN)
   _BPXK_MDUMP=WMQI.COREDUMP.Z2
   (ENVIRONMENTEND)
   ```

---

3. We allocated an empty MVS sequential data set for each data set name that we specified by a _BPXK_MDUMP environment variable. The data sets must already exist in order for core dumps to be written to them.

   Example: The following is an example of the attributes we specified to allocate the MVS data sets:

```
Data Set Name . . . . : WMQI.COREDUMP.Z2

General Data                          Current Allocation
 Management class . . : NOMIG          Allocated cylinders : 750
 Storage class  . . . : STANDARD       Allocated extents . : 1
  Volume serial . . . : PPRD0B
  Device type . . . . : 3390
 Data class . . . . . : **None**      Current Utilization
  Organization  . . . : PS             Used cylinders  . . : 0
  Record format . . . : FBS            Used extents  . . . : 0
  Record length . . . : 4160
  Block size  . . . . : 4160
  1st extent cylinders: 750
  Secondary cylinders : 250
  Data set name type  :                SMS Compressible  . : NO

  Creation date . . . : yyyy/mm/dd     Referenced date . . : ***None***
  Expiration date . . : ***None***
```

Note: We found that each time a broker writes a core dump, it simply appends to the end of the dump data set; therefore, it is important to monitor and clear out these data sets on a regular basis.

Resolving a EC6–FF01 abend in the broker

We ran into a problem where, immediately upon starting the broker, it would fail with an EC6–FF01 abend. We traced the cause of this problem back to the HFS for the broker component directory being completely full. Once we allocated more space for the HFS, the broker was able to successfully start.

Migrating WebSphere MQ Integrator V2.1 to WebSphere Business Integration Message Broker V5.0

We used the WBIMB V5.0 documentation in the online WebSphere Business Integration Information Center (publib.boulder.ibm.com/infocenter/wbihelp/index.jsp) and in the IBM Redbook, *Migration to WebSphere Business Integration Message Broker V5*, SG24-6995, to perform our migration.

Migration activities on the Windows platform

We performed the following activities to migrate to WBIMB V5.0 on the Windows platform:

1. We installed DB2 V8 on our Windows XP system, which replaced DB2 V7 that was already installed.

---

2. We had to migrate the existing broker and configuration manager databases so that they could be used with DB2 V8.

   Example: We issued the following commands from the DB2 command line processor to migrate the broker databases from DB2 V7 to DB2 V8:

   ```
   migrate database MQSIBKDB
   migrate database MQSICMDB
   migrate database MQSIMRDB
   ```

---

3. We performed some testing to verify that the WMQI V2.1 broker, configuration manager, and Control Center were still working following the database migration.

---

4. We installed the WBIMB V5.0 tool kit on our Windows XP system.

   To do this, we followed the instructions in the online Information Center and the Redbook cited earlier. We strongly recommend that you read the relevant sections in the Redbook before starting your migration. As the instructions state, it is important to first uninstall the WMQI V2.1 Control Center *excluding data,* so that the data remains on the Windows system.

Migration activities on the z/OS platform

We have not yet tested the documented migration path for taking existing WMQI V2.1 brokers to WBIMB V5.0. Since the broker is a runtime component, we felt that simply deleting the V2.1 broker, recreating it as a V5.0 broker, and deploying the appropriate flows would be a satisfactory migration path. However, we do intend to try migrating one of our brokers by using the jobs and documentation that WBIMB V5.0 provides and we will report on any relevant experiences in a future test report.

For now, we deleted our WMQI V2.1 brokers and recreated them as WBIMB V5.0 brokers with Fix Pack 01. We noticed that the installation directory in WBIMB V5.0 is different than it was in WMQI V2.1 (for us, it was /wbimb50/mqsi/V5R0M0 in V5.0, and /wbimb50 in V2.1). Later on, after applying Fix Pack 02 and Fix Pack 03

(we did one right after the other), we noticed that the installation directory had again changed (now it was /wbimb50/V5R0M1), so we again had to update our jobs with the correct directory path.

As the documentation points out, it is important to note that Java version 1.4.0 is the minimum level that is required for WBIMB V5.1 on z/OS. See the section, "Checking the level of Java (z/OS)," in the online Information Center.

Applying WBIMB V5.0 Fix Pack 02 and Fix Pack 03

It is important to realize that FixPack 02 is actually a new release of WBIMB—namely, WBIMB 5.0.1. One difference that we found is the change in the installation directory path, as we mentioned earlier. This means that the JCL in the jobs generated by the mqsicustomize step needs to be updated to point to the new directory path. We found that the easiest way to do this was by recreating the broker and customizing it with a mqsicompcif file that uses the correct installation library.

After applying the Fix Packs, we also ran into a problem where we could run the customization verification program (job name BIP$JCVP) with no errors, but when we started the broker, it would come down after a minute or two with a 4039 user abend. We found that we had not listed all of the necessary directories in the LIBPATH in the mqsicompcif and ENVFILE files (both of these files reside in the broker's component directory in the z/OS UNIX file system). We corrected the problem and the broker started and ran successfully.

Updating the Retail_IMS workload for workload sharing and high availability

In an effort to make our broker domain more complex and introduce workload sharing and high availability to our WBIMB workloads, we created another broker for a total of two brokers on our production systems. We altered the Retail_IMS workload to utilize both brokers (workload sharing) and to continue processing on one broker if the other one goes down (high availability).

Description of the workload

As mentioned in "Websphere Business Integration Message Broker" on page 22, the Retail_IMS workload uses WebSphere Application Server 5.1 to host a Web front end (html page and java servlet) to receive information from the user. This information is rolled up into a message and placed on the RETAIL.IMS.IN queue, which a message flow in WBIMB is monitoring. As shown in Figure 54 on page 252, the WBIMB message flow extracts some fields from the message, adds an IMS header, and puts the new message on the RETAIL.IMS.OUT queue. The java servlet then takes the message from the RETAIL.IMS.OUT queue and passes it to an html page for display. Any failures during WBIMB message processing result in a message on the RETAIL.IMS.FAIL queue.

Thus, there are three queues that are used in this workload:

1. RETAIL.IMS.IN - holds the input message to the WBIMB message flow
2. RETAIL.IMS.OUT - holds the output message from the WBIMB message flow when normal processing occurs
3. RETAIL.IMS.FAIL - holds the output message from the WBIMB message flow when abnormal processing occurs

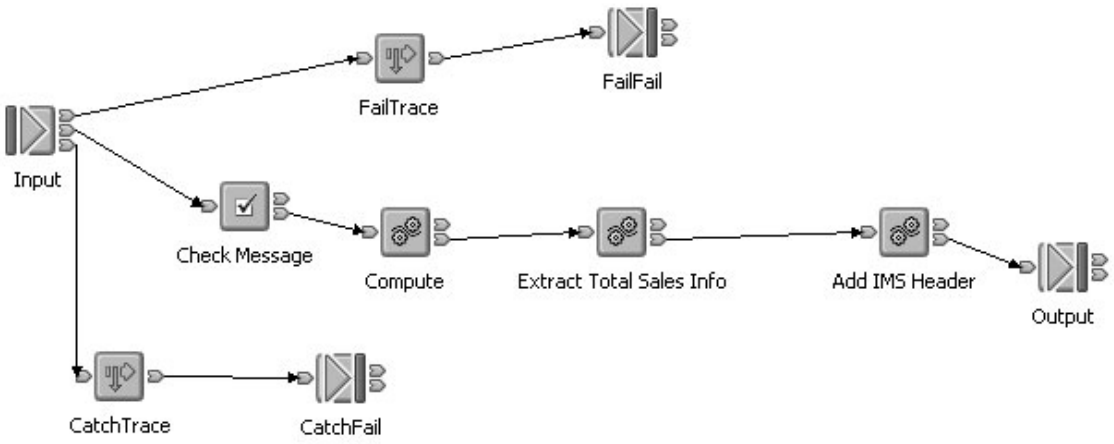


Figure 54. WBIMB message flow.

Changes to the workload

We made the following changes to the workload:

- Added the queue managers that host the two brokers and the queue managers that host the WebSphere Application Server server(s) to an existing queue sharing group
- Created a new cluster containing those queue managers
- Deployed the Retail_IMS message flow to the new broker, so that the same message flow is on both brokers
- Deleted and recreated each of the three queues to make them shared and clustered, using the following queue definitions:

```
DEFINE QL(RETAIL.IMS.IN) REPLACE                                    +
      CLUSTER(MQBROKER.CLUSTER)                                     +
      QSGDISP(SHARED) CFSTRUCT(WMQI)                                +
      DESCR('INPUT QUEUE on CSQ9 FOR WMQI RETAIL IMS WORKLOAD')     +
      SHARE DEFSOPT(SHARED) INDXTYPE(CORRELID) GET(ENABLED)

 DEFINE QL(RETAIL.IMS.OUT) REPLACE                                  +
      CLUSTER(MQBROKER.CLUSTER)                                     +
      QSGDISP(SHARED) CFSTRUCT(WMQI)                                +
      DESCR('OUTPUT QUEUE on CSQ9 FOR WMQI RETAIL IMS WORKLOAD')    +
      SHARE DEFSOPT(SHARED) INDXTYPE(CORRELID) GET(ENABLED)

 DEFINE QL(RETAIL.IMS.FAIL) REPLACE                                 +
      CLUSTER(MQBROKER.CLUSTER)                                     +
      QSGDISP(SHARED) CFSTRUCT(WMQI)                                +
      DESCR('FAILURE QUEUE on CSQ9 FOR WMQI RETAIL IMS WORKLOAD')   +
      SHARE DEFSOPT(SHARED) INDXTYPE(CORRELID) GET(ENABLED)
```

As a result of these changes, the Retail_IMS workload now utilizes both brokers, alternating between brokers for each transaction by using the round robin

functionality of MQ clustering. Additionally, if one of the two brokers fails, all of the messages are then processed by the other broker, and if the failed broker returns, the messages again round robin between the brokers. The end result is a workload that utilizes workload sharing and provides some level of high availability.

Additional information about this topic can be found in the *WebSphere Business Integration Message Broker and high availability environments* located at:

`http://www.ibm.com/developerworks/websphere/library/techarticles/0403_humphreys/0403_humphreys.html`

Some useful WBIMB Web sites

We found the following Web sites useful when working with WebSphere Business Integration Message Broker:

- README files for WebSphere MQ family products: www.ibm.com/software/integration/mqfamily/support/readme/
- Fix Packs for WebSphere Business Integration Brokers: www.ibm.com/software/integration/mqfamily/support/summary/wbib.html
- SupportPacs for WebSphere MQ family products: www.ibm.com/software/integration/support/supportpacs/product.html

  Note: We found SupportPac IP13 for WebSphere Business Integration Brokers to be particularly useful.
- IBM Redbooks: www.ibm.com/redbooks/

Chapter 17. Using IBM WebSphere Application Server for z/OS

This chapter describes our experiences using IBM WebSphere Application Server for z/OS and related products. Our test environment is now fully migrated to WebSphere Application Server for z/OS V5.1 running on z/OS V1R6. See "Migrating to WebSphere for z/OS V5.X" in our previous test report for information on our migration.

Note: References to WebSphere Application Server for z/OS V5.*x* appear in the text as ″WebSphere for z/OS V5.*x*″ or simply ″V5.*x*.″

About our z/OS V1R6 test environment running WebSphere Application Server

Over the past few months, we have made a number of changes and updates to our WebSphere Application Server for z/OS test environment. In this chapter, we provide a level-set view of our current test environment and provide details about the changes we've made and our experiences along the way.

Our z/OS V1R6 WebSphere test environment

This section provides an overview of our z/OS V1R6 WebSphere test environment, including the set of software products and release levels that we run, the Web application configurations that we support, and the workloads that we use to drive them.

Current software products and release levels

The following information describes the software products and release levels that we use on the z/OS platform and on the workstation platform.

Software products on the z/OS platform: In addition to the elements and features that are included in z/OS V1R7, our WebSphere test environment includes the following products:

- WebSphere Application Server for z/OS Version 5.1, service level W510205
- WebSphere Application Server for z/OS Version 6.0.2, service level cf10533.10
- IBM SDK for z/OS, Java 2 Technology Edition V1.4.2 (June 23, 2005 Build Data, PTF UK04987)
- WebSphere Studio Workload Simulator V1.0
- WebSphere MQ for z/OS V5.3.1
- WebSphere Business Integration Message Broker for z/OS V5.0
- DB2 V8.1 with JDBC (PQ90211)
- CICS TS 3.1
  - CICS Transaction Gateway (CICS TG) V6.0
- IMS V9 with IMS Connector for Java V9
  - IMS Connector for Java V9.1.0.1

Software products on the workstation platform: Software products on the workstation platform: On our workstations, we use the following tools to develop and test our Web applications:

- WebSphere Studio Application Developer, IE V5.1
- WebSphere Studio Workload Simulator V1.0

Our current WebSphere Application Server for z/OS configurations and workloads

The following are our current WebSphere Application Server for z/OS configurations and workloads.

Configuration update highlights: We made the following updates to our test and production configurations:

- Begun migration of cells to WebSphere Application Server for z/OS V6.0
- Migrated from using CICS Transaction Gateway (CICS TG) V5.1 / CICS TS 2.2 to using CICS TG V6 / CICS TS V3.1
- Migrated from using IMS Connector for Java V2.2 / IMS V8 to using IMS Connector for Java V9.1.0.1 / IMS V9
- Changed to use LDAP for WebSphere Application Server security backend for one cell
- Exploited DB2 UDB JCC Connectors with Syslex Distributor for higher availability
- Exploited WAS Session Memory Replication

Our test and production configurations: In our environment, we have fully migrated to WebSphere for z/OS V5.1. Our current V5.1 setup contains four cells: T1 and T2 for our test systems, P1 for our WebSphere Application Server for z/OS production systems and QP for WebSphere Application Server for z/OS applications used by MQ team. All cells are configured as network deployment cells.

Our T1 cell is configured as follows:

- Resides entirely on one of our test systems (Z1)
- Contains six different J2EE servers, each running different applications (as described below)

Our T2 cell is configured as follows:

- Generally resides on one of our test systems (Z2), but also has nodes configured on two additional systems (JB0 and JH0)
- Contains six different J2EE servers, each running different applications (as described below)

Our P1 cell is configured as follows:

- Spans four production systems in our sysplex (J80, JB0, JF0, and JH0)
- Contains six different clusters, each of which spans all four systems. Each cluster contains four J2EE servers—one J2EE server per system.
- Each cluster corresponds to one of the single J2EE servers in our T1/T2 cell. Initially, we configure and deploy applications on a test J2EE server in the T1 and/or T2 cell and then deploy them to the corresponding server cluster in the P1 cell.

Our QP cell is configured as follows:

- Spans two production systems in our sysplex (JC0 and J90)
- Contains two different clusters, each of which spans both systems. Each cluster contains two J2EE servers—one J2EE server per system.
- Each cluster hosts various applications that connect WebSphere Application Server for z/OS to MQ as used by the MQ team.

Our Web application workloads: The following applications run in the J2EE servers on our T1, T2 and P1 cells:

- J2EE server 1 runs our workload monitoring application. The application accesses only z/OS UNIX System Services files.
- J2EE server 2 runs our bookstore application, accessing DB2 and WebSphere MQ
- J2EE server 3 runs the Trade3 application, accessing DB2 and WebSphere MQ
- J2EE server 4 runs our PETRTWDB2 application, accessing DB2
- J2EE server 5 runs our PETDSWIMS application, accessing IMS
- J2EE server 6 runs our PETNSTCICS application, accessing CICS

Figure 55 on page 258 shows the server address spaces in our P1 cell.

Note: The wsp1s1 cluster is not shown in the diagram.

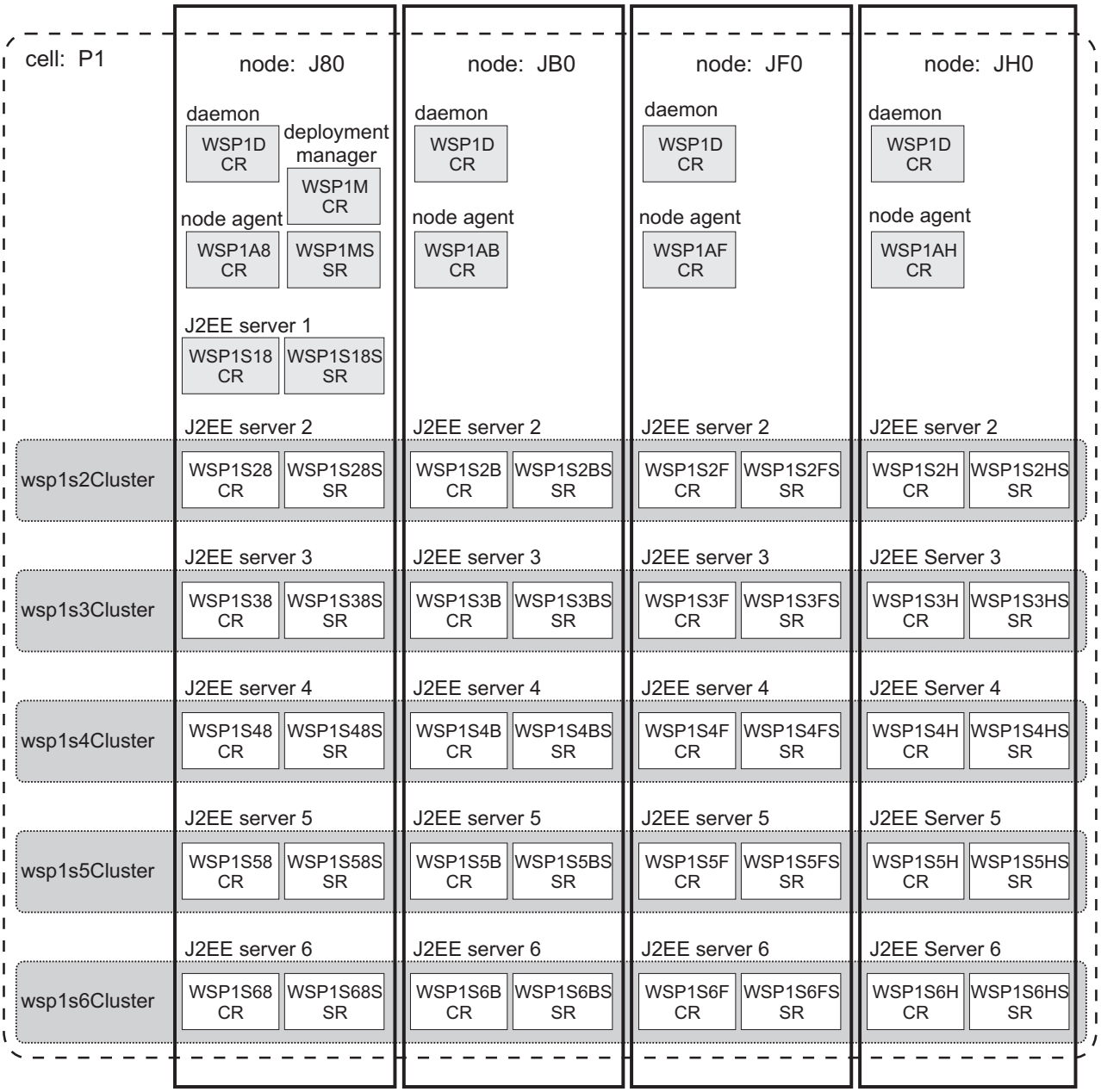


Figure 55. Our WebSphere for z/OS V5.1 configuration

About our naming conventions: After some experimentation, we settled upon a naming convention for our WebSphere setups. Our address space names are of the following format:

`WS`*`ccs`*`[`*`n`*`]`*`y`*`[S]`

where:

WS The first two characters are always “WS” to identify a WebSphere resource.

cc Cell identifier:
- **T1** Test cell 1
- **T2** Test cell 2
- **P1** Production cell 1
- **QP** MQ Team Production cell

s[*n*] Server type. For J2EE server control regions and server regions, *n* is the instance number of the server within the node:
- **A** Node agent
- **D** Daemon
- **M** Deployment manager
- **S***n* J2EE server control region, instance *n*

y System identifier:
- **1** Z1 (test)
- **2** Z2 (test)
- **8** J80 (production)
- **B** JB0 (production)
- **F** JF0 (production)
- **H** JH0 (production)

[S] Servant flag. This is appended to the name of a J2EE server control region to form the name of the associated servant region(s).

Example: The name WSP1S18S indicates a **W**eb**S**phere **p**roduction cell **1** J2EE server **s**erver region **1** on system J**8**0.

Server short names are specified in upper case. Server long names are the same as the short names, but are specified in lower case.

Other changes and updates to our WebSphere test environment

The following describe other changes and updates to our WebSphere test environment.

Migrating WebSphere Application Server for z/OS Version 5.1 to Version 6

Overall, our migrations from WebSphere Application Server for z/OS V5.1 to V6 have been very smooth. This has been even with Global Security enabled on the cell.

We initially created a new cell with WebSphere Application Server for z/OS V6, first as a Stand-alone server. After getting comfortable with V6, we then created a new DeploymentManager node and federated the new Stand-alone server into the Deployment Manager's cell. This all worked very well. It still takes a good bit of planning and work to setup V6 from scratch.

While we did have some problems with the initial V6 levels, we successfully migrated from our WebSphere Application Server for z/OS V5.1 with service level W510015 to WebSphere Application Server for z/OS V6.0.1 at service level CF10515. We followed along with the WSC Tech Doc,*"Migrating an ND Configuration from V5.1 to V6"* . The information contained in this document has now been incorporated into the WebSphere Application Server for z/OS V6 InfoCenter, but we find it easier to have the whole migration process laid out in a single document.

The configuration dialogs for the migration have also been improved from the previous set used to migrate to WebSphere Application Server for z/OS V5.1. Only the essential variables are shown on the dialog panels. The actual process of running the configuration jobs is simplified. The number of jobs that need to be run has been reduced.

References

WebSphere Application Server for z/OS - Migrating an ND Configuration from V5.1 to V6 This document can be found on the web at:

www.ibm.com/support/techdocs

Search for document number WP100559 under the category of ″White Papers

IBM WebSphere Application Server for z/OS and OS/390 documentation, available at

http://www.ibm.com/software/webservers/appserv/zos_os390/library/

IBM WebSphere Application Server Version 6.0 Information Center, available at

http://publib.boulder.ibm.com/infocenter/wasinfo/index.jsp

Migrating WebSphere Application Server for z/OS JDBC from DB2 V7 to DB2 V8

We migrated our WebSphere Application Server for z/OS servers from using DB2 7.1 to DB2 8.1 for JDBC and experienced no problems with their usage. The items we changed are described below. See the IBM WebSphere Application Server Version 5.*X* Information Center, available at publib.boulder.ibm.com/infocenter/wasinfo/index.jsp″ for a complete step-by-step guide to assist you in the proper setup for DB2 JDBC. Also see “Using DB2 UDB JCC Connectors” for configuring UDB connectors.

We did the following to migrate to using DB2 V8:

- Created a new db2sqljjdbc.properties file for DB2 V8
- Updated the following environment variables: DB2390_JDBC_DRIVER_PATH, DB2UNIVERSAL_JDBC_DRIVER_PATH, and DB2UNIVERSAL_JDBC_DRIVER_NATIVEPATH to point to the appropriate DB2 V8 JDBC/JCC directories and DB2SQLJPROPERTIES to point to the new db2sqljjdbc.properties file
- Changed all DB2 plan references to reference our DB2 V8 JDBC plan name. This needs to be done in the new db2sqljjdbc.properties file as well as the Custom Properties for the various JDBC data sources defined in WebSphere Application Server for z/OS.

Using DB2 UDB JCC Connectors

Support for DB2 Universal JDBC Type-2 and Type-4 drivers is now available. We have taken advantage of the new connectors for z/OS and experienced no problems with their usage. To use these WebSphere Application Server for z/OS must be at service level W502004 or higher and APAR PQ80841 for DB2 V7 for z/OS applied. Support is provided with DB2 UDB V8 for z/OS.

See ″Enabling WebSphere Application Server V5 for z/OS to use the DB2 Universal JDBC Driver″, TD101663, for a complete step-by-step guide to assist you in the proper setup for using the Type-2 and Type-4 connectors with WebSphere Application Server V5. This white paper is available on the IBM Techdocs Web site at: *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD101663*

See also the Redbook: ″DB2 for z/OS and WebSphere: The Perfect Couple″, SG24-6319 for full details on using these connectors in the WebSphere environment. This redbook is available at *www.redboooks.ibm.com*.

Failover Testing for JDBC using the Sysplex Distributor

Our setup for the first scenario for failover testing for JDBC using the Sysplex Distributor is as follows:

We have a J2EE server running on system J80. The application we used has two JDBC datasources which are both defined at the server level:

1. A type 4 XA where the server connects to the local DB2 for the data source
2. A type 4 non-XA where the server connects to the DB2 data sharing group data source through the VIPA address of the sysplex distributor

The Websphere Info Center documentation recommends using *"EntirePool"* as the connection setting for JDBC resources so that all connections in the pool are marked stale and connections that are not in use are closed. Subsequent connect requests from the application result in new connections to the database. We changed our setting for this test from *"FailingConnectionOnly"* to *"EntirePool"*. This setting can be found under the JDBC provider "Connection Pools" item.

For our failover test we set up a dynamic VIPA address in TCPIP for the DB2 servers to distribute requests among three DB2 subsystems. Our TCPIP definiton looks as follows:

```
TCPIP.PROFILE
VIPADEFINE MOVEABLE IMMED 255.255.255.0 192.168.33.100
VIPADISTRIBUTE DEFINE 192.168.33.100 PORT 55          (DDF is listening on port 55)
DESTIP 192.168.49.30 192.168.49.33 192.168.49.37       (The three DB2 datasharing group members)
```

This test involved stopping DB2 on the system where the WebSphere Application Server server was connected to and verifying that it switched over to another DB2. As the application ran, there were threads running from the server that WebSphere Application Server was on to all three members of the data sharing group. We stopped the distributed data facility (DDF) on one DB2 subsystem and saw the connections move to another member. Then we restarted DDF and after a few seconds WebSphere Application Server connected back to that DB2. The application took no errors.

We also tested a similar second scenario with a WebSphere Application Server server setup with only one JDBC type 4 provider defined for both datasources with the same results.

Utilizing memory-to-memory replication

We changed several of our Websphere Application Servers to use the memory-to-memory replication function to store session data instead of using session tables in DB2. We chose to implement the client/server function with remote replicators topology. Information on the different topologies that are available, and the pros and cons of each, are described in the "Information center for WebSphere Application Server for z/OS" version 5.1 section titled "Memory-to-memory replication". The steps required to define the servers and replication domain are outlined in the Websphere Application Server documentation section titled "Configuring memory-to-memory replication for the client/server function using remote replicators".

Once the replicator servers were set up we altered the settings for the application servers to switch from DB2 to memory replicators. The steps to do this can be found in the section titled " Memory-to-memory sessions settings". It was very easy to switch from DB2 to memory-to-memory and back to DB2 as desired.

During our testing we encountered a problem if the ″Single Replica″ option was chosen in the replicator domain settings. The problem was fixed in service level W510215 by APAR PK04179. This service introduced a new message, *″SESN0019E: checkMinimumInvalidationError detected that TimeBaseWrite invalidation time was not at least 3 times the Write Interval. This was temporarily corrected. ″*

The Websphere Application Server server startup messages related to session replication are prefixed by DRS and SESN. For example In the app server you will see *DRSW0006I: WebSphere internal replication client launched: HttpSessionCache*. In the replicator server you will see *DRSW0007I: WebSphere internal replication launched: wsp1rplb*.

We tested failover from one replicator to the other by bringing down one replicator server to verify that the application server switched over to the other replicator.

When an application server is started when the replicator servers are down it gets a connection error. When the replicator server is started it connects and you will see message *DRSW0005I: WebSphere internal replication has recovered from a previous connection failure.*

Migrating to CICS Transaction Gateway Connector V6.0

We have migrated our CICS Transaction Gateway (CTG) from Version 5.1 to Version 6.0. Our migration was a very simple and straight forward process, and we experienced no problems with the current level.

CICS TG V6.0 provides a number of improvements that we have taken advantage of, including:

- Installing CTG 6.0 with SMP/E
- Starting up the CICS TG Daemon using CTGBATCH

See *CICS Transaction Gateway for OS/390 Administration*, SC34-5528 for full details on other enhancements for version 6.0, including improved administration for starting, stopping and changing tracing options.

Installing CTG 6.0 with SMP/E

CICS TG for z/OS V6.0 installation is different from previous levels. The product now is an SMP/E installation which simplifies the process of installing, migrating and applying corrective maintenance to the product.

Starting up the CICS TG Daemon using CTGBATCH

CICS TG V6.0.0 now provides the CTGBATCH batch mode program for running the CICS TG daemon. While starting the daemon using BPXBATCH is still supported, CTGBATCH is the recommended way. This program provides a way of starting USS programs and allowing the output messages to be directed to the JES log or an MVS sequential dataset.

We changed to use CTGBATCH in the JCL used to run our CICS TG daemons as a Started Task and now direct all output to the Joblog. Previously, this output was sent to HFS files. All output information from the CICS TG daemon is now contained in one place.

See the ″CTGBATCH examples″ section in *z/OS Communications Server: APPC Application Suite Administration*, SC31-8835*CICS Transaction Gateway for OS/390 Administration* for sample JCL using CTGBATCH.

CICS TG V6.0 would only install into WebSphere Application Server V6 for z/OS

The CICS TG V6.0 Resource Archive (RAR) would not install into WebSphere Application Server V5.x for z/OS. This meant that we had to wait until we migrated our WebSphere Application Server setups to V6.0 before we could update them to CICS TG V6.0. We were able to run with CICS TG V5.1 in our WebSphere Application Server V6 for z/OS setups with no problems when we first migrated. We were also able to migrate our CICS TG daemons to CICS TG V6 prior to migrating to WebSphere Application Server V6 for z/OS.

Our sequence of migration was:

1. Migrate CICS TG daemons to CICS TG V6.0 (WebSphere Application Server V5.1 for z/OS using CICS TG V5.1 resource adapter)
2. Migrate WebSphere Application Server from V5.1 to WebSphere Application Server V6.0 (WebSphere Application Server V6.0 using CICS TG V5.1 resource adapter)
3. Migrate CICS resource adapter used by WebSphere Application Server V6 for z/OS from CICS TG V5.1 to CICS TG V6.0

Since the code levels were compatible for our application, the above migrations did not need to be performed concurrently.

Deploying the CICS ECI resource adapter in WebSphere Application Server V6 for z/OS

We also used the methods described in the WSC Tech Doc, *"Connecting to CICS Transaction Server from WebSphere for z/OS Version 6 "*, document number WP1000607, to create a new RAR file that includes the *libctgjni.so* prior to deploying. With this packaging, we no longer need to provide the Native Path on the resource definitions for our WebSphere Application Server setups that run CICS TG to a CICS region on the same system (*local: option*). This made for simpler and more consistent deployments across WebSphere Application Server nodes that used a local or remote connection to CICS. The Tech Doc provides very good step-by-step directions on the setups for WebSphere Application Server and CICS.

Uninstall any previous version of the CICS Connector prior to installing this version as described in the instructions in *z/OS Communications Server: APPC Application Suite Administration*, SC31-8835.

References

Documentation for CTG 5.1 is available from *http://www.ibm.com/software/htp/cics/ctg/library/* including *z/OS Communications Server: APPC Application Suite Administration*, SC31-8835.

This site also includes links to various other documents on CICS Transaction Gateway, including White Papers, Redbooks, and Configuration Guides.

WSC Tech Doc, "Connecting to CICS Transaction Server from WebSphere for z/OS Version 6 ", document number WP1000607, available at: *http://www.ibm.com/support/techdocs*

Migrating to IMS Connector for Java V9.1.0.1

We have migrated our WebSphere Application Server setups using IMS Connector for Java from Version 2.2 to Version 9.1.0.1. IMS Connector for Java Version 9.1.0.1 comes with IMS V9 and is the functional equivalent of IMS Connector for Java V2.2.2.

Our migration was a very simple and straight forward process, and we experienced no problems with the current level. We also experienced no problems when interconnecting between IMS Connector for Java V2.2 and V9.1.0.1 with IMS V8 (using IMS Connector for Java V2.2) and IMS V9 (using IMS Connector for Java V9). This allowed us to perform migrations of various components at different times.

IMS Connect for Java V9.1.0.1 install and setup for WebSphere Application Server is very simple. See the README doc that comes with the connector for detailed instructions.

See the following IBM Redbook for full information on using IMS V9, including IMS Connector for Java: "IMS Version 9 Implementation Guide - A Technical Overview, SG24-6398", available at: *http://www.redbooks.ibm.com/*

For full information about IMS Connector for Java, access the IMS Connector for Java Web site by going to the IMS home page at *www.ibm.com/ims* and clicking on ″IMS Connector for Java″.

Using the LDAP User Registry for WebSphere Application Server for z/OS administration console authentication

We configured an LDAP environment for use as an authentication mechanism for our WebSphere Application Server administration consoles. Our LDAP server can also be located on any LPAR in our sysplex because WebSphere Application Server uses a hostname and port combination to connect to the server. The LDAP server contains the same user/group structure as our original RACF definitions for userid consistency purposes. Our LDAP server uses a TDBM backend (where our user and group values are stored in DB2 tables).

Our LDAP groups are defined by the objectclass "*groupOfUniqueNames*," and our LDAP users are defined by the objectclass "*ePerson*." For example, the full name of one of our LDAP userids is: *cn=WASADM1, ou=WSADMNGP, o=WASuser, c=US*

Our LDAP setup is useful to us when we need to exploit application security such as form-based login and want a certain set of users to have access to the application that do not normally have access to that WebSphere Application Server cell. Since the scope of the user registry is the whole WebSphere Application Server cell, LDAP registries provide a way to allow different sets of users access to applications on that cell using declarative security without giving those users privileges in RACF.

To implement this idea, we simply switched the user registry from the Local OS (RACF) registry to LDAP. This allowed a new set of users to access applications for security testing in that particular WebSphere Application Server cell. This paradigm applies well to an environment where an application may progress through multiple cells in its lifecycle: a test cell, a quality analysis cell, and finally the production cell. An LDAP registry specifically configured with users for one application can be used by any of those cells depending on what stage of development the application is currently in. The WebSphere Application Server Infocenter and the IBM Developer's Domain have more information on how to set up an LDAP authentication environment.

Enabling Global Security and SSL on WebSphere Application Server for z/OS

We have enabled Global Security and Secure Sockets Layer (SSL) on each of our WebSphere Application Server for z/OS 5.x Cells. Security is extensively integrated into both the z/OS operating system and WebSphere Application Server for z/OS. There is a considerable amount of setup work required to get WebSphere Application Server for z/OS installed and initially running on z/OS. While that alone can be daunting enough, even more planning and setup work is required before enabling Global Security. Proper planning is essential.

A number of issues relate to WebSphere Application Server for z/OS security, and it is highly recommended that you pick up the latest WebSphere Application Server for z/OS service level.

In our WebSphere Application Server 5.1 environment, we are using security in the following areas:

- LocalOS (local operating system) for our User Registry, with RACF for SAF
- Unique userids for each WebSphere Application Server, including Daemon, Deployment Manager and Node Agents
- Server Certificates managed in RACF key rings
- SSL Transport Handlers enabled for all J2EE servers
- SSL enabled through HTTP Server with WebSphere Application Server for z/OS plug-in
- EJBROLE authorization checking
- Component and container managed authorization as appropriate for DB2, CICS and IMS resources.

Global Security — ″the Big Switch″

Global Security can be considered a ″big switch″ for WebSphere Application Server for z/OS. Disabled, many security checks are bypassed. When ″switched on″, things can appear that you might not have thought of or planned for.

For example, with global security disabled, the web-based Admin Console application will prompt for and accept virtually anything for a userid (even a userid that is not valid on the system) and no password. When global security is enabled, you will need a valid userid/password to enter. If EJBROLE authorization is enabled, further setup is also required to authorize the userid. It's possible to ″lock yourself out″ of the Admin Console application. (Don't worry, WebSphere Application Server for z/OS provides some ways to get in the back-door and disable global security. We found out that this function also works well! If this should happen to you, search the WebSphere Application Server InfoCenter for ″securityoff″ for full details on how to perform this task.

We highly recommend you test your security setups thoroughly before implementing them in a production environment. After enabling global security, we also recommend a close review of the output from all of the WebSphere Application Server for z/OS servers. Enabling global security also enables secure communications for administrative functions between the various WebSphere Application Server for z/OS address spaces. This is predominant in a Network Deployment setup that uses separate servers for the Deployment Manager and Node Agents.

Migrating from WebSphere Application Server for z/OS 5.0.2 to 5.1 with Global Security enabled

We didn't have too many problems enabling global security on our WebSphere Application Server for z/OS test cell that was originally installed using WebSphere Application Server for z/OS 5.1. We also didn't have any problems when we migrated our production cell from WebSphere Application Server for z/OS 5.0.2 to 5.1 **without** global security enabled. However, we had a number of problems during migration of another WebSphere Application Server for z/OS test cell from WebSphere Application Server for z/OS 5.0.2 to 5.1 **with** global security enabled.

We're happy to report that these issues have now been resolved. We were able to successfully migrate our test cell with global security enabled from WebSphere Application Server for z/OS 5.0.2 to 5.1 with the following:

- WebSphere Application Server for z/OS 5.0.2 W502017 service level
- WebSphere Application Server for z/OS 5.1 W510205 service level
- Test fix for APAR PK04797
- Formal fix now available in PTF UK03577, which is associated with service level W510212.

References

See the IBM WebSphere Application Server Version 5.*1* Information Center, available at *publib.boulder.ibm.com/infocenter/ws51help/index.jsp* for full instructions and details on the various aspects of security with WebSphere Application Server Version 5.1.

Also see the following IBM Techdocs at www.ibm.com/support/techdocs/

- ″Enabling Global Security in WebSphere Application Server V5 for OS/390 and z/OS″ found at *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD101150*
- ″WebSphere for z/OS Security Overview″ found at *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS1054*
- ″RACF Tips for customizing WebSphere for z/OS Version 5.0.2″ found at *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD101118*.

Using the WebSphere Application Server for z/OS 5.x plug-in for HTTP Server and Sysplex Distributor with our WebSphere Application Server for z/OS J2EE Servers

As part of our configuration for WebSphere Application Server for z/OS 5.x, we have incorporated the Sysplex Distributor and HTTP Server with WebSphere Application Server for z/OS plug-in to ″front end″ our WebSphere Application Server for z/OS J2EE Servers across multiple systems.

Using the Sysplex Distributor and HTTP Server with WebSphere Application Server for z/OS plug-in provides us with a number of advantages, including:

- Scalability
- High availability
- Workload balancing
- Single point of input for many J2EE applications
- Session affinity routing
- Static content serving and caching.

For full information on using and configuring the WebSphere Application Server 5.x Plug–in and the Sysplex Distributor, please see the following:

- WebSphere Application Server Library: *http://www-306.ibm.com/software/webservers/appserv/was/library/*
- WebSphere Application Server 5.x InfoCenter at: *http://publib.boulder.ibm.com/infocenter/ws51help/index.jsp*
- WSC TechDoc PRS829, ″Configuring and Troubleshooting the WebSphere for z/OS Version 5 HTTP Server plug-in″ available at: *http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS829*
- IBM HTTP Server V5.3 for z/OS Library at: *http://www-306.ibm.com/software/webservers/httpservers/doc53.html*

Using the HTTP Server with WebSphere Application Server for z/OS plug-in along with our J2EE Servers

There are numerous ways of configuring WebSphere Application Server for z/OS J2EE servers and applications. Many of these are done for reasons such as scalability, application and/or resource isolation.

We use a combination of techniques for our setups, including

- Multiple J2EE servers per system for application and resource isolation
- Multiple Server Regions per J2EE server for scalability and fail-over
- J2EE Server clusters spanning multiple systems for scalability and system fail-overs.

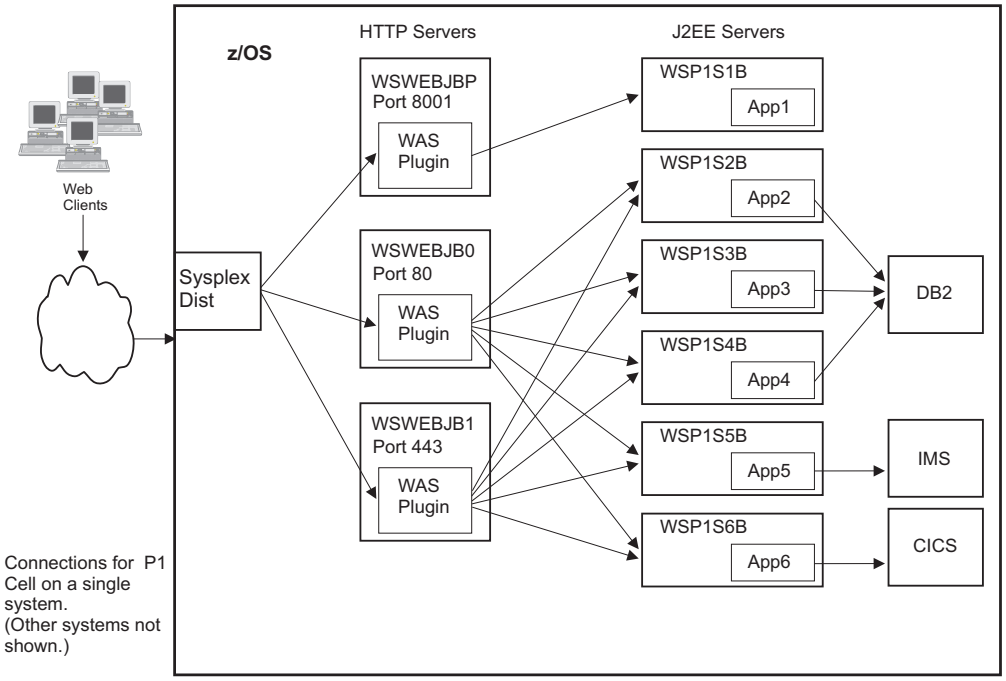


Figure 56. Servers in one system of our WebSphere Application Server for z/OS P1 Cell (production)

The above diagram depicts the various servers in one system of our WebSphere Application Server for z/OS P1 Cell (production).

- The Sysplex Distributor ″front ends″ all incoming requests

- Sysplex Distributor sends the request to one of the HTTP Servers, each listening on a different port
- The HTTP Server with WebSphere Application Server for z/OS plug-in sends the request to one of the J2EE Servers.
  - WSWEBJBP is configured to handle only requests for App1
  - WSWEBJB0 is configured to handle only HTTP (non-SSL) requests for App2, App3, App4, App5, and App6
  - WSWEBJB1 is configured to handle only HTTPS (SSL) requests for App2, App3, App4, App5, and App6.
- Multiple J2EE Servers are used to provide:
  - Application isolation
  - Resource isolation
  - Increased client capacity.
- All J2EE Servers are configured as part of a WebSphere Application Server for z/OS J2EE Server cluster. Each cluster has one J2EE server on each system.

Bottlenecks in our HTTP Server

When initially using the HTTP Server with WebSphere Application Server for z/OS plug-in to ″front end″ all of this activity, bottlenecks appeared in the HTTP Server.

To help resolve this, we needed to understand:

- The differences between the threading mechanism in the two types of servers
- The amount of concurrent users expected through an HTTP Server

Client Handling differences between HTTP Server and WebSphere Application Server for z/OS J2EE Server on z/OS: The HTTP client handling mechanism is very different for the HTTP Server from the WebSphere Application Server for z/OS J2EE servers. The concurrent client capacity that a WebSphere Application Server for z/OS J2EE server can handle can be very much higher than the HTTP Server.

In a J2EE server, client requests are initially received by the J2EE server's control region. The J2EE server's control region then queues the request to the server region(s) through WLM. Once queued, the control region thread is available to handle another request. Multiple J2EE server regions can be configured for each J2EE control region, also increasing the client capacity.

The HTTP Server, on the other hand, uses a thread for the duration of each request. This includes the time spent processing the request after it has been forwarded to a J2EE server. The thread waits for the J2EE server to respond and returns this to the client. The HTTP Server's thread is then available to handle another request.

Concurrent client traffic through HTTP Server: We also needed to take a closer look at how much traffic an HTTP Server was expected to concurrently handle, including the following considerations:

- The number of J2EE servers that the plug-in will service.

  A single HTTP Server can handle applications running in clustered J2EE servers across multiple nodes. The same HTTP Server can also handle multiple applications that are spread across multiple J2EE servers in a single node.

  When combined, this vertical and horizontal scaling can multiply the number of concurrent requests the J2EE servers can handle.

- The number of Server Regions, if configured for multiple per J2EE server regions.

  All application work is processed in the J2EE server's server region. Running multiple server regions increases the amount of work that can be concurrently handled.
- The number of threads each J2EE server region is running.

  Increasing the number of threads can have the same impact on the HTTP Server as running with multiple server regions.
- Failure of other components in the cluster and service updates.

  If one of the systems goes down, either because of a failure or for service updates, work will be routed to the remaining server(s). Allow some headroom in each HTTP Server to handle this increase.

As an example of these considerations, let's say an HTTP Server is front ending one J2EE Server that is running with 4 Server Regions, each running 10 threads. At any one time, there is threading capacity for at least 40 clients running between these J2EE application servers.

If the HTTP Server is set at the default of 40 threads, it is at it's limit of capacity for concurrent clients.

You can use the z/OS MODIFY command,

```
F server_job_name,appl,-d stats
```

to display statistics about the HTTP Server's thread usage.

Statistics can also be viewed using a web browser if the HTTP Server is configured for access to it's Server Activity Monitor (Service /Usage* directive). If using this web access, it's recommended access to this function be protected and/or secured (for example, using Protect /Usage* directives).

See the HTTP Server Planning, Installing, and Using Version 5.3, available at http://www.ibm.com/software/webservers/httpservers/library/, for full details.

Review the J2EE server's control region output for the following information:

```
BBOO0234I SERVANT PROCESS THREAD COUNT IS 9.    (this is determined by the
     server_region_workload_profile setting.
BBOM0001I     server_region_workload_profile: IOBOUND.
BBOM0001I      wlm_maximumSRCount: 1.
BBOM0001I      wlm_minimumSRCount: 1.
```

Scaling up the HTTP Server with WebSphere Application Server for z/OS plug-in along with our J2EE Servers

To help increase the overall throughput of our Web serving setups, we have implemented a few things:

- Increasing the MaxActiveThreads setting for the HTTP Server
- Splitting HTTP and HTTPS traffic between two HTTP Servers
- Splitting traffic between multiple HTTP Servers.

Increasing the MaxActiveThreads for the HTTP Server: One simple way to increase the concurrent client capacity of the HTTP Server is to increase the MaxActiveThreads setting in the HTTP Server's configuration file (httpd.conf). The default is 40 threads. It is not recommended to increase the value to greater than 150-200.

Splitting HTTP and HTTPS traffic between two HTTP Servers: The MaxActiveThreads setting for the HTTP Server sets the total number of threads the HTTP Server is running. This might not be the total number of clients that it can concurrently process. When the HTTP Server is configured for both HTTP and SSL connections, it splits the MaxActiveThreads count into two thread pools, one to handle requests for each type. If needed, the server will move a thread from one pool to the other, however, this balancing only occurs when the thread finishes processing a request. This generally works well when you have a relatively steady flow of both types of requests (HTTP and SSL). However, the HTTP Server can get ″caught off-balance.″ For example, when the HTTP Server is first started with MaxActiveThreads set for 40, two pools are created with 20 threads each. If all the current requests to the server are for non-SSL connections, only 20 threads will be available for handling these requests. Threads in the SSL pool will not be potentially moved until there is an SSL request. If the server never receives an SSL request, there will never be any thread pool movement.

To help minimize this condition, we run two HTTP Servers for our ″public″ applications in our production setups,

- One configured to handle only non-SSL traffic
- One configured to handle only SSL traffic

The HTTP Server configured for port 80 was disabled for SSL by changing the ″sslmode″ directive to off in the HTTP Server's configuration file. All threads in this server are dedicated to running non-SSL connections and no pool balancing occurs.

We created a second HTTP Server that was configured with only SSL enabled. This was done by setting the ″normalmode″ directive in the HTTP Server's configuration file to ″off″. This server is set to listen only on port 443 for SSL requests. All threads in this server are dedicated to running SSL connections and no pool balancing occurs.

Multiple HTTP Servers for multiple applications: On each system within our WebSphere Application Server for z/OS cell, we run multiple J2EE Servers to handle the various applications. While most applications are considered ″public″ applications, we have some that are considered ″internal″ applications. The ″public″ applications are expected to be normally accessed using the default ports (80 for non-SSL, 443 for SSL). The ″internal″ applications can be accessed using non-default ports (such as 8001).

While a single HTTP Server with WebSphere Application Server for z/OS plug-in can be configured to access all applications in all J2EE servers, we have multiple HTTP Servers, each configured to handle only selected applications.

The HTTP Servers configured to handle the ″public″ applications are generally configured for ports 80 and/or 443. The HTTP Servers configured to handle the ″internal″ applications are configured to run on other ports (such as 8001).

This helps to isolate the expected traffic for each of the HTTP Servers.

TrustedProxy setting in J2EE Server's WebContainer

If using the WebSphere Application Server for z/OS plug-in to front end the J2EE servers, make sure to set the TrustedProxy custom property for the J2EE Server's transport handlers to ″true″. This setting enables the application server to use the private headers that the Web server plug-in adds to requests. We set this property as a web container's Custom Properties page so all transports will support private headers. Otherwise, it needs to be added as a custom property for each transport.

If you try to use private headers without adding the TrustedProxy property, they will be ignored. If the private headers are ignored, the application server might not locate the requested application.

HTTP Server SSL setup needs J2EE Server's CA

When using the HTTP Server with WebSphere Application Server for z/OS plug-in to front end the J2EE servers for SSL connections, make sure that the SSL setup for the HTTP Server contains the CA (Certificate Authority) that signed the J2EE server's certificate. Otherwise, the SSL handshake between the plug-in and the J2EE Server will fail.

Customizing the WebSphere Application Server for z/OS plug-in configuration file (plugincfg.xml)

We made a number of changes to the configuration file that is used by the WebSphere Application Server for z/OS plug-in (plugincfg.xml).

We started by generating a plugincfg.xml file using the WebSphere Application Server for z/OS Admin Console application or by using the GenPluginCfg.sh script. This is also done after updates to the configuration that would affect the settings, such as adding/deleting applicaions, servers, ports, and others.

The plugincfg.xml file that is generated by WebSphere Application Server for z/OS is a good starting point as it contains default settings to accommodate all virtual hosts, applications, servers and clusters configured within the cell. The WSC TechDoc PRS829 document does a very good job of describing much of the customization of this file. Also see the information in the WebSphere Application Server for z/OS InfoCenter for descriptions of some of the additional settings that are not included in the generated file, such as <BackupServers>.

We customize this configuration file by making some or all of the following changes (see specifics for each below):

- Refresh interval changed for production systems
- Logging directives updated to use the HTTP Server's logging directory
- Settings are customized for only the ports, servers, clusters and applications we wish the particular HTTP Server to handle
- ConnectTimeout lowered.

Our WebSphere Application Server for z/OS plug-ins do not use the generated configuration files directly. Be aware that if you do, regeneration of the plug-in configuration file will overwrite any changes you have made. A copy of this file is created for each of our HTTP Server setups. For HTTP Servers that are being front ended by the Sysplex Distributor, all servers on a particular port use a common file.

Once the configuration file has been initially modified and placed in service, it may be more cumbersome to repeat the editing process for future changes; this depends on the amount of initial changes. We regenerated the configuration file using the WebSphere Application Server for z/OS Admin Console. Next, the updated file is compared with the previously generated file. Finally, changes are manually applied to the customized configuration files.

Setting the RefreshInterval: The ″RefreshInterval″ setting in the Config section determines the interval at which the plug-in will check for updates to the configuration file. The default for this is 60 seconds. We generally increase this value on our production systems to at least 300 (5 minutes) since the configuration rarely changes.

Logging settings: Logging directives are updated to use the HTTP Server's logging directory. This directory is located on a system-specific (non-shared) HFS for performance reasons. The date and PID of the HTTP Server is appended to the supplied name. This also helps correlate the log file with other logging files produced by the HTTP Server.

Configuring applications: In our setups, each HTTP Server with WebSphere Application Server for z/OS plug-in is configured to handle only certain applications. For each plug-in configuration, after starting with a copy of the generated configuration file, we delete the applications that we don't want the server to handle, leaving only the applications that we want the server to handle. The generated configuration file contains all applications, servers, and so on.

For example, we did not want our plug-in configured in HTTP Servers using Port 80 or 443 (SSL) to handle access to our ″internal″ applications. Since these applications run in separate J2EE servers from other applications, all we needed to do was remove the references to these applications and server clusters. In this way, the plug-in never ″sees″ the applications.

For this type of update, we removed the settings for the ″internal″ applications in the following areas:

- VirtualHost entries from the VirtualHostGroup for the J2EE servers running the applications
- ServerCluster entries for the J2EE servers running the applications
- URIGroup entry defined for the applications
- Route entry for the VirtualHost, ServerCluster and URIGroup.

Modifying the ConnectTimeout value: We generally lower the value(s) for the ″ConnectTimeout.″ This is the time the plug-in will wait for a connection to the J2EE Server. The default in the generated plugin.cfg file is 60 seconds. If the connection to the J2EE server times out, the server will be marked as unavailable. After timing out a particular server, the plug-in will try to connect with the next server in the ″PrimaryServers″ list for the application. As we added more J2EE servers to the cluster, this time could become excessive, especially during initial startup of the HTTP Server. For instance, if one of the ″PrimaryServers″ is not available, the plug-in will hold a request for one minute waiting to connect to this server before attempting to send the request to an available server. Users aren't always that patient!

To minimize this impact, we generally change this value to 10 seconds.

The server will be marked as unavailable until the ″RetryInterval″ value is met. If all ″PrimaryServers″ have been marked as unavailable, the plug-in will then try to connect to a ″BackupServer.″

Improving Static Content performance

Unfortunately, the WebSphere Application Server for z/OS J2EE servers are not the best at handling static content. They really are geared for providing dynamic content. The inclusion of the HTTP Server into our WebSphere Application Server for z/OS setups added some better ways of handling the static content for our web applications. These include using the HTTP Server as an origin server for the static content via Pass directives and using the Fast Response Cache Accelerator (FRCA). The WebSphere Application Server for z/OS plug-in for the HTTP Server can also be configured to handle some caching using Edge Side Include (ESI).

To help minimize the performance impact of running requests through the HTTP Server, we have moved most of the handling of static content of our web applications over to the HTTP Server's FRCA. Using FRCA greatly improves the overall performance of our web applications. After the initial request for static content, it is placed in FRCA. Further requests for it does not propagate beyond the TCPIP stack. This helps to use the ″right tool for the right job″.

Implementing this is not necessarily trivial, and takes some considerations and planning and might require intimate knowledge of the application. Ideally, separation of static content from dynamic content should be taken into account from the beginning of the design of the application. Static content can be easily separated from dynamic content, both logically (based on URLs) and physically. For many reasons, static content is generally included with the deployable J2EE EAR or WAR file.

See ″Handling Static Content in WebSphere Application Server″ available at: *http://www.ibm.com/developerworks/websphere/techjournal/0211_brown/brown.html* on the IBM Developer's Domain for more information on various techniques for separating Static from Dynamic Content in your applications.

Experiences with using HTTP Server and FRCA for Static Content handling: As we continue to try to improve the overall performance of our web applications, we have tried and used a variety of techniques for caching. Here are some of our experiences with using the HTTP Server with WebSphere Application Server for z/OS plug-in and FRCA for handling static content.

- If static content is deployed separately from the J2EE application, make sure you have a process in place to keep the two in sync when one or the other is updated. If static content is extracted from the J2EE application after deployment, make sure to have a process in place to perform this after application updates.
- Don't forget about less common types of static content. HTML files, GIF and JPG images easily come to mind, but don't forget about others such as CSS and WAV files. Also, keep an eye out for the various file extensions that may exist in an application. For example, HTML files may have an extension of *.html or *.htm,
- Make sure that any directives added for static content (Pass, Map, and others) do not interfere with or are ″hidden″ by service directives used to send URLs for dynamic content to the WebSphere Application Server for z/OS plug-in. Placement within the HTTP Server's configuration file is also important.

  For example, to allow for static content from an application to be handled by the HTTP Server, we added the following directive:

  ```
  Pass      /OurApp/images/*  /ws/images/OurApp/*
  ```

  The Service directive to send dynamic requests to the WebSphere Application Server for z/OS plug-in were:

  ```
  Service /OurApp/* /ws/p1wassmpe/bin/ihs390WAS50Plugin_http.so:service_exit
  ```

  Because the URL comparison string for the Service directive (/OurApp*) is more generic than the one for the Pass directive (/OurApp/images/*), the Pass directive needs to be placed ahead of the Service directive in the configuration file. Otherwise, all requests for the application will match the Service directive first and be processed. The Pass directive will never be compared with, effectively ″hidden″.
- With our HTTP Server running on the same system as the J2EE server, it looked simple to have the HTTP Server directly access the deployed J2EE application's static content, rather than ″extract″ it. The idea was to use Pass and FRCA directives to point to the static content directly in the file system where the J2EE

application was deployed, generally, //deployedApps/. While this can be a workable solution, we ran into a few glitches in the process. Some of the major issues were:

  – HFS file ownerships and permission bits
  – File translations / AddType directives.

- HFS file ownerships and permission bits.

  Be careful of HFS file ownerships and permission bits. When WebSphere Application Server for z/OS deploys an application, the files generally have the WebSphere Application Server for z/OS Administrator's uid/gid and permission bits of 640. The userid the request is being handled under in the HTTP Server (Userid directive) may not have access to these directories/files. Proper permissions must also be given for all higher level directories, which may lead to unintentional access to other WebSphere Application Server for z/OS configuration data and extreme care should be taken.

- File translations

  Due to WAR and EAR packaging of J2EE applications and the WebSphere Application Server for z/OS deployment process, the files for a deployed application are generally stored in ASCII. The ″SimpleFileServlet″ provided in J2EE Web Containers will not perform any translation of the files, so the files will be returned in the correct code page. The HTTP Server uses AddType directives to determine whether to translate a file before returning it when operating as an origin server (using Pass directives). By default, AddType directives will translate files with *.html extensions from EBCDIC to ASCII before returning them to the requestor. (Content from a J2EE server back through the HTTP Server with WebSphere Application Server for z/OS plug-in is not translated).

If the HTML files are stored in ASCII on the z/OS system, there are a few choices:

- Translate all HTML pages using a tool such as ″iconv″
- Change the AddType directive(s) in the HTTP Server's configuration file.

Changing the HTTP Server's AddType directive will affect all files of this type. If the HTTP Server is handling static content for multiple applications, each will be affected.

Sysplex Distributor usage with HTTP Server / WebSphere Application Server for z/OS J2EE Servers

We have configured our J2EE servers to run in clusters. Each cluster has one J2EE server configured on each of 4 systems in our sysplex for our production setup. Each system in the cluster also runs an HTTP Server configured with the WebSphere Application Server for z/OS plug-in to ″front end″ the J2EE Servers. We use the z/OS Sysplex Distributor to balance requests to the various HTTP Servers across the systems.

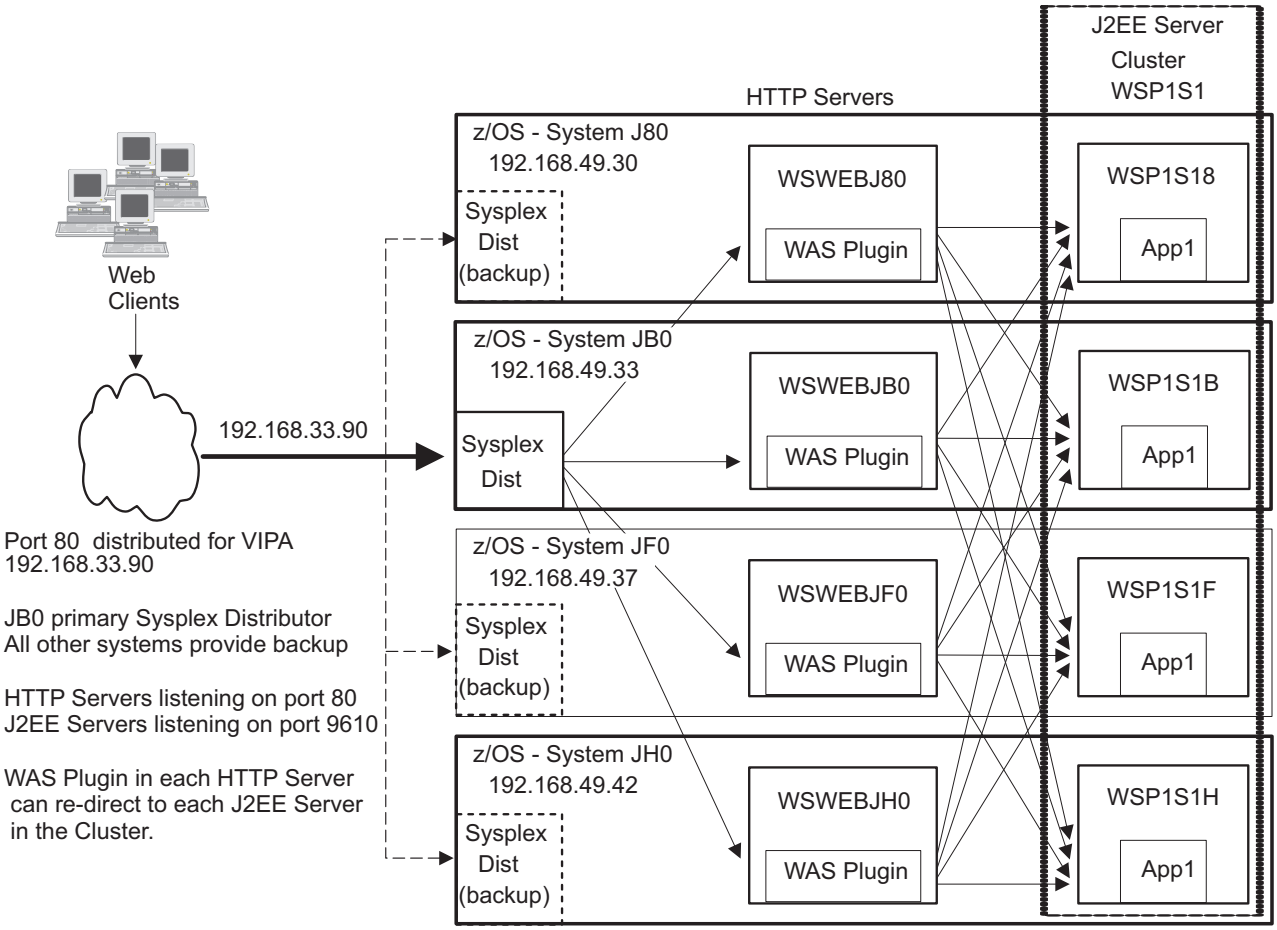


Figure 57. One J2EE Server Cluster (WSP1S1) in our WebSphere Application Server for z/OS P1 Cell (production)

Figure 57 shows one J2EE Server Cluster (WSP1S1) in our WebSphere Application Server for z/OS P1 Cell (production).

- The Sysplex Distributor ″front ends″ all incoming requests
- JB0 is the primary distributor. All other systems are configured to be backups
- Sysplex Distributor sends the request to one of the HTTP Servers
- The HTTP Server with WebSphere Application Server for z/OS plug-in sends the request to one of the J2EE Servers

On our production setups, we distribute various HTTP Server ports (80, 443, 8001, and so on). We have also configured some of our WebSphere Application Server for z/OS Administrative ports to be front ended by the Sysplex Distributor. These include the Admin Console application and the HTTP/HTTPS Transport Handler ports used by certain J2EE server clusters whose applications don't require session affinity.

One system is used as the ″primary″ Sysplex Distributor, with all other systems configured as ″backups″. The Sysplex Distributor function is automatically moved to another system in the event of a failure of the primary system (or one of the backups).

To monitor the Sysplex Distributor usage, use the `netstat` command. See the *″z/OS Communications Server IP Administrator's Commands″* at: *http://www.ibm.com/servers/eserver/zseries/zos/bkserv/* for details.

See the following for details on planning, implementing and monitoring the Sysplex Distributor for z/OS:

- WSC TechDoc WP100312, ″Use of WebSphere for z/OS with Sysplex Distributor″ available at: *http://www.ibm.com/support/techdocs/atsmastr.nsf/Web/Techdocs*
- Various IBM Communications Server product publications, available at: *http://www.ibm.com/servers/eserver/zseries/zos/bkserv/*

Configuring for session data persistence: We have configured our J2EE Servers that run applications using HTTP Sessions to use DB2 as a persistent store for the session data. The WebSphere Application Server for z/OS plug-in for the HTTP Server will generally reroute any requests with a ″Session Affinity″ back to the server that previously processed the request, since the session data is likely still in that server's memory. Backing the session data in DB2 helps allow for failure of a J2EE server. This also allows better control of memory consumption by a J2EE Server by limiting the amount of session data held in memory, without sacrificing long running sessions.

We maintain tables in DB2 just for the session data, separate from other application tables. Each J2EE server is also configured with a JDBC Datasource strictly for the connections to DB2 for the session management. This helps to minimize contention with the application for DB2 resources.

See the WebSphere Application Server Library at: *http://www-306.ibm.com/software/webservers/appserv/WebSphere Application Server for z/OS/library/* for complete information on configuring session persistence.

Where to find more information

During our testing, we used documentation from several sources, listed below. They contain all of the documents that we have cited throughout the course of this chapter.

- IBM WebSphere Application Server for z/OS and OS/390 documentation, available at http://www.ibm.com/software/webservers/appserv/zos_os390/library/
- IBM WebSphere Application Server Version 5.*X* Information Center, available at publib.boulder.ibm.com/infocenter/wasinfo/index.jsp
- IBM Techdocs (flashes, white papers, and others), available at www.ibm.com/support/techdocs/
- *Java 2 Platform Enterprise Edition Specification*, available at http://java.sun.com/products/j2ee/
- IBM CICS Transaction Gateway documentation, available at http://www.ibm.com/software/ts/cics/library/
- IBM HTTP Server for OS/390 documentation, available at http://www.ibm.com/software/webservers/httpservers/library/
- IBM WebSphere Studio Workload Simulator documentation, available at www.ibm.com/software/awdtools/studioworkloadsimulator/library/

Specific documentation we used

Documentation to assist you with the usage of your product is available in many places. We have found that the Washington Systems Center documentation is very good and very often this same information is also in the information center. While we offer a set of generic links to documentation, see "Where to find more

information" on page 276 for more information, we also wanted to take this opportunity to highlight the specific documentation we used and found especially useful.

For our current WebSphere for z/OS V5.1 configuration, we found the following technical documents were especially good at getting us up and running quickly:

- IBM TechDocs are available at www.ibm.com/support/techdocs/. We used the following specific TechDocs:
  - ″Enabling Global Security in WebSphere Application Server V5 for OS/390 and z/OS″ found at *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD101150*
  - ″WebSphere for z/OS Security Overview″ found at *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS1054*
  - ″RACF Tips for customizing WebSphere for z/OS Version 5.0.2″ found at *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD101118*.
- **WebSphere Variables to control operator message routing**

  This article describes how to manage operator message routing in WebSphere for z/OS V5 and can be found at: *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD101116*
- **DB2 UDB / JCC Connectors**

  This article describes how to enable WebSphere for z/OS V5.0.2 to use the DB2 Universal JDBC Driver and can be found at: *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD101663*

  For full details on using these connectors in the WebSphere environment, see the Redbook: *″DB2 for z/OS and WebSphere: The Perfect Couple," SG24-6319* available at *www.redboooks.ibm.com*.
- **Configuring and Troubleshooting the WebSphere for z/OS Version 5 HTTP Server Plugin**

  This article describes how to configure and troubleshoot the WebSphere for z/OS V5 HTTP Server and can be found at: *http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/PRS829*

Chapter 18. Using EIM authentication

Enterprise Identity Mapping (EIM) is an IBM @server infrastructure architecture that defines a set of services and extensions to LDAP to transform the user identity associated with a work request as it moves between systems having different user administration schemes as part of a multi-tiered application in a heterogeneous environment. EIM offers a new approach to easily manage multiple user registries and user identities in an enterprise by providing an architecture for describing the relationships between entities (such as individual users and system resources) in the enterprise and the many identities that represent them.

In z/OS V1R5, EIM has added support for the following bind types:

- Client authentication using a digital certificate over an SSL connection
- Kerberos authentication for clients and servers using a trusted third party protocol
- CRAM-MD5 password protection using a hashed password

The following sections describe our experiences deploying each bind type.

Client authentication using digital certificates

We used information from the following sources to help us set up and test EIM with client authentication using digital certificates:

- *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875
- *z/OS Integrated Security Services LDAP Server Administration and Use*, SC24-5923
- *z/OS Integrated Security Services LDAP Client Programming*, SC24-5924
- *z/OS HTTP Server Planning, Installing, and Using*, SC34-4826
- *z/OS Cryptographic Service System Secure Sockets Layer Programming*, SC24-5901

We used the System Secure Sockets Layer (SSL) gskkyman utility to generate our key databases and certificates. We know from past experience that *z/OS HTTP Server Planning, Installing, and Using* does an excellent job of explaining how to generate certificates. We used that document to assist in the generation of the certificates for EIM/LDAP, even though the HTTP server was not involved. (Basically, a certificate is a certificate, regardless of the application with which it will be used.) We then used the EIM and LDAP documentation to assist in the implementation and use of the certificates.

Resolving problems during our testing

EIM domain name missing the country attribute: The EIM domain that we had established in our previous testing did not have a country attribute in its domain name. The EIM domain name is the full distinguished name (DN) of the EIM domain. The gskkyman utility requires a domain name to contain, at a minimum, common name (cn), organization (o), and country (c). We created a new EIM domain name containing the required attributes so that our client certificates would have associated entries in the EIM domain controller. It is critical not only to insure that the domain name contains the minimum required attributes, but also that the domain name in the EIM domain controller matches the domain name in the client certificate.

Using the documented example for creating LDAP suffix and user objects: To set up a new suffix, we used the "Example for creating LDAP suffix and user objects" in *z/OS Integrated Security Services EIM Guide and Reference*. If you use this example, it is important to make sure that a blank line exists between the object entries in the sample ldif file. The blank line is what signals the end of one entry and the beginning of the next. When we created the ldif file, the blank lines were missing and, thus, the **ldapadd** command failed.

We also did not include the entry that defines the country object (c=us). This is because our slapd.conf file only defines a suffix for both the organization and country (o=ibm,c=us). If we had included the entry for the country object as in the example, we would have had to add that suffix to our slapd.conf file. This illustrates the importance of understanding the structure of the data in your directory and how it is processed.

Testing the client authentication using digital certificates

Enabling the EIM domain controller for SSL processing: We followed the instructions in the LDAP Server documentation to enable our EIM domain controller for SSL processing. We also used the HTTP Server documentation to generate the key database and digital certificates.

Testing the client certificate: We issued the following **ldapsearch** command to verify that SSL processing was working properly:

```
ldapsearch  -h ip_address  -S EXTERNAL  -Z  -l 689  -K client_key_database
     -P client_key_database_password  -V 3  -p 689  -s base  -b "" "objectclass=*"
```

This worked successfully.

We then issued the following eimadmin command using a client certificate:

```
eimadmin  -lD  -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'  -h ldaps://ip_address:689
     -K client_key_database  -P client_key_database_password  -S EXTERNAL
```

This also worked successfully.

Again, it is important to understand the structure of your data. Also, because the command syntax is long and complex, it is easy to make a mistake and it's not always clear from the error messages what is wrong.

Kerberos authentication

We used information from the following sources to help us set up and test Kerberos authentication:

- *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875
- *z/OS Integrated Security Services LDAP Server Administration and Use*, SC24-5923
- *z/OS Integrated Security Services LDAP Client Programming*, SC24-5924
- *z/OS Integrated Security Services Network Authentication Service Administration*, SC24-5926

We heavily relied on the LDAP documentation to set up the environment to allow EIM to bind using Kerberos. There are many different ways to set up this environment—what we describe here is but one way.

Clearing up a documentation inaccuracy

In the chapter on EIM APIs in *z/OS Integrated Security Services EIM Guide and Reference*, it states in three different places that, “To connect to an EIM domain using Kerberos information, you need to do so from a non-z/OS platform.” This statement occurs under the descriptions of the eimListUserAccess, eimQueryAccess, and eimRemoveAccess APIs.

The functionality to connect to an EIM domain from a z/OS platform using Kerberos information is available in z/OS V1R5. The above statement is left over from the previous release and, unfortunately, was not removed from the documentation in time for the general availability (GA) of z/OS V1R5. However, the statement will be removed from the next release of the documentation.

Testing the Kerberos authentication

Enabling the EIM domain controller for Kerberos processing: We followed the instructions in the LDAP Server documentation to enable our EIM domain controller for Kerberos processing. In addition, refer to our December 2002 edition for more information on enabling LDAP Server for use with Kerberos authentication.

Testing the EIM bind with Kerberos authentication: We used the **eimadmin** command for our testing. The EIM documentation describes the command syntax and how to bind using Kerberos authentication.

Before we could issue the **eimadmin** command, we first had to obtain a Kerberos ticket by issuing the **kinit** command, as follows:

```
kinit kerberos_principal
```

Once we had the Kerberos ticket, we issued the following **eimadmin** command specifying that we wanted to bind with Kerberos authentication:

```
eimadmin  -lR  -d 'ibm-eimDomainName=Domain,o=org,c=us'  -r 'RACF SSL'
     -h ldap://ip_address  -S GSSAPI
```

Note that the **eimadmin** command does not have any bind credentials. The `-S GSSAPI` specifies to use the Kerberos ticket obtained from the **kinit** command. However, unless something is done, the Kerberos principal identified in the ticket does not have authorization to issue EIM commands. The EIM documentation does not specify how to do this. However, there are several ways to identify or associate the Kerberos principal to IDs (or, LDAP DNs) that are already authorized to issue EIM commands. We’ll describe one method that we used.

Using TDBM mapping to associate a Kerberos principal to an EIM-authorized ID: We chose to use TDBM mapping to associate the Kerberos principal to an EIM-authorized DN, as described in *z/OS Integrated Security Services LDAP Server Administration and Use* under the “Identity mapping” section of the chapter on “Kerberos authentication”. To do this, we created an ldif file, kerberos.ldif, containing the following:

```
dn: cn=eim ssl administrator,o=eimssl,c=us
changetype:modify
add:x
objectclass: ibm-securityIdentities
altSecurityIdentities: KERBEROS:principal@REALM
```

We then issued the following ldapmodify command to update the LDAP DN:

```
ldapmodify  -h ip_address  -D "cn=LDAP Administrator"  -w password
     -f /etc/ldap/kerberos.ldif
```

We were then able to issue **eimadmin** commands binding with Kerberos authentication. However, note that the Kerberos principal will only be able to issue those EIM commands for which its associated LDAP DN is authorized.

CRAM-MD5 password protection

We used information from *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875 to help us test CRAM-MD5 password protection:

No work is needed to set up for using CRAM-MD5 binds. All we needed to do was issue the **eimadmin** command and specify the CRAM-MD5 bind option. We did not encounter any problems using the CRAM-MD5 bind.

The following are a couple of examples of using the **eimadmin** command with the CRAM-MD5 bind option:

Example: We used the following command to list a domain:

```
eimadmin  -lD  -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'  -h ldap://ip_address:389
     -b 'cn=eim ssl administrator,o=eimssl,c=us'  -w password  -S CRAM-MD5
```

Example: We used the following command to list a registry:

```
eimadmin  -lR  -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'  -r 'RACF SSL'  -h ldap://ip_address:389
     -b 'cn=eim ssl administrator,o=eimssl,c=us'  -w password  -S CRAM-MD5
```

EIM enhancements in z/OS V1R6

In z/OS V1R6 the following EIM enhancements were tested:

- “x.509 certificate registries”

We used the following documentation to help us plan and implement these enhancements:

- *z/OS Integrated Security Services EIM Guide and Reference*
- *z/OS Cryptographic Service System Secure Sockets Layer Programming*

x.509 certificate registries

First, we created an x.509 certificate registry. We used the **eimadmin** command for all of our testing.

Example: We used the following command to create the x.509 registry:

```
eimadmin -aR -h ldap://<ip address>:389 -b 'cn=EIM Administrator'
-w <password> -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'
-r 'Cert Maps' -y X509 -n 'Registry for Certificates'
```

Example: We used the following command to list the registry for verification:

```
eimadmin -lR -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'
-r 'Cert Maps' -h ldap://<ip address>:389 -b 'cn=EIM Administrator'
-w <password>
```

Result:

```
source registry: Cert Maps
  registry kind: SYSTEM
  registry type: X509
    description: Registry for Certificates
        lookups: ENABLED
       policies: DISABLED
```

Testing associations

We used the following procedures to create an association using the name stored within a certificate:

Obtain the certificate in a file:

We used the System Secure Sockets Layer (SSL) gskkyman utility to retrieve an existing client certificate from an existing kdb database.

1. Issued the gskkyman command
2. Select the kdb
3. Select option 1 for Manage keys and certificates
4. Select option 'n' for the certificate to export
5. Select option 6 for Export certificate to a file
6. Select option 2 for Base64 ASN.1 DER

Example: After the certificate is in a file, we entered the EIM command to add an association from a certificate:

```
eimadmin -aA -h ldap://<ip address>:389 -b 'cn=EIM Administrator' -w <password>
-d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us' -r 'Cert Maps'
-i "eim ssl administrator" -E <certificate file name> -t admin
```

Result: This failed with the following error message because we did not create the identifier:

```
ITY4030 Service eimAddAssociation() returned error 248
ITY0025 EIM identifier not found or insufficient access to EIM data.
```

Example: Create the identifier before the association. We used the following command to create the identifier:

```
eimadmin -aI -i 'eim ssl administrator' -n 'Identifier for eim ssl admin'
-d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'  -h ldap://<ip address>:389
-b 'cn=EIM Administrator' -w <password>
```

Next, we verified by listing the identifier:

```
eimadmin -lI -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'
-i 'eim ssl administrator'  -h ldap://<ip address>:389
-b 'cn=EIM Administrator' -w <password>
```

Result:

```
            unique identifier: eim ssl administrator
             other identifier: eim ssl administrator
                  description: Identifier for eim ssl admin
```

This worked successfully. We reissued the association command. This also worked successfully.

Note: If an identifier is used that already exists, you would not see the error on the first issuance of the command and the addition of the identifier would not be required.

Example: We listed the association for validation:

```
eimadmin -lA -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'
-i 'eim ssl administrator' -h ldap://<ip address>:389
-b 'cn=EIM Administrator' -w <password>
```

Result: That successfully created an association from a certificate located in a file.

```
            unique identifier: eim ssl administrator
                  association: ADMIN
              source registry: Cert Maps
                registry type: X509
                registry user: <SDN>CN=EIMSSLADMINISTRATOR,O=EIMSSL,C=US</SDN>
                               <IDN>CN=AE TEAM CA FOR JA0,OU=INTEGRATION TEST,
                               O=AE TEAM,L=POK,ST=NY,C=US</IDN> <HASH_VAL>CF752E
                               7699A95818799E8AC70CD6A9F8BCA0B35D</HASH_VAL>
```

Removing an association using the name stored within a certificate:
Example: We removed the association previously created, by issuing the following command:

```
eimadmin -pA -h ldap://<ip address>:389 -b 'cn=EIM Administrator'
-w <password> -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'
-r 'Cert Maps' -i 'eim ssl administrator' -E <certificate file name>-t admin
```

Example: Next, we issued the list command to verify that the association does not exist:

```
eimadmin -lA -d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us'
-i 'eim ssl administrator' -h ldap://<ip address>:389 -b
'cn=EIM Administrator' -w <password>
```

Result: The association was removed.

Removing an association using the -u flag: **Example:** We issued the following command to remove an association using the -u flag:

```
eimadmin -pA -h ldap://<ip address>:389 -b 'cn=EIM Administrator' -w <password>
-d 'ibm-eimDomainName=SSL Domain,o=eimssl,c=us' -r 'Cert Maps' -i 'eim ssl
administrator' -u '<SDN>CN=EIM SSL ADMINISTRATOR,O=EIMSSL,C=US</SDN>
<IDN>CN=AE TEAM CA FOR JA0, OU=INTEGRATION TEST,O=AE TEAM,L=POK,ST=NY,C=US</IDN>
<HASH_VAL>CF752E7699A95818799E8AC70CD6A9F8BCA0B35D</HASH_VAL>'  -t admin
```

Result: The removal was successful.

Testing Filtering

Next, we tested the x.509 certificate filtering.

Example: We issued the following command to create a filter policy:

```
eimadmin -aY -h ldap://<ip address>:389 -b 'cn=EIM Administrator'
-w <password> -d 'ibm-eimDomainName=Small Domain,o=EIM'
-r 'Cert Maps' -J 'O=EIMSSL,C=US' -F 'OU=INTEGRATION TEST,
O=AE TEAM,L=POK,ST=NY,C=US' -T 'RACF Insco' -u C00002 -t filter
```

Example: We issued the list filter command to validate the add filter command:

```
eimadmin -pY -h ldap:// ://<ip address>:389 -b 'cn=EIM Administrator' -w <password>
-d 'ibm-eimDomainName=Small Domain,o=EIM' -r 'Cert Maps' -J 'O=EIMSSL,C=US'
-F 'OU=INTEGRATION TEST,O=AE TEAM,L=POK,ST=NY,C=US' -t filter
```

Result: The following is returned:

```
              source registry: Cert Maps
                  policy type: FILTER
                       filter: <SDN>O=EIMSSL,C=US</SDN><IDN>OU=INTEGRATION
```

```
            TEST,O=AE TEAM,L=POK,ST=NY,C=US</IDN>
               target registry: RACF Insco
            target registry user: C00002
                 domain policies: DISABLED
          source registry lookups: ENABLED
          target registry lookups: ENABLED
         target registry policies: DISABLED
```

Example: We issued the following command to delete the filter policy:

```
eimadmin -pY -h ldap://<ip address>:389 -b 'cn=EIM Administrator'
-w <password> -d 'ibm-eimDomainName=Small Domain,o=EIM' -r 'Cert Maps'
-J 'O=EIMSSL,C=US' -F 'OU=INTEGRATION TEST,O=AE TEAM,L=POK,ST=NY,C=US'
-T 'RACF Insco' -u C00002 -t filter
```

Result: The filter policy was successfully removed.

Create an x.509 certificate filter policy using a certificate

Example: We issued the following command to create a certificate filter policy:

```
eimadmin -aY -h ldap://<ip address>:389 -b 'cn=EIM Administrator'
-w <password> -d "ibm-eimDomainName=Small Domain,o=EIM" -r 'Cert Maps'
-G <certificate file name> -J O= -F OU=  -T 'RACF Insco' -u C00002 -t filter
```

Example: Next, we issued the list filter command to verify using the certificate as the list criteria:

```
eimadmin -lY -h ldap://<ip address>:389 -b "cn=EIM Administrator"
-w <password> -d 'ibm-eimDomainName=Small Domain,o=EIM'
-r 'Cert Maps' -G <certificate file name> -J O= -F OU= -t filter
```

Result: Here is what returned:

```
source registry: Cert Maps
                    policy type: FILTER
                         filter:
<SDN>=EIMSSL,C=US</SDN><IDN>OU=INTEGRATION TEST,
O=AE TEAM,L=POK,ST=NY,C=US</IDN>
                target registry: RACF Insco
             target registry user: C00002
                  domain policies: DISABLED
           source registry lookups: ENABLED
           target registry lookups: ENABLED
          target registry policies: DISABLED
```

Example: To delete the filter policy using the certificate as the delete criteria, we issued the following command:

```
eimadmin -pY -h ldap://<ip address>:389 -b "cn=EIM Administrator"
-w <password> -d "ibm-eimDomainName=Small Domain,o=EIM" -r 'Cert Maps'
-T 'RACF Insco' -u C00002 -G <certificate file name> -J O= -F OU= -t filter
```

Result: The list filter was issued and nothing was returned.

EIM Java API

In z/OS V1R7, EIM has made a Java API available. This section identifies the setup and testing that we performed.

We used the following information:

- z/OS Integrated Security Services EIM - Javadoc (obtained from /usr/lpp/eim/lib/eimzOS_DOC.jar)
- *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875 (from http://java.sun.com/j2se/1.4.2/docs/api/)

We did not find or report any problems using the EIM Java API.

To use the sample code listed here, make the necessary changes to fit your EIM data.

Updating the .profile

First, we added a .profile to the user id's home directory. Use the following information in the .profile file:

```
export JAVA_HOME=<java dir>
export PATH=$JAVA_HOME/bin:$PATH

#

CLASSPATH=.

CLASSPATH=$CLASSPATH:$JAVA_HOME/lib/ext/recordio.jar
CLASSPATH=$CLASSPATH:$JAVA_HOME/lib/ext/recjava.jar
CLASSPATH=$CLASSPATH:/usr/lpp/eim/lib/eimzOS.jar:/usr/lpp/eim/lib/eim.jar
export CLASSPATH
#

#
export LIBPATH=$LIBPATH:/usr/lpp/eim/lib

LD_LIBRARY_PATH=/usr/lpp/eim/lib
export LD_LIBRARY_PATH
```

We made the following update to /<java level>/lib/security/java.security:

```
Security.provider.5=com.ibm.eim.jni.provider.IBMEimzOSProvider
```

We created a test file FindAMapping.java:

```
/**

* Looks for a mapping from the user id "C00033" in user registry "PET RACF" to
* another user id in the registry "PET OS400".
*/
import java.io.*;
import java.lang.*;
import java.util.*;
import java.util.Date;
import java.text.*;
import com.ibm.eim.*;
public class FindAMapping {

public static void main(String[] args) {
        String ldapURL;
        ConnectInfo ci;
        String description;

        try {
                // Get instance of a domain manager.
                DomainManager dm = DomainManager.getInstance();

                // Connect to an existing domain.
                String url = "ldap://<ip address>/ibm-eimDomainName=PET Domain,o=EIM";
                ci = new ConnectInfo("cn=EIM Administrator", "password");
                Domain myDomain = dm.getDomain(url, ci);
        } catch (EimException err) {
                System.out.println("Error: Unable to connect to the EIM domain. " + err.toString());
        }

        try {
                DomainManager dm = DomainManager.getInstance();
                String url = "ldap://<ip address>/ibm-eimDomainName=PET Domain,o=EIM";
```

```
                ci = new ConnectInfo("cn=EIM Administrator", "password");
                Domain myDomain = dm.getDomain(url, ci);
                Set mySet = myDomain.findTargetFromSource(
                        "C00033", "PET RACF",
                        "PET OS400");
                if (mySet.isEmpty()) {
                        System.out.println("Error: A target user id was not found"); }
                Iterator i = mySet.iterator();
                while (i.hasNext()) {
                  RegistryUser ru = (RegistryUser)i.next();
                  System.out.println("The UserID from the PET OS400 registry is: " + ru.getTargetUserName());
                }
        } catch (Exception err) {
                System.out.println("Error: Unable to use the EIM domain. " + err.toString());
        }
        }
}
```

Compiling FindAMapping.java

We compiled FindAMapping.java with the following command:

```
javac FindAMapping.java
```

Running FindAMapping

Finally, we ran FindAMapping by entering the following command:

```
java FindAMapping
```

Running FindAMapping returned the following:

```
The UserID from the PET OS400 registry is: A00033
```

Note: The registries, user id and results of running the program are specific to our environment and data. The code would have to be modified to meet individual environment specifics with the results matching that environment's data.

EIM C/C++ APIs – APF Authorization Alternative

In z/OS V1R7, EIM removed the requirement to have the APF Authorization Extended Attribute bit set for C/C++ programs written to exploit the EIM API. You should reference the EIM documentation to decide what and when authorizations are required. This section describes the setup and testing performed to support this change.

We used the following information:

- *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875
- *z/OS V1R7 Migration*

Removing the APF Authorization Extended Attribute

Previous releases of EIM required programs that used the EIM APIs to have the APF Authorization Extended Attribute bit set. This requirement no longer exists. We removed the bit from each of our locally-written EIM programs that access the EIM APIs by entering the following command:

```
extattr -a filename
```

Testing the Removal of the APF Authorization Extended Attribute

First, we tried running the program without removing the APF bit. This failed with the following error.

```
CEE3512S An HFS load of module eim.dll failed. The system
return code was 0000000157; the reason code was 0BDF03AC.
```

After we removed the APF bit, the program ran without error. We felt that this could be a problem if the program was in a shared hfs within a sysplex that had both V1R7 and a prior level of EIM running. We notified the EIM development team. The problem was caused with the removal of the APF Authorization Extended Attribute bit from /usr/lpp/eim/lib/eim.dll. The decision was made to turn the APF bit back on for the eim.dll. After we made this change, our locally-written EIM programs ran with or without the APF bit set. But again, it is recommended that the bit *not* be set for z/OS V1R7 and higher releases.

APAR OA12951 addresses this problem.

Setting the Program Control bit

We found that for a program accessing the eimconnect API, when the API was attempting to obtain the BindDn and BindPw from the RACF facility IRR.PROXY.DEFAULTS, the program would fail. If the BindDn and BindPw were passed directly to the eimConnect API, the program was successful.

The solution was to set the Program Control bit on. To turn the Program Control bit on, enter the following command:

```
extattr +p filename
```

Verifying the Documentation

We found that both *z/OS V1R7.0 Integrated Security Services EIM Guide and Reference* and *z/OS V1R7 Migration* did not address the removal of the APF Authorization Extended Attribute from EIM Program Applications. Both books have been updated and should now accurately indicate the use of the APF Authorization Extended Attribute .

---

eimadmin Utility -U Flag

In z/OS V1R7, the eimadmin utility includes the -U flag. The –U flag lists the EIM identifier associated with a UUID.

We used the following information:

- *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875

We did not find or report any problems using the eimadmin utility –U flag.

Testing the eimadmin Utility –U Flag

To test the eimadmin utility –U flag we entered the following command:

```
eimadmin -lI -d 'ibm-eimDomainName=Small Domain,o=EIM' -h ldap://<ip address>:389 -b 'cn=EIM
Administrator' -w password -U "C5ECD000-3154-1DA7-9BEF-4020642A77BA"
```

The following was returned as expected:

```
C5ECD000-3154-1DA7-9BEF-4020642A77BA    Insco ID c00002
```

To perform the above test, we had to determine the UUID by entering the following command:

```
eimadmin -lI -d 'ibm-eimDomainName=Small Domain,o=EIM' -i 'Insco ID c00002'
-h ldap://<ip address>:389 -b 'cn=EIM Administrator' -w password
```

It returned the following:

```
unique identifier: Insco ID c00002
  identifier UUID: C5ECD000-3154-1DA7-9BEF-4020642A77BA
 other identifier: Insco ID c00002
      description: Identifier for c00002
```

The second line of output is the identifier UUID.

EIM C/C++ APIs - Auditing

In z/OS V1R7, EIM has added the ability to allow auditing functions on select EIM APIs.

The EIM audit log records are written to SMF as type-83 subtype 2 records. Authentication and authorization failures are displayed on the security console and stored in the caller's job log.

This section describes the setup and testing of this new function.

We used the following information:

- *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875
- *z/OS Security Server RACF Callable Services*, SA22-7691
- *z/OS Security Server RACF Security Administrator's Guide*, SA22-7683
- *z/OS Security Server RACF Auditor's Guide*, SA22-7684
- *z/OS Security Server RACF Macros and Interfaces*, SA22-7682
- *z/OS MVS System Management Facilities (SMF)*, SA22-7630

Setting up for Auditing

The caller must have READ access to IRR.RAUDITX profile in the FACILITY class. To check this issue the following command from MVS:

```
rlist facility IRR.RAUDITX
```

For us, the IRR.RAUDITX profile was not defined. We defined IRR.RAUDTIX with the following commands:

```
RDEFINE FACILITY IRR.RAUDITX UACC(READ)
SETROPTS RACLIST(FACILITY) REFRESH
```

We did not use the SETROPTS options to enable logging due to the following Note that appears in the EIM book:

Note: *When you activate auditing using SETROPTS, you're activating auditing for all applications that use the RAUDITX class, not just EIM.*

Instead we enabled EIM Auditing using profiles to restrict it to EIM.

Turn on GENERICs for the RAUDITX class with the following command:

```
SETROPTS GENERIC(RAUDITX)
```

Note: This step is not listed in *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875. APAR OA13581 addresses this problem.

We issued the following command to enable log records to be written for all EIM events for all users in all domains.

```
RDEFINE RAUDITX EIM.* AUDIT(ALL)
```

Ensure the EIM.* profile was defined by issuing either of the following commands:

- For a detailed listing

  ```
  rlist RAUDITX EIM.*
  ```

- For a brief listing

  ```
  SEARCH CLASS(RAUDITX) NOMASK
  ```

In both cases ensure (G) is specified after the profile name of EIM.* in this case. The (G) indicates that GENERICs is on for the profile.

Enable RAUDITX in the Active Classes by issuing the following command:

```
SETR CLASSACT(RAUDITX)
```

Note: This step is not listed in *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875. APAR OA13874 addresses the problem.

When using profiles, as is being done here, define RAUDITX in the Logoptions Default by issuing the following command:

```
SETROPTS LOGOPTIONS(DEFAULT(RAUDITX))
```

Note: This step is not listed in *z/OS Integrated Security Services EIM Guide and Reference*, SA22-7875. APAR OA13874 addresses the problem.

At this point everything should be set and ready to go. As a last check, issue the following command to ensure the SETROPTs settings are correct:

```
SETR LIST
```

Ensure RAUDITX is listed in the following:

ACTIVE CLASSES
GENERIC PROFILE CLASSES
GENERIC COMMAND CLASSES
LOGOPTIONS ″DEFAULT″ CLASSES

Note: A problem was found when EIM invokes the R_auditx callable service in RACF, the service checks the SETROPTS LOGOPTIONS setting to help determine if an SMFtype83 subtype2 record should be cut. If there is ANY class in the LOGOPTIONS NEVER list, then these SMF records will never be written, even if the requested class (RAUDITX) is not in the list.

In addition, if the NEVER list is empty, if there is anything in the LOGOPTIONS ALWAYS List, but not the RAUDITX class, an SMF record is always cut, despite the success/failure status of the call compared to the LOGOPTIONS SUCCESS/FAILURE lists. To obtain the SMF Type 83 Sub Type 2 audit records, empty the LOGOPTIONS NEVER list if you can. Otherwise these records are not generated until this problem is fixed. APAR OA13584 has been taken to address the problem.

Verifying the SMF Type 83 Sub Type 2 Audit records

We used 2 different methods to verify the generation of the SMF Type 83 Subtype 2 records. The simplest method was to use the ERBSCAN command. The second more detailed method was to use the RACF SMF Data Unload utility.

Using ERBSCAN

To use the ERBSCAN command, use ISPF option 3.4 to display the SMF dataset that contains the SMF Type 83 Sub Type 2 records. In the Command column next

to the SMF dataset enter ERBSCAN. This will create a temporary VSAM dataset that displays the contents of the SMF dataset. Enter the following in the EDIT command line to analyze the specified record in detail.

```
ERBSHOW <recnum>
```

Where <recnum> is the number in the first column of data. Expect to see something like the following:

```
Record Number 16584: SMF Record Type 83(2)
==========================================

-> SMF record header
====================

   SMF record length      : 349
   SMF segment descriptor : '0000'X
   SMF system indicator   : '01011110'B
   SMF record type        : 83
   SMF record time        : 12:28:18
   SMF record date        : 05.236
   SMF system id          : JA0
   SMF subsystem id       :
   SMF record subtype     : 2
```

Using the RACF SMF Data Unload utility

Sample JCL for running the RACF SMF Data Unload utility:

```
//SMFEIM1 JOB 'Y0308P,Y03,B7100016,S=C','BUEHL',TIME=1440,
//   NOTIFY=BUEHL,MSGLEVEL=(1,1),CLASS=J,MSGCLASS=H
//SMFDMP   EXEC  PGM=IFASMFDP,REGION=0K
//SMFDATA  DD    DSN=SMFDATA.SMFJA0.G0254V00,DISP=SHR
//OUTDD    DD    DSN=BUEHL.SMFEIM.IRRADU00,DISP=SHR
//SYSPRINT DD    SYSOUT=H
//ADUPRINT DD    SYSOUT=H
//SMFOUT   DD    DUMMY
//SYSIN    DD    *
    INDD(SMFDATA,OPTIONS(DUMP))
    OUTDD(SMFOUT,TYPE(83))
    ABEND(NORETRY)
    USER2(IRRADU00)
    USER3(IRRADU86)
/*
Updates required to the sample JCL.
SMFDATA DD - update the DSN with the name of the SMF dataset containing type 83 records
OUTDD DD – Pre-allocated dataset where the results will be written to.
Pre-allocated dataset characteristics of the dataset listed above.
Organization  . . . : PS
Record format . . . : VB
Record length . . . : 8192
Block size  . . . . : 27998
1st extent tracks . : 500
Secondary tracks  . : 15
```

See *z/OS Security Server RACF Auditor's Guide*, SA22-7684 Chapter 3 for more details. This is where the above sample was obtained from as well.

The following is an example of what the output will look like:

```
----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
*CONNECT SUCCESS  18:34:13 2005-10-14 JA0                  NO   NO   NO
*CONNECT SUCCESS  18:34:15 2005-10-14 JA0                  NO   NO   NO
*CONNECT SUCCESS  18:34:16 2005-10-14 JA0                  NO   NO   NO
--+----8----+----9----+----0----+----1----+----2----+----3----+----4-
   BUEHL    SYS1     NO   NO   NO   NO   NO   NO   NO   NO   NO   NO
   BUEHL    SYS1     NO   NO   NO   NO   NO   NO   NO   NO   NO   NO
   BUEHL    SYS1     NO   NO   NO   NO   NO   NO   NO   NO   NO   NO
---+----5----+----6----+----7----+----8----+----9----+----0----+----1-
  NO   YES  NO   NO   NO   NO   000 NO   NO   094169AD BUEHL9   18:34:
  NO   YES  NO   NO   NO   NO   000 NO   NO   094169AD BUEHL1   18:34:
  NO   YES  NO   NO   NO   NO   000 NO   NO   094169AD BUEHL2   18:34:
```

```
---+----2----+----3----+----4----+----5----+----6----+----7----+----8-
13 2005-10-14          NO   NO   NO   NO   NO            NO   NO   NO
14 2005-10-14          NO   NO   NO   NO   NO            NO   NO   NO
16 2005-10-14          NO   NO   NO   NO   NO            NO   NO   NO
---+----9----+----0----+----1----+----2----+----3----+----4----+----5-
  NO   NO   7720 BUEHL    SYS1     EIM      NO
  NO   NO   7720 BUEHL    SYS1     EIM      NO
  NO   NO   7720 BUEHL    SYS1     EIM      NO
.
.blanks to 845
.
0----+----1----+----2----+----3----+----4----+----5----+----6----+----7-
                                          EIM.SMALLDOMAIN.CONNECT
                                          EIM.SMALLDOMAIN.CONNECT
                                          EIM.SMALLDOMAIN.CONNECT
.
.blanks to 1093
.
--9----+----0----+----1----+----2----+----3----+----4----+----5----+----
     RAUDITX   EIM.*
     RAUDITX   EIM.*
     RAUDITX   EIM.*
.
.blanks to 1351
.
5----+----6----+----7----+----8----+----9----+----0----+----1----+----2-
 HIT7720  EIM
 HIT7720  EIM
 HIT7720  EIM
.
.blanks to 3000
.
0----+----1----+----2----+----3----+----4----+----5----+----6----+----7-
eimConnect
eimConnect
eimConnect
.
.blanks to 3130
.
3----+----4----+----5----+----6----+----7----+----8----+----9----+----0-
LDAP://<host>:389
LDAP://<host>:389
LDAP://<host>:389
---+----1----+----2----+----3----+----4----+----5----+----6----+----7---
                                                    SIMPLE
                                                    SIMPLE
                                                    SIMPLE
The remainder of the columns in the data set were blank. Had this been an error the following would be listed starting in column 3294
=COLS> -+----8----+----9----+----0----+----1----+----2----+----3----+----4----+
000001                    cn=BAD Administrator,o=EIM
000002                    cn=BAD Administrator,o=EIM
000003                    cn=BAD Administrator,o=EIM
```

Note: There was not a clear identification of the layout of the SMF Type 83 Sub Type 2 records in any of the existing documentation. APAR OA13528 has been taken to correct this problem.

Here are the results of ADUPRINT in the JCL's JES output:

```
IRR67652I The utility processed 0 SMF type 30 records.
IRR67652I The utility processed 0 SMF type 80 records.
IRR67652I The utility processed 0 SMF type 81 records.
IRR67655I The utility processed 0 SMF type 83 subtype 1 records.
IRR67655I The utility processed 3 SMF type 83 subtype 2 records.
IRR67655I The utility processed 0 SMF type 83 subtype 3 records.
IRR67653I The utility bypassed 2 SMF records not related to IRRADU00.
IRR67650I SMF data unload utility has successfully completed.
```

Note the identity of 3 SMF type 83 subtype 2 records.

Testing additional scenarios

We also tested for creation of SMF Type 83 subtype 2 records for failures and for a specific user id being authorized for auditing.

Testing Failures

We issued an EIM transaction that had an invalid administrator id. This resulted in an SMF Type 83 Subtype 2 record being created. You should also expect to see the following types of messages in the system log and the caller's job log:

```
ITY7001I EIM AUTHENTICATION FAILURE: UNABLE TO CONNECT TO DOMAIN. 819
         SERVICE(eimConnectToMaster)
         DOMAIN URL(ldap://<host>:389/ibm-eimdomainname=ScriptDomain,o=EIM)
         BIND USER(cn=BAD Administrator,o=EIM)
IRRY000I A SECURITY RELATED EVENT HAS BEEN LOGGED. 820
         COMPONENT(EIM)
         EVENT(AUTHENTICATION) TYPE(FAILURE) MESSAGE(ITY7001I)
         USER(BUEHL) GROUP(SYS1) NAME(PETUSER)
         CLASS(RAUDITX)
```

Testing a User ID

To enable a user id for auditing issue the following command:

```
ALTUSER BUEHL UAUDIT
```

Then from the user id BUEHL an EIM command was issued that would generate an SMF Type 83 Subtype 2 record. It did!

Part 3. Linux virtual servers

The following chapters describe the Linux virtual servers aspects of our computing environment.

Chapter 19. About our Linux virtual server environment

In recent years, Linux has emerged as an operating system for the enterprise. As a result, the zSeries Integration Test team has recently expanded to add a Linux virtual server arm to its overall environment, which will be used to emulate leading-edge customer environments, workloads, and activities.

This section consists of the following, including two solutions we worked on:

- "Cloning Linux images on z/VM 5.1" – We rolled our own cloning solution using what was available to us. See Chapter 20, "Cloning Linux images on z/VM 5.1," on page 301.
- "Establishing security in a heterogeneous Linux server environment" – We'll talk about our network configuration, middleware environment, and the security products used as well as security testing conducted. See Chapter 21, "Establishing security in a heterogeneous Linux server environment," on page 307.
- Products we'll talk about:
  - z/VM
  - Linux on zSeries
  - WebSphere Application Server (WAS)
  - WebSphere Application Sever Network Deployment (including Edge Components)
  - Tivoli Access Manager for e-business (TAM)
  - TAM WebSEAL
  - Tivoli Risk Manager
  - TrendMicro ScanMail
  - TrendMicro ServerProtect
  - iptables
  - z/OS LDAP and z/OS RACF
  - DB2
  - Apache plus zSeries hardware cryptographic acceleration
  - and various other open source security products.
- We migrated to the Linux 2.6 kernel which provides many new and improved features over the 2.4 kernel. These features include better performance, scalability, improved security, and a better basis for middleware products running on Linux for zSeries. In addition, with the move to the 2.6 kernel, IBM's strategic focus for middleware support on zSeries is shifting from 31-bit Linux distributions to the 64-bit versions (either natively, or in 31-bit compatibility mode). See Chapter 22, "Migrating Linux Virtual Servers from the 2.4 to 2.6 Kernel," on page 341.
- Chapter 23, "Future Linux on zSeries projects," on page 447 – What's coming soon.

Chapter 20. Cloning Linux images on z/VM 5.1

Our team needed a simple system to clone Linux images running on VM that would require very little care and feeding. We have come up with a simple solution using FLASHCOPY2 and a few basic REXX EXECs and a script running on Linux. Because the test environment spans a number of VM systems, the cloning system has been designed to run across multiple VM systems using shared DASD.

This chapter outlines how we implemented a cloning solution. It is not intended to be a complete reference and installation guide but rather a description of how the system works and what is needed to implement it in your shop. The REXX EXECs and Linux scripts are not the most elegant, but they get the job done. Although there are many different ways to approach cloning of Linux systems, this method works well for us because of its simplicity and ability to span VM systems, not because it includes a robust set of features. Its focus is on provisioning a Linux distribution into existing z/VM guests. It does not dynamically create z/VM guests. The z/VM administrator must manually define the z/VM guests where the Linux distribution are provisioned and IPLed.

Assumptions: Consider these few assumptions for our test environment:

- z/VM is installed and running.
- DASD supports FLASHCOPY2
- All Master Images and LTICxxxx 201 disks reside on the same Enterprise Storage System (ESS).
- A basic understanding of the z/VM, REXX and the VM Directory is needed.
- A basic understanding of Linux and scripting is needed.

Notes:

1. All of the Linux guests are named LTICxxxx where xxxx is from 0000 to 9999. The LTIC0000 guest is reserved for building new master Linux images. You can use any naming convention you would like. However doing so requires updates in the EXEC's and scripts. In this chapter we will often refer to the Linux guest as the LTICxxxx system or LTICxxxx guest.
2. The cloning system is made up of 3 basic parts:
   - The Linux master images
   - The VM EXECs
   - The Linux setup script.

The Linux master images: The Linux master images are Linux images installed on a single 3390 Model 3 with an IP address of 192.168.70.170 and a hostname of LTIC0000. We try to have one Linux image of every supported flavor available for our users to IPL; for example, SUSE LINUX Enterprise Linux 9, SUSE LINUX Enterprise Linux 9 SP1, Red Hat EL 3, and Red Hat EL 4, just to name a few.

The VM EXECs: Each of the Linux guests across all z/VM LPARs access a shared read-only 191 disk containing the PROFILE EXEC that sets up the environment and prompts the user with a menu. From the menu the user can " IPL Linux", "Clone a new Linux image" or "Install Linux from RAM disk". It also provides the user with a few basic tools.

The Linux setup script: This script needs to be on a FTP server that the Linux master images have access to. After a Master Linux image is built, the setup scripts are installed on the Master Linux image.

Preparing the VM environment for the cloning system

The following steps were used in setting up VM in our testing:

- Adding the FLASHCOPY command to the ″Z″ class
- Defining VM userid “USER” and common DASD
- Defining the key files on common DASD
- Including the LTICPRO directory profile
- Defining the LTICxxx directory entry
- Setting up the LTICxxxx system
- Setting up the IP and HOSTNAME on the LTICxxxx guest system
- Verifying the setup.

Adding the FLASHCOPY command to the ″Z″ class

Flashcopy requires a guest to have CLASS B privileges. We defined a new class, CLASS Z, to which we added the FLASHCOPY command.

Defining VM userid “USER” and common DASD

The Cloning system requires VM userid “USER” to be defined in the z/VM directory with minidisks 194 and 195. These disks contain all common files used by the LTICxxxx automation system, and are shared by all z/VM LPARs. All LTICxxxx guests on all z/VMs will link to these shared disks.

```
USER 194 - This disk is linked as the 191 disk on the linux guest.
USER 195 - This is the source disk for all of the automation EXECs.
```

The definitions for the disks are as follows:

```
MDISK 0194 3390 1 005 VM5435 RR ALL ALL ALL
MDISK 0195 3390 1 END VM5436 RR ALL ALL ALL
```

Note: 194 and 195 disks are defined in the directory as RR to prevent one or more VM systems from accessing the volume in write mode. Doing so would corrupt data. Link the disk MR from MAINT when you need to update the volume.

Defining the key files on common DASD

Following are some of the key files that we defined for our environment. Samples of these files can be found in Appendix C, “Some of our Linux for zSeries samples, scripts and EXECs,” on page 455.

USER 194 Disk

This disk is linked as the LTICxxxx 191 disk R/O.

PROFILE EXEC: This EXEC is run when the LTICxxxx guest is logged on. This EXEC performs 2 functions.

1. If the user is autologged, this EXEC will IPL the linux system.
2. If the user logs onto the LTICxxxx guest, this EXEC will call the “WELCOME EXEC”

WELCOME EXEC: This is the main menu for the LTICxxxx automated system. This EXEC will prompt the user with the following options.

1. IPL Linux on the 201 disk
2. IPL Linux on the a disk other then 201

3. Install a new Linux system
4. Copy a pre-built Linux system
5. Display my networking information
6. What can I do with a LTICxxxx system
7. EXIT

The menu calls the following EXEC's to perform the function:

```
3 - DISTRO EXEC - on USER 195 Disk
4 - DISTCOPY EXEC  - on USER 195 Disk
5 - IPDATA EXEC - on USER 195 Disk
6 - LTIC HELPCMS - on USER 194 Disk
```

USER 195 Disk

This disk is linked as the LTICxxxx user's 192 disk R/O and contains the following:

DISKCOPY LIST: This file contains a list of all available Linux systems that can be cloned. This file must be updated manually by the cloning administrator. The file consists of a description of the Linux systems and the device address that the distribution is on.

DISKCOPY EXEC: This is the EXEC that will perform the copy of the Linux system. We say "COPY", not cloning because it does not perform any function other than the copy. All Linux configuration and Linux customization must be done manually after the copy has completed. The EXEC will present the user with a list of systems that can be copied. After a system is selected, the copy will begin.

DISTRO LIST: This file contains a list of all the Linux systems that can be installed using the LTICxxxx automation system. This file must be kept up to date manually by the LTIC administrator.

DISTRO EXEC: This EXEC will present the user with a list of systems that can be installed. Once the selection is made, it will load the RAM disk install/recovery system.

IPDATA LIST: This file contains a list of all the LTICxxxx IDs and the associated IP addresses.

IPDATA EXEC: This EXEC will give the user all kinds of information about it's TCPIP configuration. Device addresses that are available, IP address, and so on.

Other files found on the 195 disk: All of the files needed to start a RAM disk system are on the 195 disk. There are 3 files for each distribution. The filetypes are IMAGE, PARM and INITRD. The filenames are a unique system identifier that is mapped to the distribution in the DISTRO LIST file.

Including the LTICPRO directory profile

The following directory profile needs to be included on all VM systems using the LTICxxxx automated system. You may need to modify the profile for your environment. The goal of the LTICxxxx system is to use common devices across all VM images. This allows you to move the Linux system from one VM system or LPAR to another and not require any changes to the Linux image. This is why we put the network NIC definition in the profile, which attaches each Linux guest to the VSWITCHes "Intranet" and "Private."

```
Profile LTICPRO
 CRYPTO APVIRT
 IUCV ALLOW
```

```
SPOOL 00C 2540 READER
SPOOL 00D 2540 PUNCH
SPOOL 00E 1403 A
CONSOLE 009 3215 T
LINK MAINT 0190 0190 RR
LINK MAINT 019D 019D RR
LINK MAINT 019E 019E RR
LINK USER 194 191 RR
LINK USER 195 192 RR
NICDEF 9A0 TYPE QDIO LAN SYSTEM INTRANET
NICDEF 600 TYPE QDIO LAN SYSTEM PRIVATE
```

Defining the LTICxxx directory entry

The directory entry for each Linux guests is the same. Only the real device address of the 0201 minidisk changes. We use the DEVNO rather then the volume label for the 0201 disk because when we clone the Linux system the volume label will change. This also gives us the ability to IPL the volume on a LPAR because it is a full pack minidisk.

```
USER LTIC0001 999999 256M 1024M GZ
 INCLUDE LTICPRO
 IPL CMS PARM AUTOCR
 MACHINE ESA
 MDISK 200 FB-512 V-DISK 2048000 MR
 MDISK 0201 3390 DEVNO 5731 MR ALL ALL ALL
```

Setting up the LTICxxx system

Setting up your VM system to use the LTICxxx cloning system requires only a few steps.

1. Create the user 194 and 195 disks.
2. Copy the EXEC's from Appendix C, "Some of our Linux for zSeries samples, scripts and EXECs," on page 455 to the 194 and 195 disks.
3. Create the LTICPRO profile in your VM directory.
4. Create the LTICxxxx systems in the VM directory.
5. Define the VSWITCH networks for INTRANET and PRIVATE .
6. Build the Master Linux images on full 3390 mod 3's starting at CYL 0.
7. Update IPDATA LIST with your installations IP addresses and system names.
8. Update DISKCOPY LIST with the Master Linux images you have built.
9. Update DISTRO LIST with the RAM disk system you will support.
10. Update the Master Linux images with the files and scripts needed to customize the list system detailed in the section "Setting the IP and HOSTNAME on LTICxxxx Guest Systems".

Setting the IP and HOSTNAME on the LTICxxxx guest sytem

The script (lticIPsetup) sets the hostname and the IP address on the cloned Linux system after it has been IPLed. The following need to be set up on the master Linux system(s) in order for this EXEC to work.

1. The HOSTNAME of the system MUST be ltic0000
2. The IP address MUST be 192.168.70.170
3. A list of allowable IP address and Hostnames must be in the file

   `/etc/ip.list`
4. The file `/etc/run_lticIPsetup` MUST exist for the script to run. This is a 0 byte file that can be created with touch. For example:

   `touch /etc/run_lticIPsetup`

5. You must add the line `/etc/init.d/lticIPsetup` to one of the following for the script to run.
   a. On SUSE Linux:
      `/etc/init.d/boot.local`
   b. On Red Hat
      `/etc/rc.d/rc.local`

Verifying the setup

The following are the steps we took to verify our setup:

1. Log onto one of the predefined LTICxxxx z/VM guests.
2. Select Option 4, Copy a pre-built Linux System

   Note: If you do not have FLASHCOPY installed on your DASD, DDR will do the copy.
3. After the copy is complete, select Option 1, and IPL Linux on the 201 disk. Your Linux image should IPL.

Chapter 21. Establishing security in a heterogeneous Linux server environment

The Test and Integration Center for Linux conducted an open source security study in 2003 and 2004 that used only open source security products to secure a Linux server environment. The environment being protected consisted of various IBM middleware products such as WebSphere Application Server, and DB2. The study is documented in a white paper which can be accessed here:

ftp://ftp.software.ibm.com/eserver/zseries/misc/literature/pdf/whitepapers/gm130636.pdf

This year, with the merging of Linux, z/VM and z/OS Integration Test activities into a common environment, we decided to expand the security study, by extending to IBM and Independent software vendor (ISV) security products. In the sections that follow, we'll provide details to our planning, environment, and the products used.

Planning for our Linux on zSeries environment

We had an existing environment of various middleware products that we wanted to secure using a set of IBM and ISV products. We started by creating a matrix of all of our existing middleware products and the security products we wanted to use, and the OS levels they supported, in order to figure out their compatibility. If a security product is to be installed on an existing Linux guest, then it must support that OS level. Tivoli Risk Manager Host Intrusion Detection system is one example. We wanted to install TRM Host IDS adapters on all our WebSphere Application Servers, and our WebSphere Application Server servers on zSeries were running on SUSE LINUX Enterprise Server 8 SP3, that meant we could only use TRM Host IDS if it also supported SUSE LINUX Enterprise Server 8 SP3. The compatibility matrix helped us see clearly what's compatible and what's not. IBM also has out a middleware on Linux matrix for each of its eServers, *http://www.ibm.com/linux/matrix/linuxmatrixhwz.html*, and this helped us as well.

When you are doing your planning, also keep in mind the various prerequisite products that many products require. They may or may not be supported on the same OS level that the product itself is. In that case, you need to think about where you can place the prerequisites so that you can use the product. Usually, the product's release notes or planning guide will provide topology information and recommended prerequisite placements.

Table 15. Middleware compatibility matrix.

Middleware product versions:	Distro installed on:	Platform:
WebSphere Application Server 5.1.0	RHEL AS 2.1 SP1, SLES8 SP3	xSeries® zSeries
WebSphere Application Server Network Deployment 5.1.0	RHEL AS 2.1 SP1, SLES8 SP3	xSeries zSeries
DB2 V8R1M0	z/OS V1R6	zSeries
DB2 Connect 8.1.0.16	RHEL AS 2.1 SP1, SLES8 SP3	xSeries zSeries
DB2 UDB 8.1.0.16	SLES8 SP3	zSeries

Table 15. Middleware compatibility matrix. (continued)

Middleware product versions:	**Distro installed on:**	**Platform:**
WebSphere Application Server Network Deployment Edge Component Caching Proxy 5.1.0	SLES8 SP2	zSeries
WebSphere Application Server Network Deployment Edge Component Load Balancer 5.1.0	SLES8 SP2	zSeries
TAM/WebSeal 5.1	SLES8 SP3	zSeries
Tivoli Directory Server 5.1	RHEL AS 2.1 SP1	xSeries
Tivole Storage Manger 5.2.0	mixed	zSeries
Security product versions:	**Distro supported:**	**Platform:**
Apache 2.0.49	SLES8 SP3	zSeries
z/OS LDAP V1R6	z/OS V1R6	zSeries
TrendMicro ScanMail 2.6	SLES8 SP3	zSeries
TrendMicro ServerProtect 1.3	SLES8 SP3	zSeries
TRM 4.2	SLES8 SP3	zSeries

Linux on zSeries network configuration

The intent of Figure 58 on page 309 is to show the various network connections and flow of traffic.

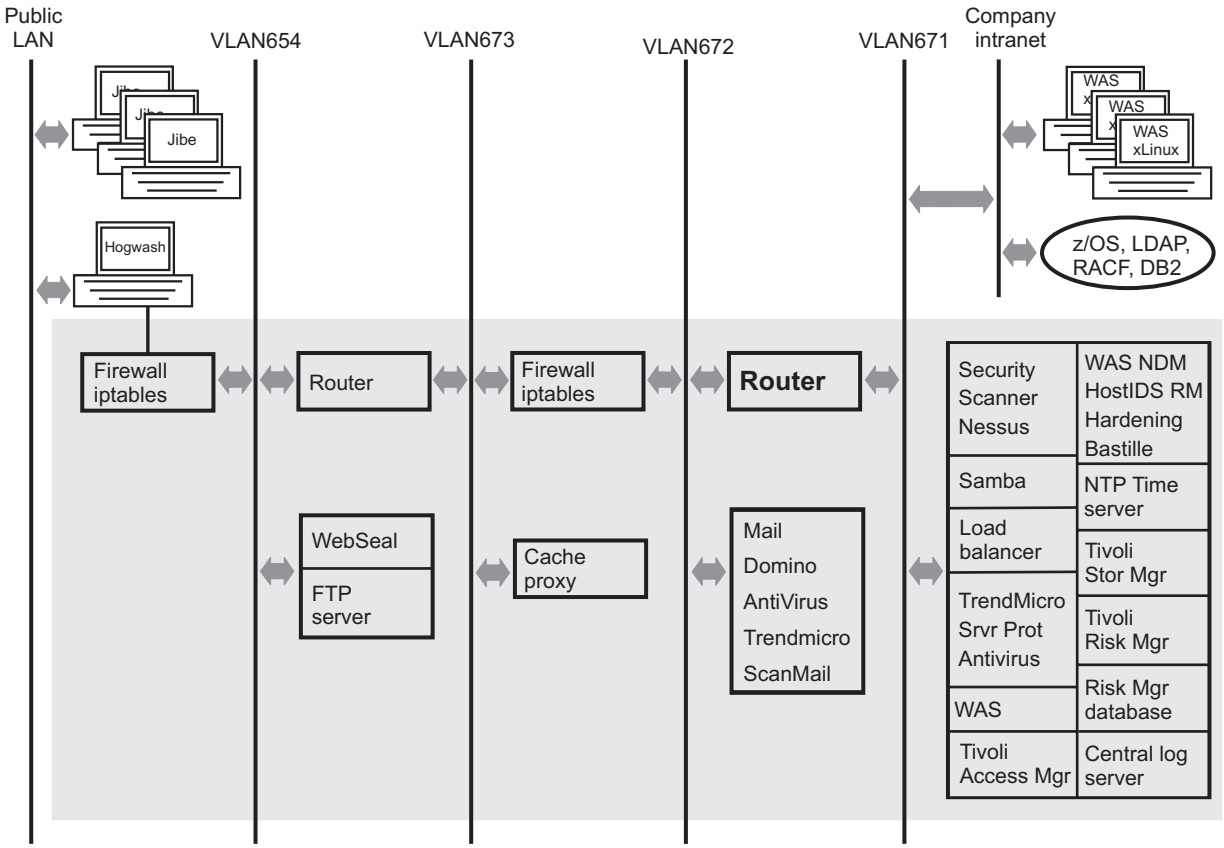


Figure 58. Linux on zSeries network configuration.

The shaded area contains our Linux guests, which are running on a single VM system on a z900 processor. The arrows are used to distinguish which network segment the guests are running on. xSeries Linux systems are represented by the PC icons. There is also a connection to z/OS backend applications through the company intranet. The primary flow of traffic goes through a firewall, a router, another firewall and another router, all of which have IP_forwarding enabled to allow the flow of packets. Which distribution you are running will determine where this is enabled. The router images are configured to compensate for the lack of certain originally-planned elements of the configuration that were omitted because of time constraints. For example, we ran out of time before configuring a mail server proxy between VLAN674 and VLAN673, so the router was required to enable mail traffic to flow from the public LAN to the Domino server.

We encountered the following issues while setting up our network environment over multiple LANs.

- **VSWITCH definitions and grants:** Initially, we were able to ping anything coupled to the VSWITCH from anything else coupled to that VSWITCH but when the traffic went out on the wire, the physical switch wouldn't allow VLAN672 tagged frames through, so the clients never saw them. Nothing outside could ping a Linux guest on that VSWITCH. The following were our definition and grant statements:

  ```
  DEFINE VSWITCH PRVV72 RDEV 1108 VLAN 672 PORTTYPE ACCESS PORT PRVVLAN
  SET VSWITCH PRVV72 GRANT LITDOM01
  ```

  The VLAN keyword on DEFINE VSWITCH defines the default VLAN ID active in the switch. CP will associate this VLAN ID with the untagged frames that it sends and receives. Because our z/VM guests were not VLAN-aware, and because we

didn't specify a VLAN ID on our SET VSWITCH command for each guest, they were sending untagged frames which the VSWITCH then associated with a default VLAN ID of 672. At the same time, our xSeries systems were also not VLAN-aware, so they were sending untagged frames, but the physical switch in our network was associating those frames with a default VLAN ID of 1. The two defaults did not match. The switch default is usually VLAN 1 but you have to ask the physical switch maintainers to be certain. The PORT option was not required and was removed. We corrected our definition and grant statements as follows:

```
DEFINE VSWITCH PRVV72 RDEV 1108 VLAN 1 PORTTYPE ACCESS
SET VSWITCH PRVV72 GRANT LITDOM01 VLAN 672
```

We went forward with the following definitions (not all grants shown):

```
DEFINE VSWITCH PRVV71 RDEV 1104 VLAN 1 PORTTYPE ACCESS
SET VSWITCH PRVV71 GRANT LITDAT01 VLAN 671

DEFINE VSWITCH PRVV72 RDEV 1108 VLAN 1 PORTTYPE ACCESS
SET VSWITCH PRVV72 GRANT LITDOM01 VLAN 672

DEFINE VSWITCH PRVV73 RDEV 110C VLAN 1 PORTTYPE ACCESS
SET VSWITCH PRVV73 GRANT LITCP01 VLAN 673

DEFINE VSWITCH PRVV74 RDEV 1110 VLAN 1 PORTTYPE ACCESS
SET VSWITCH PRVV74 GRANT LITDCS3 VLAN 674
```

- **Inability to communicate from the Linux on zSeries systems on VLAN671 to the xSeries for Linux systems running on the company intranet:** In the network diagram, you will notice the **Router** that is **bold** between VLAN671 and VLAN672. This image was defined as primary router on VSWITCH PRVV71 and VLAN-aware. VSWITCH PRVV71 was also defined as primary router on its OSA. With these definitions, we could not communicate outside our configuration.

  To resolve this issue, a separate VSWITCH was created and the Router image was granted to it. This VSWITCH had to be defined as the primary router and VLAN unaware. This VSWITCH also used a different OSA adapter that was connected to a switch port which did not send VLAN tagged frames. The following shows how the VSWITCH was created:

  ```
  DEFINE VSWITCH IT71 RDEV 700 PRIROUTER PORT IT71
  SET VSWITCH IT71 GRANT LITROUT1

  #cp q vswitch it71
  VSWITCH SYSTEM IT71     Type: VSWITCH Connected: 1    Maxconn: INFINITE
    PERSISTENT  RESTRICTED    PRIROUTER                 Accounting: OFF
    VLAN Unaware
    State: Ready
    IPTimeout: 5         QueueStorage: 8
    Portname: IT71       RDEV: 0700 Controller: TCPIP    VDEV:  0700
  ```

- **Inability to communicate to our network from the Public LAN:** The packets first go through Hogwash, which is an inline packet scrubber that runs on an xSeries box and is transparent to the network. Next is the Firewall between the Public LAN and VLAN674. We have dedicated a real OSA device in the VM directory to this Linux Firewall guest (which is on VLAN674). This OSA device was cabled directly into the xSeries Hogwash box, not into a switch. This needed to be defined with the primary router option. The default gateway on the xSeries systems needed to point to the Firewall. These two changes enabled the Public LAN to communicate with the rest of our network:

  1. To update definitions in `/etc/chandev.conf` we did the following:

     ```
     noauto;qeth1,0x1400,0x1401,0x1402;add_parms,0x10,0x1400,0x1402,\
     portname:CHP07,primary_router
     ```

  2. To set the default gateway on our xSeries systems we ran:

     ```
     route add def gw 192.168.75.252
     ```

Linux on zSeries middleware environment

The following topics describe the Linux on zSeries middleware test environment.

Existing environment

We had two WebSphere Application Server clusters serving a test application called Trade3. One cluster resided on Linux on zSeries, and another on xSeries. Redundant clusters enhance overall availability, and we chose to spread the clusters across two different hardware platforms to add more variety to the test environment.

We used the WebSphere Application Server Network Deployment Edge Component Load Balancer to balance the load between the two clusters, and the cluster WebSphere Application Server Network Deployment Manager to balance the load among its cluster members. WebSphere Application Server Network Deployment Edge Component Caching Proxy was used to tunnel SSL connections from the Tivoli Access Manager WebSEAL component to the Load Balancer.

New middleware

We also set up Domino mail server to provide mail services, and a Samba server for file serving purposes. The FTP server was set up for anonymous file transfer and can be used for transferring certain files from our Samba server.

We'll talk about the WebSphere Application Server components, Samba, and Domino in this section. For WebSEAL/TAM configuration See "IBM security products" on page 328.

Installing WebSphere Application Server and WebSphere Application Server Network Deployment V5.1

Installing WebSphere Application Server and WebSphere Application Server Network Deployment V5.1 requires that you install V5.0 first and then use the update installer to install the fixpack. We followed the installation guide in the WebSphere Application Server Info Center at

```
http://publib.boulder.ibm.com/infocenter/ws51help/index.jsp
```

and the readme file that comes with the fixpack to install WebSphere Application Server V5.1.

When you have installed WebSphere Application Server and WebSphere Application Server Network Deployment V5.1, you must federate the WebSphere Application Server nodes to the WebSphere Application Server Network Deployment Manager to form a cluster. We used the following command for the federation to the WebSphere Application Server Network Deployment V5.1 node, using our nodehostname of `litwas04.ltic.pok.ibm.com`:

```
# $WAS_HOME/bin/addNode.sh litwas04.ltic.pok.ibm.com
```

We installed Trade3 on WebSphere Application Server Network Deployment Manager and synchronized with cluster members. We configured one cluster on zSeries and another on xSeries.

Web Servers for WebSphere Application Server and zSeries Hardware Cryptographic Accleration

We used one web server for each cluster. For the xSeries cluster, we used the IBM HTTP Server that came with WebSphere Application Server. For the zSeries cluster, we built Apache2 version 2.0.49.

Configuring the IBM HTTP Server

We used the IBM HTTP Server that came with WebSphere Application Server, and put it on a separate system. We copied the plugin-cfg.xml file from the WebSphere Application Sever cluster (any member from the cluster will have the same plugin-cfg.xml file) and pointed to it in the `httpd.conf` file of the web server, as follows:

```
LoadModule ibm_app_server_http_module \
/opt/WebSphere/AppServer/bin/mod_ibm_app_server_http.so \
WebSpherePluginConfig /opt/WebSphere/AppServer/config/cells/plugin-cfg.xml
```

Enabling HTTPS on the IBM HTTP Server

We used the following steps to enable HTTPS on the IBM HTTP Server:

- Create a key database named `plugin-key.kdb` and store it in `/opt/WebSphere/AppServer/etc`
- Generate a self-signed certificate with the label 'WebSphere Plugin Key'
- Add the following changes to the IHS conf file `/opt/IBMHttpServer/conf/httpd.conf`

```
LoadModule ibm_ssl_module libexec/mod_ibm_ssl_128.so
<VirtualHost *:443>
DocumentRoot /opt/IBMHttpServer/htdocs/en_US
   SSLEnable
   SSLClientAuth none
   SSLServerCert WebSphere Plugin Key
   Keyfile /opt/WebSphere/AppServer/etc/plugin-key.kdb
</VirtualHost>
```

- Restart the web server normally.

```
/opt/IBMHttpServer/bin/apachectl restart
```

Configuring the Apache2 Server

For the zSeries cluster, we built Apache2, version 2.0.49, on a SUSE LINUX Enterprise Server 8 SP3 system, and took advantage of the PCICA crypto card on our z990 hardware. At the time of this test, we used the crypto card on the z990 since there were no crypto cards available for us on the z900. The parameters to insert in the `httpd.conf` file is a little different for Apache2 than IBM HTTP Server:

```
LoadModule was_ap20_module \
/usr/local/apache2.0.49_susessl7c/mod_was_ap20_http.so \
WebSpherePluginConfig /usr/local/apache2.0.49_susessl7c/plugin-cfg.xml
```

Enabling HTTPS on the Apache2 server

We used the following steps to enable HTTPS on the Apache2 server:

- Create a self-signed certificate using openssl.
- Edit `/etc/ssl/openssl.cnf` and change so `stateOrProvinceName` is optional:

```
stateOrProvinceName     = optional
```

- Issue a certificate request for a certificate which will be one of our Certificate Authorities (CA):

```
litzweb:/etc/ssl # openssl req -config openssl.cnf -new -nodes -keyout
lit.key -out lit.csr
Using configuration from openssl.cnf
Generating a 1024 bit RSA private key
```

```
.....................................................++++++
..++++++
writing new private key to 'lit.key'
-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:US
State or Province Name (full name) [Some-State]:
Locality Name (eg, city) []:
Organization Name (eg, company) [Internet Widgits Pty Ltd]:IBM
Organizational Unit Name (eg, section) []:
Common Name (eg, YOUR name) []:litzweb.ltic.pok.ibm.com
Email Address []:

Please enter the following 'extra' attributes
to be sent with your certificate request
A challenge password []:password
An optional company name []:
```

- Encrypt the key:

```
litzweb:/etc/ssl # openssl rsa -in lit.key -des3 -out litencrypt.key
read RSA key
writing RSA key
Enter PEM pass phrase: password
Verifying password - Enter PEM pass phrase: password
```

- Sign the certificate:

```
litzweb:/etc/ssl # openssl x509 -in lit.csr -out lit.crt -req -signkey
litencrypt.key -days 999
Signature ok
subject=/C=US/ST=Some-State/O=IBM/CN=litzweb.ltic.pok.ibm.com
Getting Private key
Enter PEM pass phrase: password
```

- You can now use the encrypted key database and certificate in Apache. Edit the following lines in `httpd.conf` to reflect the new key database and certificate:

```
SSLCertificateFile /etc/ssl/lit.crt
SSLCertificateKeyFile /etc/ssl/litencrypt.key
```

- Start Apache2 with SSL:

```
litzweb:/usr/local/apache2.0.49_susessl7c/bin # ./apachectl startssl
Apache/2.0.49 mod_ssl/2.0.49 (Pass Phrase Dialog)
Some of your private key files are encrypted for security reasons.
In order to read them you have to provide us with the pass phrases.

Server litzweb.ltic.pok.ibm.com:443 (RSA)
Enter pass phrase:  password

Ok: Pass Phrase Dialog successful.
```

- Access to the Apache web server at *https://192.168.71.119* can be established.

Enabling HTTPS using hardware crypto acceleration on the Apache2 server

The following are the details on the crypto hardware used for the test:

- PCICA: (PCI Cryptographic Accelerator):
  - Provides support for clear keys
  - Feature code 0862
  - Only available if you have CP Assist for Cryptographic Functions feature

– Available on zSeries 990 (can support a max of 12 PCICAs, each feature code has 2 coprocessors)
– Enables max SSL performance

We used the following steps to enable HTTPS using hardware crypto acceleration on the Apache2 server:

- Ensure the correct levels of `openssl` and `libica` are installed:

```
openssl-z990-0.9.7c
libica-z990-1.3.4-3
```

- Ensure the libraries in `/usr/lib` are linked to the correct libraries:

```
sles8bas:/usr/lib # ln -s /opt/openssl-z990/lib/libcrypto.a libcrypto.a
sles8bas:/usr/lib # ln -s /opt/openssl-z990//lib/libcrypto.so libcrypto.so
sles8bas:/usr/lib # ln -s /opt/openssl-z990/lib/libssl.a libssl.a
sles8bas:/usr/lib # ln -s /opt/openssl-z990/lib/libssl.so libssl.so
sles8bas:/usr/lib/ # mv libica.so libica.so.OLD
sles8bas:/usr/lib/ # ln -s /opt/libica-z990/lib/libica.so libica.so
```

- Change the link for `openssl` in `/usr/include`:

```
sles8bas:/usr/include # ln -sf /opt/openssl-z990/include/openssl openssl
```

- Run the `openssl` command to verify if `ibmca` is a supported engine. This is the support required to exploit crypto acceleration for RSA algorithms used for SSL on PCICA card.

```
sles8bas:/opt/openssl-z990/bin # ./openssl engine
(dynamic) Dynamic engine loading support
(cswift) CryptoSwift hardware engine support
(chil) nCipher hardware engine support
(atalla) Atalla hardware engine support
(nuron) Nuron hardware engine support
(ubsec) UBSEC hardware engine support
(aep) Aep hardware engine support
(ibmca) Ibmca hardware engine support
(sureware) SureWare hardware engine support
(4758cca) IBM 4758 CCA hardware engine support
```

- Compile/build Apache 2 to use it with crypto.
  – Downloaded the source from http://www.apache.org

```
httpd-2.0.49.tar.gz
```

  – Run the following commands to build Apache 2:

```
sles8bas:~/httpd-2.0.49 # export CPPFLAGS="-DSSL_EXPERIMENTAL_ENGINE"
sles8bas:~/httpd-2.0.49 # ./configure --prefix=/usr/local/apache2.0.49_susessl7c --enable-mods-shared=all --with-
ssl=/opt/openssl-z990 --enable-ssl --enable-rule=SSL_EXPERIMENTAL
sles8bas:~/httpd-2.0.49 # make
sles8bas:~/httpd-2.0.49 # make install
```

  – Use the same steps from the previous section located on page 313 in generating an encrypted key database and certificate.

```
Key database name = private.key
Certificate name = private.crt
```

  – Edit `/usr/local/apache2.0.49_susessl7c/conf/ssl.conf`:
    1. Include `private.key` & private.crt in `conf`:

```
SSLCertificateFile /usr/local/apache2.0.49_susessl7c/conf/private.crt
SSLCertificateKeyFile usr/local/apache2.0.49_susessl7c/conf/private.key
```

    2. Add the following under *'SSL Global Context'*:

```
SSLCryptoDevice ibmca
```

  – Ensure that the correct `hostname` is defined in `/usr/local/apache2.0.49_susessl7c/conf/ssl.conf`:

```
# General setup for the virtual host
DocumentRoot "/usr/local/apache2.0.49_susessl7c/htdocs"
ServerName sles8bas.pdl.pok.ibm.com:443
```

```
#ServerAdmin you&example.com
ErrorLog /usr/local/apache2.0.49_susessl7c/logs/error_log
TransferLog /usr/local/apache2.0.49_susessl7c/logs/access_log
```

– Load the z90crypt module. Add the following text into a bash script (z90crypt_load):

```
#!/bin/sh -
#*********************************************************************/
#* */
#* s390 only */
#* */
#* Copyright (c) IBM Corporation 2001 */
#* Licensed Material - Program Property of IBM */
#* All rights reserved */
#* Licensed under the IBM Public License (IPL) */
#* */
#* Script to be used to load device driver z90crypt. */
#* */
#*********************************************************************/
module="z90crypt"
device="z90crypt"
group="root"
mode="666"

# invoke insmod with all arguments we got
/sbin/insmod -f -m $module $* >z90crypt.map || exit 1

major=`cat /proc/devices | awk "\\$2==\"$module\" {print \\$1}"`

# Remove stale nodes and replace them, then give gid and perms
# create unrouted device (minor b'00000000' decimal 0)
rm -f /dev/${device}
mknod /dev/${device} c $major 0
chgrp $group /dev/${device}
chmod $mode /dev/${device}
```

– Run the script:

```
./z90crypt_load
```

– Check the hardware response of the crypto driver module. This will show you the status of the card and whether you have any open handles, requests, or pending counts:

```
sles8bas:~ # cat /proc/driver/z90crypt

z90crypt version: 1.1.2
Cryptographic domain: 4
Total device count: 1
PCICA count: 1
PCICC count: 0
requestq count: 0
pendingq count: 0
Total open handles: 0

Mask of online devices: 1 means PCICA, 2 means PCICC
0000000100000000 0000000000000000 0000000000000000 0000000000000000

Mask of waiting work element counts
0000000000000000 0000000000000000 0000000000000000 0000000000000000
```

- Start Apache2 with SSL, crypto enabled:

```
sles8bas:/usr/local/apache2.0.49_susessl7c/bin # ./apachectl startssl
```

- When Apache 2 is started, a “handle” is open to z90crypt. The z90crypt status display shows one open handle:

```
sles8bas:/usr/local/apache2.0.49_susessl7c/bin # cat /proc/driver/z90crypt
cat /proc/driver/z90crypt
```

```
z90crypt version: 1.1.2
Cryptographic domain: 4
Total device count: 1
PCICA count: 1
PCICC count: 0
requestq count: 0
pendingq count: 0
Total open handles: 1 <======== Once you bring up Apache with SSL, this will be 1


Mask of online devices: 1 means PCICA, 2 means PCICC
0000000100000000 0000000000000000 0000000000000000 0000000000000000

Mask of waiting work element counts
0000000000000000 0000000000000000 0000000000000000 0000000000000000
```

- Test the crypto card by running heavy SSL handshake workloads against it. Check for requests that are queued:

```
requestq count: 0
```

Configuring DB2 V8.1 clients on Linux on zSeries to a z/OS DB2 backend

The DB2 database used by our WebSphere Application Server clusters resided on z/OS. The database and its objects were created for us by the z/OS DB2 administrator. All tables and indixes are owned by DB2LIT. The following are key information we used in configuring DB2 clients on zSeries for Linux:

- Database Name – DBLNXTR3
- IP address – 192.168.25.36
- Port – 446
- Database Location name - USIBMT6PETDB2

We have DB2 Connect EE V8.1 FP6 installed on WebSphere Application Server Network Deployment Manager and every WebSphere Application Server node within the cluster. On every DB2 Connect instance (`db2inst1`) or wherever DB2 Connect EE is installed, we needed to define the following catalog entries in order to communicate with DB2 on z/OS.

```
db2 catalog tcpip node DBLNXTR3 remote 192.168.25.36 server 446
db2 catalog dcs db DBLNXTR3 as USIBMT6PETDB2
db2 catalog database DBLNXTR3 as DBLNXTR3 at node DBLNXTR3 authentication \ DCS
```

To test if the connection works, we tried a simple DB2 connect command like the following:

```
db2 connect to DBLNXTR3 user db2lit using password
```

Problems encountered

Following are some of the problems we encountered:

1. When trying to connect to the database DBLNXTR3, we received the following error:

   ```
   db2lit@litwas01:~> db2 connect to DBLNXTR3 user db2lit
   Enter current password for db2lit:
   SQL30082N  Attempt to establish connection failed with security reason "15"
   ("PROCESSING FAILURE").  SQLSTATE=08001
   ```

   The userid db2lit did not exist on z/OS. Once we created it, we were able to connect.

2. The following are two separate problems with the same solution:

- Connecting to the database (DBLNXTR3) using the `db2 connect` command was possible, however, when we tried executing a test connection in the data source from the WebSphere Application Server console, we encountered the following error:

  ```
  [4/19/05 18:41:35:513 EDT] 34923e0b DataSourceCon E DSRA8040I: Failed
  to connect to the DataSource.  Encountered : java.lang.Exception:
  COM.ibm.db2.jdbc.DB2Exception: [IBM][CLI Driver] SQL5042N  One of the
  communication protocol server support processes failed to start up.
  ```

- When populating the trade3 database through the trade3 application, we received the following exception in `<WAS_HOME>/log/TradeCluster[x]/SystemOut.log`:

  ```
  Message:TradeConfigServlet.service(...) \
  Exception trying to perform action=buildDB
  Exception details: com.ibm.websphere.command.CommandException: com.ibm.db2.jcc.a.i
  is not serializable.
  ```

  To fix both problems, we defined a synchronous point manager (SPM_NAME) everywhere that DB2 Connect EE is installed. We needed to define the shortname of the host where the DB2 Connect is being run – **litwas01**.ltic.pok.ibm.com

  Example: Let's say DB2 Connect is running on host `litwas01.ltic.pdl.pok.ibm.com`. From your DB2 instance (`db2inst1`), issue the following command to update the synchronous point manager name (SPM_NAME) in `dbm cfg`:

  ```
  db2 update dbm cfg using SPM_NAME litwas01
  ```

  We had to do this for all DB2 Connect EE instances.

Setting SSL tunneling on in the WebSphere Application Server Edge Component Caching Proxy V5.1

WebSphere Application Server Network Deployment Edge Component Caching Proxy provides functionality that caches static web content as well as dynamic content generated by the WebSphere Application Server. Tivoli Access Manager (TAM) WebSEAL normally acts as a reverse Web proxy by receiving HTTP/HTTPS requests from a Web browser and delivering content from its own Web server or from junctioned back-end Web application servers. Requests passing through TAM WebSEAL are evaluated by the TAM authorization service to determine whether the user is authorized to access the requested resource. In our scenario, a SSL proxy junction was created on the TAM WebSEAL server to deliver post-authorized requests to the back-end WebSphere Application Server cluster. In this case, the Caching Proxy acts as a SSL proxy that tunneled SSL web traffic from WebSEAL to the WebSphere Application Server cluster. In order to set SSL Tunneling on in the Caching Proxy, edit `ibmproxy.conf` with the following parameters:

```
Enable CONNECT
SSLTunneling ON
```

Start the Caching Proxy normally:

```
/etc/init.d/ibmproxy start
```

See "Authenticating and authorizing Web transactions using Tivoli Access Manager and TAM WebSeal" on page 333 for more details on setting up WebSEAL.

Configuring WebSphere Application Server ND Edge Component Load Balancer V5.1

With WebSphere Application Server ND Edge Component Load Balancer V5.1, it is recommended that you use the latest version of Java with Load Balancer. We are using the following Java version:

```
litlb01:~ # java -version
java version "1.4.2"
Java(TM) 2 Runtime Environment, Standard Edition (build 1.4.2)
Classic VM (build 1.4.2, J2RE 1.4.2 IBM build cx390142sr1a-20050209
(JIT enabled: jitc))
```

Our Load Balancer configuration includes two WebSphere Application Server clusters, each with a different Web server:

- Apache2 2.0.49 on zSeries (IP: 192.168.71.119)
- IBM HTTP Server 1.3.28 on xSeries (IP: 192.168.71.32)

We created a Load Balancer cluster that encompassed both WebSphere Application Server clusters with the IP address 192.168.71.98. We created a `lb.config` script that ran all the Load Balancer commands to setup the cluster. You must make sure that `dsserver` is running before running the script. `dsserver` handles requests from the command line to various Load Balancer components. To start `dsserver`, type:

```
dsserver start
```

Here's our lb.config script:

```
dscontrol executor start
dscontrol set loglevel 1
dscontrol cluster add 192.168.71.98
dscontrol cluster set 192.168.71.98 proportions 49 50 1 0
dscontrol executor configure 192.168.71.98 eth0 255.255.255.0
dscontrol port add 192.168.71.98:443 reset no
dscontrol server add 192.168.71.98:443:192.168.71.32 address 192.168.71.32
dscontrol server add 192.168.71.98:443:192.168.71.119 address 192.168.71.119
dscontrol manager start manager.log 10004
dscontrol advisor start Http 443 Http_443.log
```

As you can see, we only allowed HTTPS (port 443) connections to the cluster address.

Problems we encountered

Here are some of the problems we encountered:

- Initially, we were using JDK 1.3.1, but Load Balancer was not functioning correctly. When using JDK 1.3.1, the manager and advisor reports from the cluster were not being returned. Once we updated to JDK 1.4.2, the reporting mechanism worked as expected.
- When accessing our LB cluster, it would only load balance to the xSeries Web server and never to zSeries. We found that this is a known and documented problem in the *Load Balancer's User Guide*, also known as the 'ARP problem'. To resolve the problem, we needed to issue this command once on LB as well as on every server being load balanced (in our case, the two Web servers):

  ```
  sysctl -w net.ipv4.conf.lo.hidden=1 net.ipv4.conf.all.hidden=1
  ```

  Every time the systems are rebooted, we had to issue this command again. We recommend you put this in a startup script so that you don't have to manually type the command on every reboot.

Defining Samba on Red Hat Enterprise Linux 3 Update 4

Samba is a file serving system that is useful if you have Windows systems and Linux on zSeries systems in the same operating environment. It allows Windows users to attach Linux on zSeries file systems as network drives. It also allows Linux users to access those files. Samba is part of the Linux on zSeries distributions and is available for use if it is configured in the system. If it is not already configured, it can be configured using rpm facilities.

We found that it was installed on our Red Hat Enterprise Linux-3 (RHEL3-update 4) system. We decided to use it as a file server for various Linux on zSeries distributions of operating systems and packages. To verify that Samba was installed we ran the following command:

```
rpm -qa |grep sam
```

Here are the results:

```
[root@litsmb01 root]# rpm -qa |grep sam
samba-common-3.0.7-1.3E.1
samba-common-3.0.7-1.3E.1
samba-3.0.7-1.3E.1
redhat-config-samba-1.0.16-2
samba-client-3.0.7-1.3E.1
samba-3.0.7-1.3E.1
samba-swat-3.0.7-1.3E.1
```

We then defined the file systems to Samba that would be used. This required updating the Samba configuration files in the `/etc` directory.

1. Copy the `/etc/samba/smb.conf` to `/etc/samba/smb.conf.orig` to save it

   ```
   cp   /etc/samba/smb.conf    /etc/samba/smb.conf.orig
   ```

2. Add the following lines to the end of the file `/etc/samba/smb.conf`

   ```
   # Created for I/T testing

     [pubmw]
         comment = Download images for install/updates of middleWare
         path = /pub/mw

     [pubdistro]
         comment = Download images install/updates of Base systems
        path = /pub/distro
   ```

   This creates two shared filesystems under Samba, pubmw and pubdistro, which are located at the directories specified by the respective path statements. The share name is limited in length. We first named pubmw, pubmiddleware, but the system did not recognize it so we renamed it pubmw, and that was accepted.

   We then defined the users that would have access to the shared file systems.

   To do this we used the command `smbpasswd` , which defines the users to the Samba system and establishes a Samba password for access. The process is repeated for each user:

   ```
   [root@litsmb01 etc]# smbpasswd -a usera
   New SMB password:
   Retype new SMB password:
   startsmbfilepwent_internal: file /etc/samba/smbpasswd did not exist.
   File successfully created.
   Added user usera.
   [root@litsmb01 etc]# smbpasswd -a samtest1
   New SMB password:
   Retype new SMB password:
   Added user samtest1.
   [root@litsmb01 etc]#
   ```

3. We checked to insure that Samba was running:

```
[root@litsmb01 sbin]# service smb status
smbd (pid 10845 10844) is running...
nmbd (pid 10849) is running...
[root@litsmb01 sbin]# ps -ef | grep mbd
root     10844     1  0 16:00 ?        00:00:00 smbd -D
root     10845 10844  0 16:00 ?        00:00:00 smbd -D
root     10849     1  0 16:00 ?        00:00:00 nmbd -D
root     11085  5455  0 17:45 pts/0    00:00:00 grep mbd
```

4. We stopped and started Samba to pick up the changes we made:

```
[root@litsmb01 vendor]# service smb stop
Shutting down SMB services: [  OK  ]
Shutting down NMB services: [  OK  ]
[root@litsmb01 vendor]# service smb start
Starting SMB services: [  OK  ]
Starting NMB services: [  OK  ]
[root@litsmb01 vendor]#
```

5. To check if the Samba system is working, we logged on to Samba on another Linux on zSeries system:

```
usera@mplinux1:~> smbclient //192.168.71.108/pubmw -U usera
added interface ip=192.168.70.8 bcast=192.168.70.8 nmask=255.255.255.255
added interface ip=x.xxx.xxx.xxx bcast=x.xxx.xxx.xxx  nmask=255.255.255.0
Password:
Domain=[MYGROUP] OS=[Unix] Server=[Samba 3.0.7-1.3E.1]
smb: \>get  sample
<<<<<<<<< command hung forever>>>>>>>>>>>>>>>
```

It appeared to be working, but when we tried to actually retrieve a file, the command hung and did not complete.

We found that the level of Samba that we had installed was back level (version 3.0.7). We found the current level (3.0.9) at:

```
http://www.redhat.com/software/rhn/
```

and reinstalled using rpm; everything worked.

We needed the following Samba 3.09 files:

- For a 31 bit system:

```
samba-common-3.0.9-1.3E.3.s390.rpm
samba-3.0.9-1.3E.3.s390.rpm
samba-swat-3.0.9-1.3E.3.s390.rpm
samba-client-3.0.9-1.3E.3.s390.rpm
```

- For a 64 bit system:

```
samba-common-3.0.9-1.3E.3.s390x.rpm
samba-3.0.9-1.3E.3.s390x.rpm
samba-swat-3.0.9-1.3E.3.s390x.rpm
samba-client-3.0.9-1.3E.3.s390x.rpm
```

Installing and running Domino Mail Server V6.5.4 on Linux on zSeries

We wanted to install and run a Domino Server for Lotus Notes® mail service with the Domino server on a Linux on zSeries 31-bit distribution so we investigated what level of Domino was required. Domino on Linux on zSeries required a SUSE LINUX Enterprise Server 8 (plus fixpacks) distribution. It was not supported on Red Hat levels at the time of our test, so we got the copy of the Domino Server for Linux on zSeries – Domino Version 6.5.4 - and downloaded it to the system.

We accessed the Lotus Domino Administrator Help web site at:

```
http://www.lotus.com/ldd/doc/domino_notes/6.5.1/help65_admin.nsf/Main?OpenFrameSet
```

Under the “Installation” chapter we found that, although the server can be on Linux on zSeries, you need Windows machines for the Domino Administrator and the Lotus Notes clients. We secured three Windows machines for our installation running Windows 2000 Professional.

The installation process is a multi-step operation that requires:

1. Installation of the server code on the Linux on zSeries system
2. The definition of an Administrator to run the server and a group for notes (We defined a user “Domino Admin” with Linux userid of “`domad1`” on the Linux on zSeries system for this purpose.)
3. Installation of the Domino Administrator Client package on a Windows system
4. Starting the Server Setup program on the Linux on zSeries server
5. Starting a Domino Setup program on the Windows machine where you configure the server by the remote process
6. Restarting the Domino Server on the Linux on zSeries system
7. Configuring the Lotus Domino Administrator system on the Windows machine to work with the server
8. Defining clients to the server and the client systems
9. Installing the Lotus Notes Client systems on the additional Windows machines.

When the system was up and running we exchanged a few messages between the users to verify that messages were being transmitted.

Very early in the process, we realized that each time we had to do something on the server directly we needed to log on the Linux on zSeries machine as the administrator and move to the directory containing the Lotus Notes data. In our case this directory was `/notesdata`, and we issued a command residing in the lotus program directory defined at `/opt/lotus/bin`. So we added the following line to the `.bashrc` file for the administrator:

```
export PATH=$PATH:/opt/lotus/bin
cd /notesdata
```

and this made it easier to issue commands.

Installing the Domino server on Linux on zSeries

The installation of the Domino server was relatively easy but we did a few things in preparation. The Administrator’s Help website is very useful to make the estimates of system requirements and names and addresses needed in the installation.

We used the SUSE YAST tool to do the following:

1. Define a Domino group to Linux on zSeries (“notes”)
2. Define a Domino administrator (“Domino Admin” with user id “domad1”)

We then defined the following directories:

1. Domino Data Directory to contain the notes data (“/notesdata”). This will hold all the data related to the server
2. Domino program directory (“/opt”) (the default directory and it was already defined).
3. A directory to hold the installation package and package contents. We defined a directory `/root/domino` and placed the package in that directory.

The first stage of the Domino installation and setup was done by “root” on the Linux on zSeries system. Later operation of the server was done by the Administrator

(domad1). You needed to tell the installation program about the Administrator, and the name of the Domino Data directory. We downloaded the Domino installation package (`c82buna.tar`) to `/root/domino` and untarred it (`tar -xvf c82buna.tar`) producing a directory called `zseries`. We changed to that directory and started the installation session by issuing the command (`./install`). A series of panels was presented where we identified what to install (components), where the Domino Data directory was located, the administrator's userid, etc. When complete, the terminating message directed us to the next step.

We found the installation step can be rerun multiple times without having to uninstall, so, if errors were made at this time, it was easy to correct them.

Installing the Domino Administrator Client on Windows

A Domino server on a Linux on zSeries box is controlled by an administrator running on a Windows machine. There was no local Administrator client package for Linux on zSeries at the time of this test. Thus we needed to install the Domino Administrator Client package. This also was relatively easy to accomplish, as follows:

1. Downloaded the package to the Windows machine
2. Ran the installation Wizard to install the package.

In preparation for using the Administrator Client, we made sure we had a method to transfer files between the Windows machine and the Linux on zSeries machine. We used the `winscp3` program to download the client ID files from the server. The `winscp3` freeware is available from *http://winscp.net*. It is an open source SFTP/SCP client for Windows.

The installation program itself is an installation wizard that provides a GUI interface to make it easy to install. The key thing to note is that when it asks for what to install, we needed to pick everything. We needed the "Domino Designer" and "Domino Administrator" which are not part of the default packages installed.

Starting the Domino Server on the Linux on zSeries system in Setup mode

After installing the Domino Administrator Client on the Windows machine we needed to run the Domino server setup program to complete the installation of the server. The controlling side of the setup program is run from the Windows machine but the server itself must be started in setup mode on the Linux on zSeries system.

Here is where we first needed the administrator. We logged on to the Linux on zSeries system as the Domino Admistrator (`domad1`), moved to the Domino Data directory (`/notesdata`) and issued the command to start the server in setup mode. Since we set up the `.bashrc` file earlier (to add the `/opt/lotus/bin` path to the PATH variable) all we needed to do was issue `server -listen`. The server started up in setup mode (listening for a call from the Windows machine).

Running the Setup program from the Administrator's Windows system

We returned to the Windows machine and started the "Remote Server Setup" (`Start ->Programs->Lotus Applications->Remote Server Setup`). A GUI interface was started and stepped us through the setup process.

We set up the server as a stand alone mail server. The only tricky part about this process was that we wanted to run the Server Load Utility to produce a workload on the server for testing purposes. The Server Load Utility requires that the organization name be the same as the domain name. We did not realize this until

later and had to reinstall the Domino Server and Client to run the test environment. It is in the setup program that the name of the server, the name of the domain, the administrator id, and the beginning of the security levels were established.

Restarting the Domino server on the Linux on zSeries system

From this point on all operations were done under the Domino Administrator's userid on the Linux on zSeries system. When the setup program completed, the server was shut down. We needed to get it started in normal mode. This was done by logging on as the administrator and going to the Domino Data directory and issuing the command `server`.

The server started and the command did not return to the command line but continued and acted as the administrator's console. Progress messages and error messages were displayed. Later when the server was shut down, it was from this session that the `quit` subcommand is issued to terminate the server.

Configuring the Domino Administrator system to work with the server

After the setup completed we went back to the Windows machine and started the Lotus Domino Administrator to configure the Windows machine as the administrator's system. It is here that we defined the server we would work with. It was important to realize that this step defined what server the administrator would work with and not the server itself. It is in this step that we downloaded the `admin.id` file from the server (it was located in the `/notesdata` directory) to the Windows system.

Defining clients to the server

After configuring the administrator system, we defined some users. It was important to realize that there were two independent ways to make a user known to the server. The first method registered the user to the system, defined the mail database (`username.nsf`) on the server, and defined the user id file on the server (`username.id`). This method also added the user to the server directory (`names.nsf`) on the server. A second method only added a user name to the server directory. In both methods we logged on to the Lotus Domino Administrator program and clicked on the `People & Groups` tab. The first method used the `People` tab on the right and the `Register` pulldown menu. The second method used the `People` tab on the left and the `New` tab on the top on the center panel.

We used the first method to define our first users. When the registration was complete, we downloaded (using `winscp3`) the user id files (`username.id`) to the client machine and placed them in `C:Program Files\lotus\notes\data` for easy access at logon time.

Installing the Lotus Notes Client systems on additional Windows machines

Because we wanted to establish a work flow between multiple users and machines, we then repeated the installation of the Lotus Domino Client System on two additional Windows machines.

The steps were the same as before except that we did not have to do the setup again and we did not have to register the users. When the installation completed we downloaded the user id files (`username.id`) to the systems to allow us to log on as those users.

Open source security products

The open source security products we used are Bastille, iptables for both of the firewalls, and Hogwash as the network intrusion prevention system. For details on the implementation of these products, see the following white paper:

ftp://ftp.software.ibm.com/eserver/zseries/misc/literature/pdf/whitepapers/gm130636.pdf

Changing the placement of Hogwash

We changed the placement of Hogwash, see “Linux on zSeries network configuration” on page 308, from where it was in the open source security study. Hogwash is an invisible inline packet scrubber, otherwise known as network intrusion prevention system. By invisible, we mean the system that is running Hogwash does not have an IP address, thus it is invisible to the network. And by placing it in front of the first firewall (instead of behind the firewall like in the open source security study), we are able to scrub incoming packets before they reach the firewall – thus preventing certain attacks targeted at the firewall.

iptables

iptables is the standard Linux software firewall. A user can configure a set of iptables rules to log, deny, or permit packets. We currently utilize 2 firewalls in this environment; both are running iptables.

Defining the rules for the firewall between between Public LAN and VLAN674

We defined the rules for the firewall between between Public LAN and VLAN674:

```
# Turn off ICMP redirects
for x in /proc/sys/net/ipv4/conf/*/accept_redirects
do
   echo 0 > $x
done
for x in /proc/sys/net/ipv4/conf/*/send_redirects
do
   echo 0 > $x
done

#  Turn on ICMP broadcast rejection
echo 1 > /proc/sys/net/ipv4/icmp_echo_ignore_broadcasts

# Turn on Source address validation
for x in /proc/sys/net/ipv4/conf/*/rp_filter
do
   echo 1 > $x
done

#  Turn on syn_cookies
echo 1 > /proc/sys/net/ipv4/tcp_syncookies

#    Flush all the current rules
iptables -P INPUT ACCEPT
iptables -P OUTPUT ACCEPT
iptables -P FORWARD ACCEPT
iptables -F

# Set a policy to drop all forwarded packets
iptables -P FORWARD DROP

#set the forward rules

# allow everybody to get to the namesever
iptables -A FORWARD -p udp --dport 53 -s 192.168.75.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 53 -s 192.168.75.0/24 -j ACCEPT
```

```
# allow Public lan & VLAN674 to access webSEAL
iptables -A FORWARD -p tcp --dport https -d 192.168.74.112 -s 192.168.74.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport https -d 192.168.74.112 -s 192.168.75.0/24 -j ACCEPT

# allow SAMBA/HUB to ssh to all VLANs
iptables -A FORWARD -p tcp --dport 22 -s 192.168.71.108 -j ACCEPT

# allow Nessus to ssh to all VLANs
iptables -A FORWARD -p tcp --dport 22 -s 192.168.71.112 -j ACCEPT

# allow Public lan access to Domino
iptables -A FORWARD -d 192.168.72.117 -s 192.168.75.0/24 -j ACCEPT

# allow NTP Communications from VLAN674 & 673
iptables -A FORWARD -p udp --dport 123 -d 192.168.71.111 -s 192.168.74.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 123 -d 192.168.71.111 -s 192.168.73.0/24 -j ACCEPT
iptables -A FORWARD -p udp --dport 873 -d 192.168.71.111 -s 192.168.74.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 873 -d 192.168.71.111 -s 192.168.73.0/24 -j ACCEPT

# allow Central log server communication from VLAN674 & 673
iptables -A FORWARD -p udp --dport 514 -d 192.168.71.109 -s 192.168.74.0/24 -j ACCEPT
iptables -A FORWARD -p udp --dport 514 -d 192.168.71.110 -s 192.168.74.0/24 -j ACCEPT
iptables -A FORWARD -p udp --dport 514 -d 192.168.71.109 -s 192.168.73.0/24 -j ACCEPT
iptables -A FORWARD -p udp --dport 514 -d 192.168.71.110 -s 192.168.73.0/24 -j ACCEPT

# allow Public lan to ftp server
iptables -A FORWARD -p tcp --dport 21 -d 192.168.73.113 -s 192.168.75.0/24 -j ACCEPT

# allow established and related communication - both ways.
iptables -A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT

# LOG everything that is dropped
iptables -A FORWARD -j LOG --log-prefix "DROPPING " --log-level alert

#######  INPUT     INPUT      INPUT    #######

## Prevent anything from getting into the firewall
iptables -P INPUT DROP

# allow SSH on the firewall
iptables -A INPUT -p tcp --dport 22 -s 192.168.71.108 -j ACCEPT
iptables -A INPUT -p tcp --sport 22 -s 192.168.71.108 -j ACCEPT
iptables -A INPUT -p tcp --dport 22 -s 192.168.71.112 -j ACCEPT
iptables -A INPUT -p tcp --sport 22 -s 192.168.71.112 -j ACCEPT

# allow established and related communication - both ways.
iptables -A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT

# LOG everything that is dropped
iptables -A INPUT -j LOG --log-prefix "DROPPING " --log-level alert

#list the rules
iptables -L -n
```

Defining the rules for the firewall between VLAN673 and VLAN672

We defined the rules for the firewall between VLAN673 and VLAN672:

```
# Turn off ICMP redirects
for x in /proc/sys/net/ipv4/conf/*/accept_redirects
do
   echo 0 > $x
done
for x in /proc/sys/net/ipv4/conf/*/send_redirects
do
   echo 0 > $x
done

#  Turn on ICMP broadcast rejection
```

```
echo 1 > /proc/sys/net/ipv4/icmp_echo_ignore_broadcasts

# Turn on Source address validation
#
for x in /proc/sys/net/ipv4/conf/*/rp_filter
do
   echo 1 > $x
done

#  Turn on syn_cookies
echo 1 > /proc/sys/net/ipv4/tcp_syncookies

#    Flush all the current rules
iptables -P INPUT ACCEPT
iptables -P OUTPUT ACCEPT
iptables -P FORWARD ACCEPT
iptables -F

# Set a policy to drop all forwarded packets
iptables -P FORWARD DROP

#### FORWARD   FORWARD    FORWARD #########
#set the forward rules

# allow everybody to get to the namesever
iptables -A FORWARD -p udp --dport 53 -s 192.168.71.0/24 -j ACCEPT
iptables -A FORWARD -p udp --dport 53 -s 192.168.72.0/24 -j ACCEPT
iptables -A FORWARD -p udp --dport 53 -s 192.168.73.0/24 -j ACCEPT
iptables -A FORWARD -p udp --dport 53 -s 192.168.74.0/24 -j ACCEPT
iptables -A FORWARD -p udp --dport 53 -s 192.168.75.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 53 -s 192.168.71.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 53 -s 192.168.72.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 53 -s 192.168.73.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 53 -s 192.168.74.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 53 -s 192.168.75.0/24 -j ACCEPT

# allow VLAN674 to access caching proxy
iptables -A FORWARD -p tcp --dport 80 -d 192.168.73.150 -s 192.168.74.0/24 -j
ACCEPT

# allow SAMBA/HUB to ssh to all VLANs
iptables -A FORWARD -p tcp --dport 22 -s 192.168.71.108 -j ACCEPT

# allow Nessus to ssh to all VLANs
iptables -A FORWARD -p tcp --dport 22 -s 192.168.71.112 -j ACCEPT

# allow Public LAN admin access to Domino / WebSeal
iptables -A FORWARD -p tcp -d 192.168.72.117 -s 192.168.75.0/24 -j ACCEPT
iptables -A FORWARD -p tcp --dport 443 -d 192.168.74.112 -s 192.168.75.0/24 -j
ACCEPT

# allow WebSEAL communications from VLAN674 to the Policy Server
iptables -A FORWARD -p tcp --dport 7135 -d 192.168.71.120 -s 192.168.74.112 -j
ACCEPT

# allow WebSEAL communications from VLAN674 to the Load Balancer
iptables -A FORWARD -p tcp --dport 443 -d 192.168.71.98 -s 192.168.74.112 -j
ACCEPT

# allow WebSEAL communications from VLAN674 to LDAP on zLinux
iptables -A FORWARD -p tcp --dport 636 -d 192.168.71.25 -s 192.168.74.112 -j
ACCEPT
iptables -A FORWARD -p tcp --dport 389 -d 192.168.71.25 -s 192.168.74.112 -j
ACCEPT
```

```
# allow Cacing Proxy communications to the Load Balancer
iptables -A FORWARD -p tcp --dport 443 -d 192.168.71.98 -s 192.168.73.150 -j
ACCEPT

# allow NTP Communications from VLAN674 & 673
iptables -A FORWARD -p udp --dport 123 -d 192.168.71.111 -s 192.168.74.0/24 -j
ACCEPT
iptables -A FORWARD -p tcp --dport 123 -d 192.168.71.111 -s 192.168.73.0/24 -j
ACCEPT
iptables -A FORWARD -p udp --dport 873 -d 192.168.71.111 -s 192.168.74.0/24 -j
ACCEPT
iptables -A FORWARD -p tcp --dport 873 -d 192.168.71.111 -s 192.168.73.0/24 -j
ACCEPT

# allow Central log server communication from VLAN674 & 673
iptables -A FORWARD -p udp --dport 514 -d 192.168.71.109 -s 192.168.74.0/24 -j
ACCEPT
iptables -A FORWARD -p udp --dport 514 -d 192.168.71.110 -s 192.168.74.0/24 -j
ACCEPT
iptables -A FORWARD -p udp --dport 514 -d 192.168.71.109 -s 192.168.73.0/24 -j
ACCEPT
iptables -A FORWARD -p udp --dport 514 -d 192.168.71.110 -s 192.168.73.0/24 -j
ACCEPT

# allow Public lan & VLAN674 to ftp server
iptables -A FORWARD -p tcp --dport 21 -d 192.168.73.113 -s 192.168.75.0/24 -j
ACCEPT
iptables -A FORWARD -p tcp --dport 21 -d 192.168.73.113 -s 192.168.74.0/24 -j
ACCEPT

# allow samba to get to webseal
iptables -A FORWARD -p tcp --dport https -d 192.168.74.112 -s 192.168.71.108 -j
ACCEPT

# allow VLAN674 & 673 limited time window to TSM Server for Backups
iptables -A INPUT -p tcp --dport 1500 -d 192.168.71.121 -s 192.168.74.0/24
-j ACCEPT
iptables -A INPUT -p tcp --dport 1500 -d 192.168.71.121 -s 192.168.73.0/24
-j ACCEPT

# allow established and related communication - both ways.
iptables -A FORWARD -m state --state RELATED,ESTABLISHED -j ACCEPT

# LOG everything that is dropped
iptables -A FORWARD -j LOG --log-prefix "DROPPING " --log-level alert

#######  INPUT     INPUT      INPUT    #######

## Prevent anything from getting into the firewall
iptables -P INPUT DROP

# allow SSH on the firewall
iptables -A INPUT -p tcp --dport 22 -s 192.168.71.108 -j ACCEPT
iptables -A INPUT -p tcp --sport 22 -s 192.168.71.108 -j ACCEPT
iptables -A INPUT -p tcp --dport 22 -s 192.168.71.112 -j ACCEPT
iptables -A INPUT -p tcp --sport 22 -s 192.168.71.112 -j ACCEPT

# allow established and related communication - both ways.
iptables -A INPUT -m state --state RELATED,ESTABLISHED -j ACCEPT

# LOG everything that is dropped
```

```
iptables -A INPUT -j LOG --log-prefix "DROPPING " --log-level alert

#list the rules
iptables -L –n
```

For clearing our firewall rules for testing purposes, we created another script that flushes all the firewall rules in addition to turning the Linux switches back to default. The following is our script:

```
# Flush all the current rules
#
iptables -P INPUT ACCEPT
iptables -P OUTPUT ACCEPT
iptables -P FORWARD ACCEPT
iptables -F
#
# Turn on ICMP redirects
for x in /proc/sys/net/ipv4/conf/*/accept_redirects
do
echo 1 > $x
done

for x in /proc/sys/net/ipv4/conf/*/send_redirects
do
echo 1 > $x
done
#
# Turn off ICMP broadcast rejection
#
echo 0 > /proc/sys/net/ipv4/icmp_echo_ignore_broadcasts
#
# Turn off Source address validation
#
for x in /proc/sys/net/ipv4/conf/*/rp_filter
do
echo 0 > $x
done
#
# Turn off syn_cookies
#
echo 0 > /proc/sys/net/ipv4/tcp_syncookies
#
#list the rules

iptables -L
```

IBM security products

Following are our experiences with the IBM security products we used.

Planning and installing Tivoli Risk Manager (TRM) Host IDs

In order to use Tivoli Risk Manager for Host Intrusion Detection, we first needed to plan it out. We wanted to use the latest version of TRM, which at the time of the test was TRM V4.2. We determined that TRM was supported on SUSE LINUX Enterprise Server 8 SP3. If you are thinking of using TRM on a specific Service Pack, first check with Tivoli support to ensure it is supported. With this information, we went ahead and planned our TRM topology.

We referenced the RedBook “Centralized Risk Management Using Tivoli Risk Manager 4.2” (SG24-6095-00) and followed the recommendation to keep various components of TRM on separate Linux on zSeries images. We had a TRM Event Server in the internal zone (VLAN671), as the central server that collects all the incidents and events and passes them onto the archive database or Tivoli

Enterprise Console® (TEC). We had a TRM Distributed Correlation Server installed in the internal zone to collect events from TRM clients and correlate them to the Event Server. The TRM Event Server required a database, so we installed DB2 V7.2 FP8 (a TRM supported version of DB2) server on a separate system.

Components of our TRM installation

The installation order is very important in setting up TRM. Because there are multiple components involved, you need to take care in planning them out. We installed them in the following order (each component on its own Linux on zSeries image):

1. **TRM database server:** Needed for TEC's event database and TRM's archive database. TEC and TRM configurations require database server information. The database server we are using is DB2 V7.2 FP8.
2. **TRM Event Server:** The Event Server is the last point in the overall layout where sensor events can be independently siphoned off to the archive database. It needs to be installed before the TRM Distributed Correlation Server because DCS requires TRM information during its installation so it knows who to send incidents to.
3. **TRM Distributed Correlation Server:** The DCS collects events from TRM clients and correlates them into incidents before sending incidents to the TRM Event Server. It needs to be installed before TRM clients because TRM clients require DCS information during their installations so they know who to send events to.
4. **TRM Client:** Finally, the endpoint that collects events gets installed. The endpoint needs TRM client to be installed first, and then you can install various adapters and/or configure the TRM client to collect the type of events you are looking for. In our case we installed the Linux Host IDS adapter to collect local host events.

Installing DB2 V7.2 FP8 Server: According the TRM Release Notes, the only DB2 version supported is V7.2 so we decided to go with that. First install the base DB2 V7.2. Then apply FP8. After applying FP8, run `db2iupdt db2inst1`.

Note: The DB2 V7.x product is no longer supported. If you are thinking about installing TRM in your environment, consider using one of the other TRM-supported databases (see the TRM 4.2 Release Notes).

Installing the TRM Event Server: The Event Server requires that you install the following components:

1. Java Runtime Environment (JRE), Version 1.3.1

   Tivoli Risk Manager ships with IBMJava2-JRE-1.3.1-5.0, which was what we used for the Event Server. If you encounter problems with the TRM installation wizard, for example, if it doesn't load, then your pre-existing JRE might not be compatible. Use the one that ships with TRM.
2. Tivoli Management Framework, Version 4.1

   Note here that the GUI version of the TMF install is not supported on Linux on zSeries, you must install from command line. Follow the *TMF Installation Guide* when installing from the command line. We used the following command to install TMF after generating the scripts with the `WPREINST.SH` script that came with the installation package (see the *TMF Installation Guide* for more details on using the `WPREINST.SH` script):

   ```
   littec:/usr/local/Tivoli/installdir # ./wserver -c /opt/TMFinstall
   BIN=/opt/Tivoli/TMF/bin LIB=/opt/Tivoli/TMF/lib ALIDB=/opt/Tivoli/TMF/database
   MAN=/opt/Tivoli/TMF/man APPD=/opt/Tivoli/TMF/X11 CAT=/opt/Tivoli/TMF/cat
   RN=NoonTide-Region AutoStart=1 SetPort=1 CreatePaths=1 IP=Tivoli4Ever
   ```

Then you must install the TMF license with the `odadmin set_platform_license` license command. See the *TMF Command Reference* for how to use this command.

Set the TMF environment by running:

```
. /etc/Tivoli/setup_env.sh
```

Install TMF patches 10E, 13, 14 and 15.

Extract the patches in some temporary directory, for example; `/opt/TMFinstall/fixpacks`:

```
tar -xzvf 4.1-TMF-0013.tar
tar -xzvf 4.1-TMF-0014.tar
tar -xzvf 4.1-TMF-0015.tar
tar –xzvf 4.1-TMF-0010E.tar
```

Now install the patches:

```
# cd /opt/TMFinstall/fixpacks
# wpatch -c /opt/TMFinstall/fixpacks/41TMF010E -i 41TMF010E LCF_NEW=! LCF41=!
# wpatch -c /opt/TMFinstall/fixpacks/41TMF014 -i 41TMF014 LCF_NEW=! LCF41=!
#wpatch -c /opt/TMFinstall/fixpacks/41TMF015 -i 41TMF015 LCF_NEW=! LCF41=!
# wpatch -c /opt/TMFinstall/fixpacks/41TMF013 -i 41TMF013 LCF_NEW=! LCF41=!
```

Create an administrator with the `wcrtadmin` command. See the *TMF Command Reference* for details on command options.

3. Tivoli Enterprise Console, Version 3.9

   Install DB2 client, it must be the same version as the server, in our case V7.2 FP8. Catalogue a local DB2 node that communicates with the remote DB2 server:

   ```
   db2 catalog tcpip node litrmdb remote litrmdb server TEC
   ```

   Where TEC is the DB2 server port number, in our case, it was set to port 3700.

   Catalog a local database:

   ```
   db2 catalog database TECDB as TECDB at node litrmdb
   ```

   Then create the TEC RIM component (this is the event database connector). This is the command we ran (See the *TMF Command Reference* for more details on the parameters):

   ```
   wcrtrim -v DB2 -h littec -d TECDB -u db2inst1 -H /usr/IBMdb2/V7.1 -s
   tcpip -I /home/db2inst1 -t db2inst1 TECRIM
   RDBMS password: db2inst1
   ```

   On SUSE LINUX Enterprise Server 8 SP3, there is a known problem with the TEC installation. TEC requires the `compress` utility, and more recent version of Linux distributions from SUSE LINUX do not include the compress utility. Before you progress with the TEC installation, follow our workaround in “Problems we encountered” on page 332.

   Use the GUI Installation Wizard to install TEC. First select “Configure the database”, make sure to select “DB2 client” for the RIM host parameter. After the database is configured, go back to the main menu and select “Install the TEC components” and then select the following components to install: Event server, User interface server, Event console, and Adapter Configuration Facility. You can also install these components with the command `winstall` (See *TMF Command Reference* and *TEC Installation Guide* for more details).

4. Tivoli Risk Manager, Version 4.2, Event Server configuration

   Start the GUI install with the following command:

   ```
   littec:/opt/TRMinstall# java -Dis.javahome=/opt/IBMJava2-s390-131/jre \
   cp ./riskmgr42.jar run
   ```

Follow through the GUI panels and make sure to select the “Event Server” configuration. In the database configuration panel, point to the right JDBC driver path. In our case, this was `/usr/IBMdb2/V7.1/java/db2java.zip`.

5. Starting the TRM Event Server.

   First make sure TMF is running by issuing the `ps -ef` command and looking for an `oserv` process. Then make sure the TEC event server is started by running `wstatesvr`; if it’s not running, start it with `wstartesvr`. Setup the TRM environment variables by executing the script `/etc/Tivoli/rma_eif_env.sh`. And now start TRM by running `rmagent &`.

   Verify that it is running by executing `wrmadmin –info`, and you should see the following:

```
littec:/usr/IBMdb2/V7.1/instance # wrmadmin -info
HRMRM0003I Tivoli Risk Manager Version 4.2.
HRMRM0004I The Tivoli Risk Manager Agent is active.

        Tivoli Risk Manager Agent Component Status
        ==========================================
        Engines
                correlation: Running

        Event sources
                eif_receiver: Running

        Event destinations
                incident_sender: Running
                db_sender: Running
```

Setting up the TRM Distributed Correlation Server: The following are the steps in setting up the TRM Distributed Correlation Server:

1. Install the DB2 client, and catalogue a local node to point to the DB2 server.
2. Catalogue a local database that connects to the DB2 server’s TRM archive table. In our case, the database name is TECDB. See 3 on page 330for the specific DB2 commands to do these tasks.
3. Using the TRM installation GUI as above, select to install the DCS configuration. During configuration, point to the TRM Event Server for sending incidents. Start it the same way as you would the Event Server.

Setting up the TRM Client & Host IDS Adapter: The following are the steps in setting up the TRM Client & Host IDS Adapter:

1. Install JRE 1.3.1.
2. Install the TRM client configuration using the TRM installation GUI.
3. Use the EventMonitor’s `launch.sh` to install the Host IDS Adapter. You can download the Host IDS Adapter and the EventMonitor package for Linux from the TRM support website. During configuration of the client, point to the DCS server for sending events. Start it the same way as you would the Event Server or DCS.

Checking for incidents

Crystal Report is not supported on Linux on zSeries so you need to install Crystal Report which is a TRM install option on the Windows platform only, and configure it point to your archive database. TRM provides 22 packaged reports which can be parameterized at execution time to provide a wide variety of views into the Risk Manager event/archive database.

At the time of the security testing, we didn’t have time to secure a Windows machine to install Crystal Report on so we used the `wtdumprl` command to view

incidents reported. The command dumps the whole database that contains all the incidents. An incident entry looks similar to this:

```
1~3839~65537~1116304713(May 17 00:38:33 2005)
### EVENT ###
RM_SrcDstCat_Incident;rm_WindowSize=600000;repeat_count=4;rm_CategoryDisplay
Names=['Authentication denied'];msg='Category: SECAUTH.DENY. Suspicious activity
at litxwas03.';sub_source=INCIDENT;
rm_FirstEventTime=1115648843;rm_Level=12.0;rm_CustomerID=N/A;
rm_ThresholdLevel=10.0;rm_EventCount=4;hostname='SECAUTH.DENY :
litxwas03 => litxwas03';
rm_CategoryTokens=['SECAUTH.DENY'];rm_Timestamp='Tue May 17 00:38:32 2005';
rm_DestinationTokens=['litxwas03'];
source=RISKMGR;severity=CRITICAL;rm_AgentNormalized=true;
rm_Sensors=['OS_Linux/litxwas03'];rm_Timestamp32=1116304712;
rm_LastEventTime=1115648843;
rm_Signatures=['N/A'];rm_SourceTokens=['litxwas03'];END

### END EVENT ###
```

Problems we encountered

Following are the problems we encountered in planning and installing Tivoli Risk Manager (TRM) Host IDs:

1. **SUSE LINUX Enterprise Server 8 SP3 `compress`, `uncompress` issue:**

   On SUSE LINUX Enterprise Server 8 SP3, the compress, `uncompress` commands point to a dummy shell script and the `gzip` command. Tivoli Management Framework's `wbkupdb` command calls `compress/uncompress` and does not work right unless it is the actual command. In our case, we had an indefinite hang. Installing TEC through the GUI installer backs up the objects first so that hung as well.

   This is a known problem and it is documented in TEC's Release Notes,

   `http://publib.boulder.ibm.com/infocenter/tiv3help/index.jsp?topic=/com.ibm.itecrn.doc/econmst20.htm`

   This documentation states ″For SUSE and SUSE LINUX Enterprise Server (SLES) distributions of Linux, if the compress utility is not installed, you might experience problems, such as the rule base not being loaded or the event server not starting due to a missing rule base. The Tivoli Enterprise Console product requires the compress utility, and more recent versions of Linux distributions from SUSE do not include the compress utility.

   Workaround: You could obtain the compress utility from an older level of Linux distributions from SUSE."

   Instead of copying the compress binary from an older system, we built the utility from source and found that it links the binaries for you and worked just as well.The following are the steps for building the `ncompress` utility:

   a. Get the source package from

      `ftp://ftp.nectec.or.th/pub/linux-distributions/Debian/pool/non-free/n/ncompress/ncompress_4.2.4.orig.tar.gz`

   b. Unpack it:

      ```
      tar xvzf ncompress_4.2.4.orig.tar.gz
      ```

   c. Run the build script:

      ```
      littec:~/ncompress/ncompress-4.2.4.orig # ./build
      ```

   d. Select "c" for compile

   e. Select "i" for install

   f. Test it with TMF's wbkupdb command (it should complete relatively quickly):

      ```
      littec:~/ # wbkupdb

      Starting the snapshot of the database files for littec...
      ```

```
.....................................................
.........................

Backup Complete.
```

2. **DB2 server and client must be the same version.**

   If you have a remote DB2 server as we do, and installed DB2 clients on your TRM Event Server and DCS and configured them to send events and incidents to the DB2 server, you must have the same versions on both your server and client. At the time of this testing, the only DB2 version supported on Linux by TRM was DB2 V7.2 FP8, so we had to make sure that all the clients had this version as well. Otherwise, you will see a `db_sender: Failed Retrying` status when you do a `wrmadmin –info` to check on your agent status.

3. **Incident sender is failing.**

   Another problem we ran into was the `incident_sender` component on the TRM Event Server getting a `Failed Retrying` status during a `wrmadmin –info` command. It turned out that we had the wrong login name in `$RMADHOME/etc/incident_sender.conf`. To check what our login name was, we did a `wgetadmin` command, and our login name is indicated below in bold. (Note that the login name is just the front part before the @ sign):

```
littec:~ # wgetadmin
Administrator:  Root_NoonTide-Region
logins: root@littec.ltic.pok.ibm.com
roles:  global  super, senior, admin, user, install_client, install_product,
policy, RIM_view, RIM_update, Query_execute, Query_view, Query_edit,
ACF_glopol, ACF_polmod, ACF_rwdist, ACF_readonly
        security_group_any_admin        user
        Root_NoonTide-Region    admin, user, rconnect
        TecUIServer     super, senior, admin, user, install_client,
install_product, policy, RIM_view, RIM_update, Query_execute, Query_view,
Query_edit, ACF_glopol, ACF_polmod, ACF_rwdist, ACF_readonly
        EventServer     super, senior, admin, user, install_client,
install_product, policy, RIM_view, RIM_update, Query_execute, Query_view,
Query_edit, ACF_glopol, ACF_polmod, ACF_rwdist, ACF_readonly
        ACPdefault      super, senior, admin, user, install_client,
install_product, policy, RIM_view, RIM_update, Query_execute, Query_view,
Query_edit, ACF_glopol, ACF_polmod, ACF_rwdist, ACF_readonly
notice groups:  TME Administration, TME Authorization, TME Diagnostics, TME Scheduler
```

   Now you want to make sure that everything is working. Restart the `rmagent` with `wrmadmin –r`, wait a few minutes, and then run `wrmadmin –info`.

```
littec:/opt/RISKMGR/etc # wrmadmin -info
HRMRM0003I Tivoli Risk Manager Version 4.2.
HRMRM0004I The Tivoli Risk Manager Agent is active.

        Tivoli Risk Manager Agent Component Status
        ==========================================
        Engines
                correlation: Running

        Event sources
                eif_receiver: Running

        Event destinations
                incident_sender: Running
                db_sender: Running
```

Authenticating and authorizing Web transactions using Tivoli Access Manager and TAM WebSeal

Tivoli Access Manager V5.1 and Tivoli Access Manager WebSeal were used in our environment to authenticate and authorize Web transactions. We connected TAM to a backend z/OS LDAP server.

First run the ivrgy_tool command that comes with TAM to setup TAM schema in the LDAP server:

```
littam71:/opt/PolicyDirector/sbin # ./ivrgy_tool -h z0eip -p 3389 -D
"cn=webadm" -w webadm schema
```

We wanted to use SSL connection between LDAP and TAM/WebSeal. So we created a key database with a user or server certificate with 1024-bit RSA key, using the gskkyman tool in z/OS USS. In the /Z0/etc/ldap/slapd.conf file on z/OS, we specified the port for SSL connection as well as the key database information (Z0 is the name of our z/OS system):

```
 9  listen ldaps://:6636
10
11  sslAuth serverAuth
12  sslKeyRingFile /Z0/etc/ldap/J80LDAP/keys/Z0ldaptim.kdb
13  sslCertificate cert_ldap
14  sslKeyRingFilePW password
15  sslCipherSpecs ANY
16  sslKeyRingPWStashFile /Z0/etc/ldap/J80LDAP/keys/Z0ldaptim.sth
```

We transferred the Z0ldaptim.kdb key database over to the TAM and WebSeal systems. Now we wanted to configure TAM and WebSeal as usual. When configuring the TAM runtime, we chose the regular non-SSL LDAP port, but when configuring the policy server and WebSeal, we chose the SSL LDAP port, making sure to point to the key database that was just transferred.

As noted in “Setting SSL tunneling on in the WebSphere Application Server Edge Component Caching Proxy V5.1” on page 317, we used WebSeal to create a SSL proxy junction that tunneled authorized traffic through to the WebSphere Application Severcluster. To create a SSL proxy junction we ran the following command from the TAM pdadmin command prompt:

Problems we encountered

If you have any other suffix defined in z/OS LDAP other than:

```
34  suffix "o=ibm, c=us"
35  suffix "secAuthority=Default"
```

Then you need to tell TAM to ignore the other suffixes defined in slapd.conf on your z/OS LDAP. Do this by editing /opt/PolicyDirector/etc/ldap.conf with:"

```
ignore-suffix = sysplex=utcplxj8,o=ibm,c=us
```

The suffix sysplex=utcplxj8,o=ibm,c=us was a complete suffix (different from the TAM accepted o=ibm,c=us) that was used for a z/OS RACF backend.

Authenticating Linux users using RACF and LDAP on z/OS

The guide for which we used as a reference is found at the following link:

```
http://www.ibm.com/developerworks/eserver/library/es-sles-ldap/
```

The above documentation is geared toward SUSE LINUX Enterprise Server 9 setup. Our systems are running SUSE LINUX Enterprise Server 8 SP3 31bit. There are differences between the changes required in /etc/pam.d/sshd. Here is our /etc/pam.d/sshd after we modified it:

```
litzweb:/etc/pam.d # cat sshd
#%PAM-1.0
auth requisite          pam_nologin.so
auth     required       pam_nologin.so
auth     required       pam_env.so
#authenticaion against an LDAP server
auth     sufficient     pam_ldap.so
```

```
auth required           pam_unix.so use_first_pass
auth     required       pam_unix2.so use_first_pass
#LDAP Server account and session
account  sufficient     pam_ldap.so
account  required       pam_unix2.so
account  required       pam_nologin.so
session  required       pam_unix2.so    none # trace or debug
session  required       pam_limits.so
password sufficient     pam_ldap.so
password required       pam_unix2.so  use_first_pass use_authtok
```

The other addition we had to make was in the /etc/openldap/ldap.conf file to include the non-unique port (3389) we use for LDAP on z/OS.

```
litzweb:/etc/openldap # cat ldap.conf
# $OpenLDAP: pkg/ldap/libraries/libldap/ldap.conf,v 1.9 2000/09/04 19:57:01 kurt Exp $
#
# LDAP Defaults
#

# See ldap.conf(5) for details
# This file should be world readable but not world writable.
host z0eip.pdl.pok.ibm.com
port 3389
base sysplex=UTCPLXJ8,o=IBM,c=US
binddn racfid=WEBADM,profiletype=user,sysplex=UTCPLXJ8,o=IBM,c=US
bindpw webadm
ldap_version 3
pam_login_attribute racfid

#BASE   dc=example, dc=com
#URI    ldap://ldap.example.com ldap://ldap-master.example.com:666

#SIZELIMIT      12
#TIMELIMIT      15
#DEREF          never
```

The rest of the guide is accurate for both SUSE LINUX Enterprise Server 8 and SUSE LINUX Enterprise Server 9.

Independent service vendor (ISV) security products

Following are some of the ISV security products that we used and tested.

Installing TrendMicro's ScanMail

In order to protect the mail users from viruses, we decided to install the TrendMicro ScanMail program. We used V2.6 with SUSE SLES 8 SP3.

We downloaded the product with the following three files:

1. readme-smln-zlinux26-b1529.txt - basic description and install instructions
2. smln26-gsg.pdf - installation and users guide
3. smln26-sp1-zlinux-b1529.tar - program iteslf

We stopped the Domino server by issuing "quit" from the start up session.

We untarred the program file and began the installation by issuing the ./sminst command and were surprised to find it did not execute. We checked the mode of the file and found it was not executable and so changed the mode to 555 for this execution. (chmod 555 sminst).

The installation went very easily with only a few questions to answer. We had to identify the Domino administrator, where the Domino Data Directory was, and a few other things. The process took only a few minutes.

On completion we restarted the Domino server and went to the Windows machine to try and send some mail. Everything went well, but the question remained: “Are we checking for viruses?”. To answer that question, Trend Micro provided an inert virus test file to try and pass in the mail.

Testing to see if it detects viruses

In order to test if the system is detecting viruses, you need to introduce a virus into the system. From Trend Micro’s Getting Started Guide:

“The European Institute for Computer Antivirus Research, or EICAR has developed a test script that can be used to test your antivirus software. This script is an inert text file whose binary pattern is included in the virus pattern file from most antivirus vendors. *It is not a virus and does not contain any program code*.”

We tried to create a file on the Windows system containing the test virus but failed. Each time we tried to file the text, the Windows virus scan program (Symantic’s Norton Antivirus program) isolated the file and destroyed it.

In order to make the test, we had to stop the antivirus program temporarily. To do this we had to go into the Systems settings and disable it.

Finally we were able to create the test file by opening a Notepad file and inserting the following string

```
X5O!P%@AP[4\PZX54(P^)7CC)7}$EICAR-STANDARD-ANTIVIRUS-TEST-FILE!$H+H*
```

and filing it under the name `eicar.com`.

We then logged on to a Lotus Notes client and sent a message with the `eicar.com` file as an attachment. The file was caught and isolated. The receiver got a message with the attachment, but the attachment contained only one character of data and a ″RED″ warning message that the file had a virus. The sender was not notified of the problem.

We went back to the ″ScanMail Getting Started Guide″ and found that we missed setting some ScanMail options. Following the instructions on page 4-14, we logged on to Lotus Notes as the Administrator, opened the ScanMail data base, and went to the section on ″Virus Notification″. There we turned on the options to notify the sender, the receiver, and the Administrator of any virus detected. We retested the virus detection and found that in addition to the ″RED note″ the sender received, the sender, receiver, and Administrator, each received an additional note identifying the problem and its source.

Installing TrendMicro’s ServerProtect

Trend Micro ServerProtect™ for Linux™ provides comprehensive protection against computer viruses, Trojans, and worms for file servers based on the Linux operating system. Managed through an intuitive, portable Web-based console or Linux command line console, ServerProtect provides centralized virus scanning, pattern updates, event reporting and antivirus configuration.

TrendMicro ServerProtect is only supported on SUSE (SLES 8), and not Red Hat (RHEL 3). We tried installing ServerProtect on RHEL 3, but it failed with an unsupported kernel version when installing the rpm.

Instead, we installed Server Protect on SLES 8 SP3 31bit. Installation of the product is straightforward; run the `SProtectLinux-1.3.0.SLES_S390.s390.bin` install EXEC from the install source.

To access the ServerProtect Web Console, access it through the URL at port *http://xxx:14942/ or https://xxx:14943/*.

Trend Micro recommends testing ServerProtect and confirming that it works by using the EICAR test file, which is a safe way to confirm that your antivirus software is properly installed and configured.

To test the ServerProtect installation with EICAR:

1. Open an ASCII text file and copy the following 68-character string to it:
   `X5O!P%@AP[4\PZX54(P^)7CC)7}$EICAR-STANDARD-ANTIVIRUS-TEST-FILE!$H+H*`
2. Save the file as eicar_test.com to a temp directory and then close it.
3. Access ServerProtect Web Console at *http://192.168.71.119:14942/*. By default, it will have `/root` in its list of directories to scan; specify / and add it to list to scan entire system.
4. Click *save and scan*. ServerProtect locates the fake virus as displayed in Figure 59 on page 338:

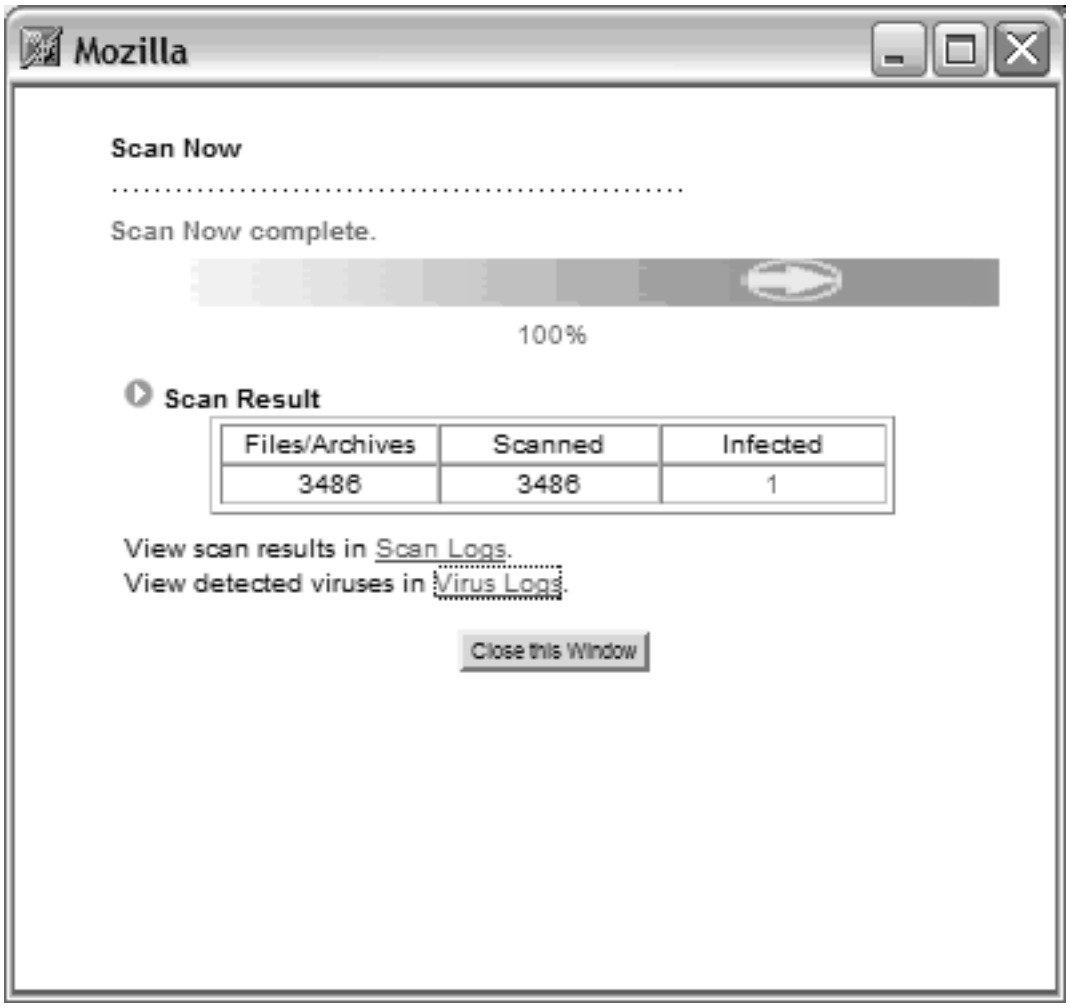


Figure 59. ServerProtect's Scan Complete display.

5. Click *Virus Logs* that shows details about the virus and how it was dealt with. See Figure 60 on page 339.

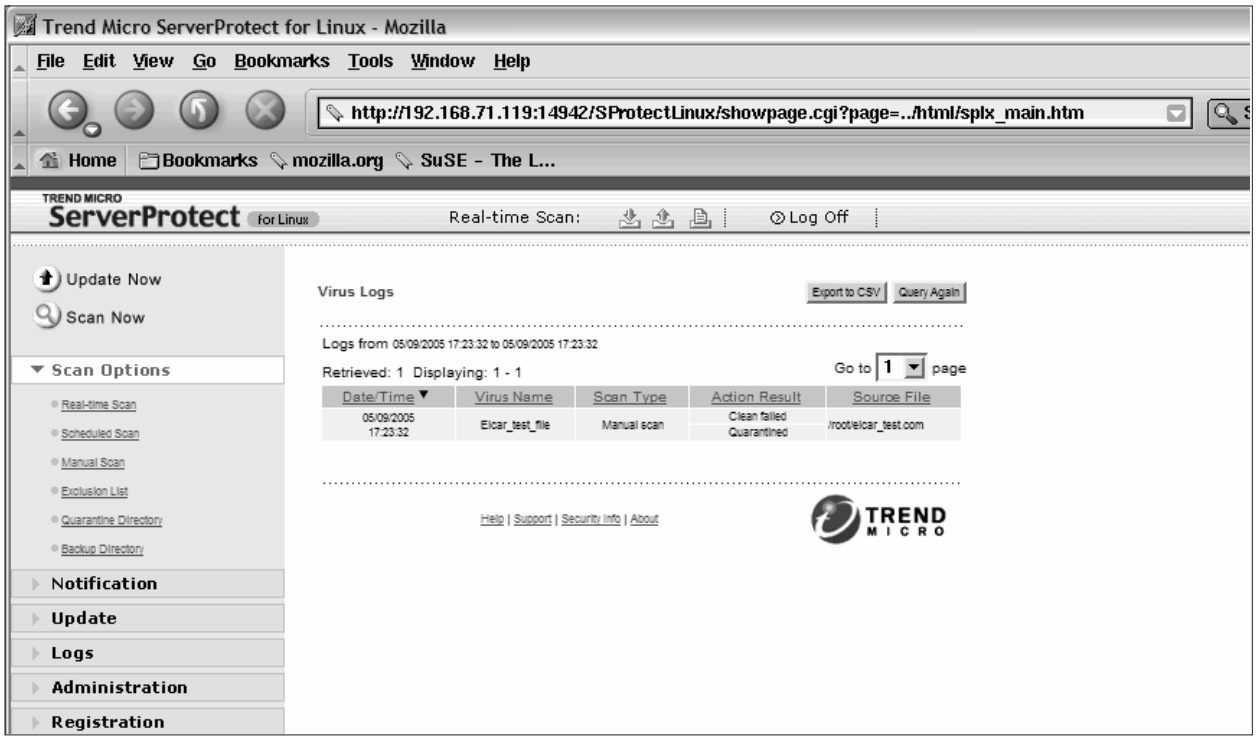


Figure 60. ServerProtect's "Virus Logs" display.

In our case, the virus was quarantined and moved to `/opt/TrendMicro/SProtectLinux/SPLX.Quarantine` where it can be deleted by the user.

Security testing

We ran nmap scans on both our firewalls to make sure that only ports and IP addresses that are open through the firewall are accessible. For more details on running nmap, see the open source security paper at:

`ftp://ftp.software.ibm.com/eserver/zseries/misc/literature/pdf/whitepapers/gm130636.pdf`

We brought in an internal ethical hacker who worked with us during the open source security study. This time, the hacker was able to bring down our VM image with attacks against one of our Linux servers. We took the dump and analyzed it to find that the problem was reported in APAR VM63634 . We will need to apply the fix and re-test to see that it works, so apply the fix to avoid the problem.

Hogwash filtered many attacks with its base `stock.rules` and on the Hogwash console we would see messages alerting that packets were dropped. Tivoli Risk Manager reported many alerts as well. You can check Tivoli Risk Manager incidents by using Crystal Report or with the `wtdumprl` command and redirect the output to a file that you can analyze. For details on the command and Crystal Report, see "Planning and installing Tivoli Risk Manager (TRM) Host IDs" on page 328.

Security: Next steps

The security test is an on-going project; we will improve our security environment by experimenting with new products and installing the latest security patches.

Chapter 22. Migrating Linux Virtual Servers from the 2.4 to 2.6 Kernel

Introduction

The Linux 2.6 kernel provides many new and improved features over the 2.4 kernel. These features include better performance, scalability, improved security, and a better basis for middleware products running on Linux for zSeries. In addition, with the move to the 2.6 kernel, IBM's strategic focus for middleware support on zSeries is shifting from 31-bit Linux distributions to the 64-bit versions (either natively, or in 31-bit compatibility mode). The Linux Virtual Server team of zSeries Integration Test migrated appropriate portions of our existing infrastructure from 2.4 kernel-based to 2.6 kernel-based systems (see the June 2005 zSeries Platform Test Report for z/OS and Linux Virtual Servers at:

`http://www-1.ibm.com/servers/eserver/zseries/zos/integtst/`

Part 3, for details on our existing infrastructure). The migration was done in a controlled, customer-like manner, following recommendations from the IBM 2.4 to 2.6 Transition Guide which can be found at :

`http://www.ibm.com/servers/eserver/zseries/library/techpapers/pdf/lnux-14mg.pdf`

In addition, our goal was to migrate all our Linux on zSeries systems to 64-bit. However, not all middleware products supported 64-bit at the time of our testing. For those middleware products that did not support 64-bit 2.6 kernel distributions, we migrated to the 31-bit 2.6 kernel. In the future when the support becomes available, we will then migrate to the 64-bit version. If the middleware that is on the server is integrated with other middleware products in our environments, we took on the "do one thing at a time" approach and migrated the integrated middleware one piece at a time. We wanted to verify each piece worked before moving on to migrate the next piece.

Where a migration guide was available for the middleware product, we referenced it along with the Transition Guide if we had to upgrade the middleware to the level that supported both distributions.

For migrating to 2.6 kernel versions of 31-bit distributions, we followed the Transition Guide's recommendations as well as documentation from the distributors.

This report is broken down into two major sections, the first one talks about "Upgrading the OS", and the second talks about "Migrating Linux Virtual Servers".

Migration Summary

The overall migration experience was relatively smooth, we did run into a few road bumps but generally the approach recommended by the Transition Guide was correct. We spent time up front and planned out a migration matrix (see "IBM Products" on page 357) which saved us a lot of time later on. Many middleware products required multiple steps for migration, most of them didn't have direct migration paths. We talk about how we migrated each product separately, in chronological order, and we talk about the issues we hit and how we got around them.

Here are the issues that we hit during our migration that we talk about in more detail later on:

Upgrading the OS

SLES8 to SLES9 upgrade issues

- SLES9 reordered the /dev/dasdx assignments based on device address, making the device with the lowest address /dev/dasda, the next lowest address /dev/dasdb, etc. In cases where our root device on the SLES 8 system did not have the lowest address, we saw problems such as /etc/fstab getting out of sync. Fortunately, it is possible to disable this reordering, as we describe later.
- SLES 9 did not tolerate the same delimiters in /etc/zipl.conf as did SLES 8, so some minor modifications needed to be made in this file.

RHEL 3 to RHEL 4 upgrade issues

- The file /etc/chandev.conf is no longer used on RHEL 4. Instead, it uses new parameters in the network init script files. Unfortunately, the upgrade process did not make this translation for us, so we needed to do it by hand. We added the appropriate parameters to the RHEL 3 init script files prior to performing the upgrade. RHEL 3 ignores these extra parameters, so adding them caused no problems to the original RHEL 3 systems.
- RHEL 4 does not use /etc/modules.conf. The upgrade process copied the entire contents of that file to /etc/modprobe.conf. Unfortunately, this included copying information on any zFCP (SCSI) devices, but RHEL 4 expects that information to be described in /etc/zfcp.conf instead. As a result, we had to manually change the configuration files to properly describe our zFCP devices. (RHIT 68004, 68153)
- After the upgrade to RHEL 4, information on zFCP devices needed to be manually added to the initrd file and zipl run before those devices could be used. (RHIT 68154)
- As a result of these upgrade issues, RedHat recommended that we open 3 separate bugzillas, presumably because the items are handled by 3 different software features of the RedHat system. Bugzilla RHIT 68004 deals specifically with the migration of /etc/modules.conf to /etc/modprobe.conf. RHIT 68153 deals with building the new configuration files that are needed. RHIT 68154 deals with the needed modules in the initrd in order for the device configuration to work.

Migrating Linux Virtual Servers

WebSphere Application Server Network Deployment Edge Component Caching Proxy

- We upgraded our Caching Proxy from v5.1.0 to v5.1.1 prior to the migration. But, we found that there was a security enhancement added to CP v5.1.1 that affected creating our SSL proxy junction to our load balancer cluster on our WebSEAL system. We needed to add 'Enable CONNECT OutgoingPorts all' to the CP configuration file.

WebSphere Application Server Network Deployment Edge Component Load Balancer

- We upgraded our Load Balancer from v5.1.0 to v5.1.1 prior to the migration. But we found that LB v5.1.1 did not provide support for our base SLES 9 kernel (though it does provide support for later kernels). We upgraded SLES 9 to latest SP1 Security update, which was supported by LB v5.1.1

DB2

- We found that DB2 Connect EE must be at the same FP level or higher than DB2 UDB ESE in order to run our test application successfully. Otherwise connection via the application resulted in errors.

WebSphere Application Server and WebSphere Application Server Network Deployment

- We had originally upgraded a WAS node to v5.1.1, leaving ND at v5.1. However, we found that after the upgrade, the admin console could not gather any information from the node. This is because ND must be at the same or higher level than the nodes it is monitoring. So, we upgraded ND before proceeding with further node upgrades.

Tivoli Storage Manager Tape Support

- In migrating to TSM 5.3 on our SLES 9 system, we first needed to upgrade the tape support. However, as with WebSphere Application Server Network Deployment Load Balancer, we found that the 3580 tape driver did not offer support for the base level of SLES 9. We had upgrade SLES 9 to the SP1 level before proceeding with the tape driver install.

Tivoli Storage Manager Database Reload

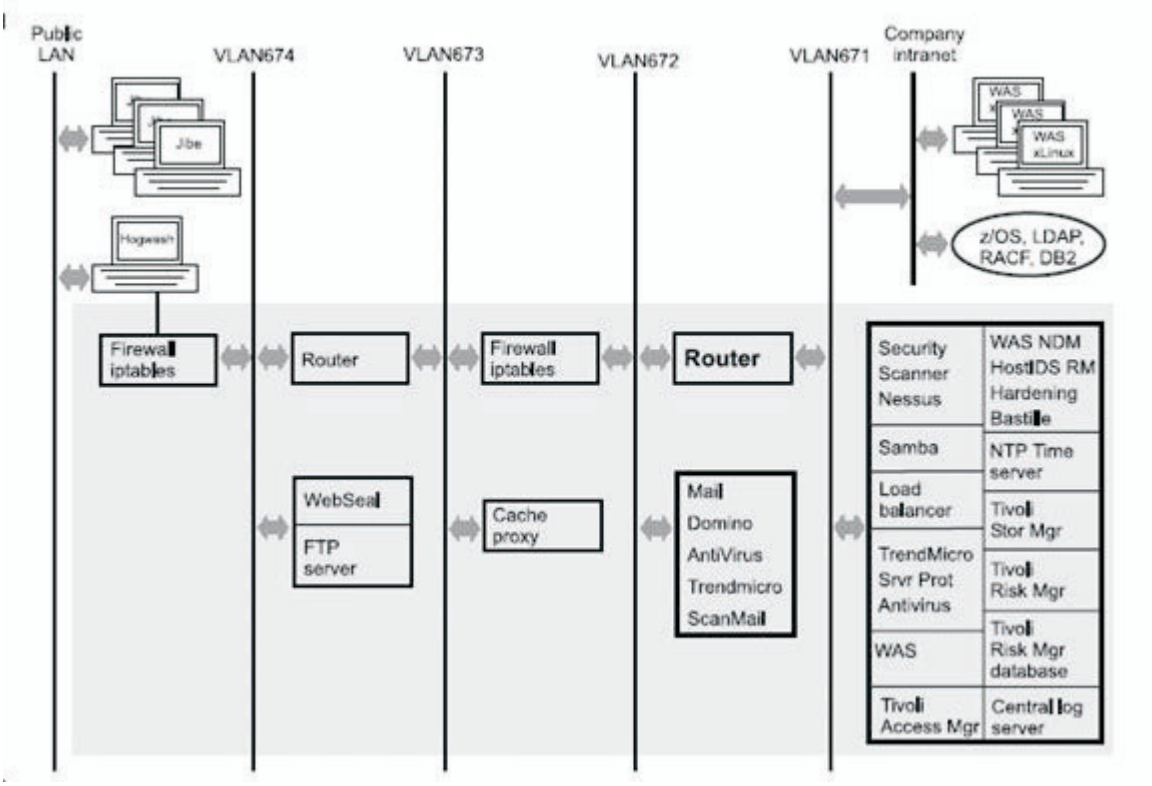
- Before reloading the TSM database on the new server, we found it was critical to first create the disk pool volumes, and recreate empty versions of the database files and the log files. The process was first to create and format the disk pool volumes via dsmserv dsmfmt commands, and then tell TSM how to use them via the dsmserv loadformat command. We also needed to install the new TSM system and partially configure it (for the tape) before reloading.
- Another thing we learned was to be careful to specify the correct label for the tape from which you are reloading! If you specify the wrong label (as we did), it takes time to rectify the error.

Tivoli Storage Manager Client

- When installing the TSM client on the 64-bit SLES 9 system, we found that the TIVsm-API64 rpm prerequisites the TIVMsm-BA rpm, which in turn prerequisites the 31-bit TIVsm-API rpm. As long as the correct prerequisites were in place, the client install went smoothly.

Upgrading the OS

The majority of our initial environment consisted of systems running the 2.4 kernel 31 bit. Our goal was to migrate everything to the 2.6 kernel 64-bit where possible.



To create our migration plan, we first had to determine what middleware products and levels were supported on 64-bit. We gathered all that information, which is detailed in the Migrating Linux Virtual Servers section, and came up with our migration plan. The systems with middleware that supported 64-bit were going to be “migrated” to the 2.6 kernel 64-bit. Migrated is defined as a complete replacement of the current OS system. Systems with middleware that did not support 64-bit would be “upgraded” to the 2.6 kernel 31-bit. Upgraded is defined as taking the current OS system and executing a set of procedures to bring it to the new level. Upgrading a 31-bit image directly to a 64-bit image is not a valid option.

One of our goals for advancing our current environment to the 2.6 kernel was to keep the outages to a minimum. For migrations, we created a fresh 2.6 kernel system and cloned the new ones from it. Generally, for migrating to 64-bit 2.6 kernel, we followed the Transition Guide’s recommendation on migrating middleware:

1. Check that the release and fix pack level of the middleware product supports both the 31-bit version of the older Linux distribution and the 64-bit version of the newer Linux distribution.
2. If the release and fix pack do support both, move on to step 3. If not, upgrade the middleware to the minimum level that does support both distributions. At this point, you are running the upgraded middleware and its applications on the 31-bit version of the older Linux distribution. We then verified that our workloads still ran to see that the new version of the middleware operated as expected.
3. Perform a fresh install of the 64-bit version of the new Linux distribution. In our case, we cloned a 64-bit system.
4. Reinstall the middleware product on the 64-bit version of the new Linux distribution.
5. Move relevant applications which exploit the middleware product over to the new system. Now the upgraded middleware and the applications it supports are

running on the 64-bit version of the new Linux distribution. We retested our workloads, halted the production system and brought up the cloned 64-bit system in its place.

For upgrades, we used pretty much the same process except the OS was upgraded, not replaced:

1. Make a copy of the existing system.
2. Upgrade the middleware on the copy and verify workloads.
3. Upgrade the OS on the copy and verify workloads.
4. Replace the production system with the copy.

With each system migration, we made backup copies of files that contained information pertaining to the network configuration and file systems that we may need later as a reference. On VM, we kept a copy of the existing system directory.

SLES8 31-bit Migration to SLES9 64-bit

In this example, BUILDSU is the name of our 2.6 64-bit system that we cloned from. We made the following changes on BUILDSU each time we created a new system:

- Edited /etc/sysconfig/network/ifcfg-eth0 adding the new IP address.
- Edited /etc/hosts adding the new IP address and host name.
- Edited /etc/HOSTNAME adding the new host name.
- Ensured /etc/chandev.conf contained the proper network device.

On our VM admin account, we utilized the FLASHCOPY command to make the clone:

1. Linked the disk to clone:

```
==> link buildsu 201 500 rr
```

2. Attached the new disk:

```
==> attach 5200 to * 5200
```

3. Copied the disk:

```
==> flashcopy 500 0 end 5200 0 end
```

4. Detached the clone disk:

```
 ==> det 500
```

5. Labeled the new disk:

```
==> cpfmtxa, label, 5200, LX5200
```

6. Detached the new disk:

```
 ==> det 5200
```

We defined a new guest (in this case, LITWAS10) to RACF:

```
==> racf
==> adduser litwas10
==> altuser litwas10 password(xxxxxxxx)
==> altuser litwas10 name('litwas10') group(ourgrp)
```

We issued DIRMAINT command to get the existing z/VM system directory entry for the current production guest (in this case, LITWAS01).

```
==> dirm for litwas01 get
```

This file was stored on our “A” disk as ORIGWAS1 DIRECT. Then we created a new directory entry from it called LITWAS10 DIRECT. This contains the device we cloned above, 5200.

```
USER LITWAS10 XXXXXXXX 1024M 1536M GZ                                  0
   INCLUDE LINDFLT                                                     0
   CPU 0                                                               0
```

```
CPU 1                                                                  0
IPL CMS PARM AUTOCR                                                    0
MACHINE ESA 2                                                          0
DEDICATE A00B A00B                                                     0
DEDICATE A10B A10B                                                     0
DEDICATE A20B A20B                                                     0
DEDICATE A30B A30B                                                     0
DEDICATE E000 E214                                                     0
DEDICATE E001 E215                                                     0
DEDICATE E002 E216                                                     0
NICDEF 0700 TYPE QDIO LAN system PRVV71                                0
MDISK 0191 3390 31 2 VM3017 RR ALL SOME FEW                            0
MDISK 0200 FB-512 V-DISK 2048000 MR                                    0
MDISK 0201 3390 DEVNO 5200 MR ALL ALL AL                               0
```

We issued DIRMAINT command to add the directory entry:

```
==> dirm add  (enter)
==> litwas10  (submit)
```

We logged on LITWAS10 and changed the password.

Back on our VM admin account, we issued commands to grant the new system access to the VSWITCH:

```
==> set vswitch prvv71 grant litwas10 vlan 671
==> send cp litwas10 couple 0700 system prvv71
```

Back on LITWAS10's console, we brought up the image:

```
==> i 201 cl
```

We now had the current image still running in production and the new image up for the middleware to be installed and verified on. Once this task was complete, we took down both images, made the z/VM directory changes and brought the new image into production.

1. Remove directory entry:

   ```
   ==> dirm for litwas10 purge noclean
   ```
2. Rename litwas10 direct (on the A disk):

   ```
   ==> rename / litwas01 = =
   ```
3. Replace directory entry:

   ```
   ==> dirm for litwas01 rep
   ```

SLES8 31 bit Upgrade to SLES9 31 bit

We decided to minimize the potential for problems to impact production users by upgrading a copy of the server and testing the entire package on the copied image before promoting it to production. This way, in the event that things went poorly, the original system remained untouched and could be returned to production while the problems were analyzed. Even though we performed the upgrade on the copied image, the original production image was still down during the process. This was because the verification of this particular server, the WAS ND Edge Component Load Balancer, required usage of cluster addresses that would interfere with the original production server if it was running at the same time. In this example, we are using our production system with z/VM userid LITLB01, and our new image with userid LITLB10. Following are the steps we took to migrate this system, with the items we talk about in this section highlighted in bold:

1. Stopped running processes on production system LITLB01.
2. **Made a copy of the production system to our new image LITLB10.**
3. Upgraded the middleware on the new image LITLB10.
4. Verified that the upgraded middleware on new image LITLB10 works.

5. **Upgraded the OS on LITLB10.**
6. Verified functionality of middleware on the upgraded LITLB10.
7. Replace the production system LITLB01 with the new image LITLB10 now with upgraded middleware.

Upgrading the middleware is explained in “Migrating WebSphere Application Server Network Deployment Edge Component Load Balancer v5.1 on SLES 8 SP3 31-bit to v5.1.1 on SLES 9 31-bit base”. The production system was down during steps 2 - 6.

First, we verified that nothing was active on the production system before executing the FLASHCOPY command on VM. The FLASHCOPY command executed in seconds.

On our VM account, we utilized the FLASHCOPY command to make the copy:

1. Link the disk to clone:

```
==> link litlb01 201 500 rr
```

2. Attach the new disk:

```
 ==> attach 5300 to * 5300
```

3. Copy the disk:

```
==> flashcopy 500 0 end 5300 0 end
```

4. Detach the clone disk:

```
 ==> det 500
```

5. Label the new disk:

```
==> cpfmtxa, label, 5300, LX5300
```

6. Detach the new disk:

```
==> det 5300
```

We defined a new guest (in this case, LITLB10) to RACF:

```
==> racf
==> adduser litlb10
==> altuser litlb10 password(xxxxxxxx)
==> altuser litlb10 name('litlb10') group(ourgrp)
```

We issued the following DIRMAINT command to get the existing z/VM system directory entry for the current production guest (in this case, LITLB01):

```
==> dirm for litlb01 get
```

This file was stored on our “A” disk as ORIGLB01 DIRECT. Then we created a new directory entry from it called LITLB10 DIRECT. This contains the device we copied above, 5300. Here we also added a volume for /opt, 311B.

```
USER LITLB10 XXXXXXXX 256M 1024M GZ                                  0
   INCLUDE LINDFLT                                                   0
   CPU 0                                                             0
   CPU 1                                                             0
   IPL CMS PARM AUTOCR                                               0
   MACHINE ESA 1                                                     0
   NICDEF 0700 TYPE QDIO LAN system PRVV71                           0
   MDISK 0191 3390 31 2 VM3017 RR ALL SOME FEW                       0
   MDISK 1000 3390 DEVNO 5300 MR ALL ALL AL                          0
   MDISK 0202 3390 DEVNO 311B MR ALL ALL AL                          0
```

We issued DIRMAINT command to add directory entry:

```
==> dirm add  (enter)
==> litlb10  (submit)
```

We logged on LITLB10 and changed the password.

Back on our VM account, we issued commands to grant the new system access to the VSWITCH.

```
==> set vswitch prvv71 grant litlb10 vlan 671
==> send cp litlb10 couple 0700 system prvv71
```

We went back to LITLB10 and brought up the image.

```
==> I 1000 cl
```

We used the sed command to edit the following files:

- /etc/sysconfig/network/ifcfg-eth0 adding the new IP address.
- /etc/hosts adding the new IP address and host name.
- /etc/HOSTNAME adding the new host name.
- Ensured /etc/chandev.conf contains the proper network device.

From the new Linux, LITLB10, we formatted the new DASD we added, /dev/dasdb and moved the contents of /opt to it. Then we updated /etc/fstab with the new /opt and rebooted.

```
litlb10:~ # cat /etc/fstab
/dev/dasda1          /                reiserfs   defaults              1 1
devpts               /dev/pts         devpts     mode=0620,gid=5       0 0
proc                 /proc            proc       defaults              0 0
/dev/dasdb1          /opt             ext3       defaults              1 2
```

We now have the current image still running in production and the new image up for the middleware upgrade. Middleware upgrades are described in “Migrating WebSphere Network Deployment Edge Components” on page 359. When complete, we continued with the OS upgrade.

We brought down LITLB10. On LITLB10’s VM console, we FTPed the following SUSE LINUX Enterprise Linux 9 install files to the “A” disk from another server , and stored them as SLES_9 INITRD, SLES_9 IMG, SLES_9 PARM, respectively:

- INITRD
- VMRDR.IKR
- PARMFILE

We ran the following EXEC to start the upgrade:

```
/* REXX LOAD EXEC FOR SUSE LINUX S/390 VM GUESTS       */
/* LOADS SUSE LINUX S/390 FILES INTO READER            */
SAY ''
SAY 'LOADING FILES INTO READER...'
'CP CLOSE RDR'
'PURGE RDR ALL'
'SPOOL PUNCH * RDR'
'PUNCH SLES_9 IMG A (NOH'
'PUNCH SLES_9 PARM A (NOH'
'PUNCH SLES_9 INITRD A (NOH'
'CH RDR ALL KEEP NOHOLD'
'I 00C'
```

When prompted we entered in all the necessary system information on the console and then SSH’ed into the image. From the command prompt on the new SSH session, we performed the following steps:

1. Issued: yast
2. Selected: Upgrade an existing system
3. Selected: OK

Here we hit our first problem.

This was due to a change with SLES9. It reorders the /dev/dasdx based on the address. Because we had 1000 as root and 202 as /opt, it made the lower address, 202, /dev/dasda1.

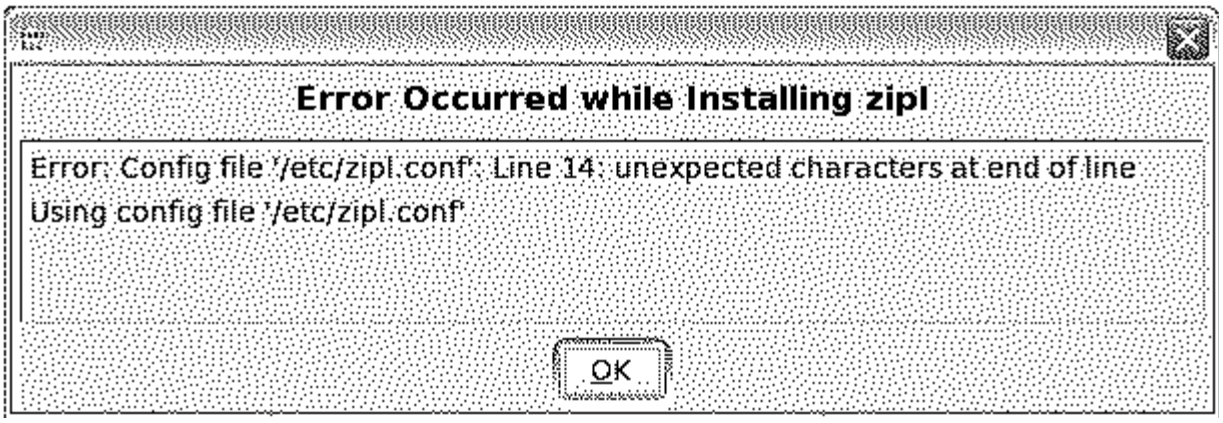
The solution for using a higher device number for root is to disable the reordering script. Before you hit the “Next” button in the Configure DASD Disks panel, open another SSH session to the system you’re upgrading and issue the following command:

```
# echo "exit 0" > /sbin/dasd_reload
```

Now it will allow you to have disk 1000 as /dev/dasda1 and disk 202 as /dev/dasdb1. On the Update Options panel we:

- Selected: Default system
- Selected: Delete Unmaintained Packages
- Selected: Accept

At this point, resolve any conflicts that you may have. We only had one because we had a newer level of Java installed. Select “Yes, Update” to begin the upgrade. When the upgrade was almost complete, we received the following error:



This is the line it was complaining about:

```
parameters="'dasd=1000,202 root=/dev/dasda1 vmpoff=\"LOGOFF\"' TERM=dumb"
```

So we cancelled the retry and paused the bootup, then we opened a new SSH session and updated /etc/zipl.conf with the following:

```
parameters='dasd=1000,202 root=/dev/dasda1 vmpoff="LOGOFF" TERM=dumb'
```

Then we issued the following commands:

```
# chown /mnt
# zipl
```

Then we rebooted the system and everything came up fine.

Go back to YaST and hit OK to allow it to shutdown. Then on the VM console, IPL the upgraded system:

```
==> I 1000 cl
```

Once everything was verified, we took down both images, made the z/VM directory changes and brought the new image into production.

1. Remove directory entry:

   ```
   ==> dirm for litlb10 purge noclean
   ```

2. Rename litlb10 direct:

   ```
   ==> rename / litlb01 = = (on the "A" disk)
   ```

3. Replace directory entry:

   ```
   ==> dirm for litlb01 rep
   ```

RHEL3 31 bit Migration to RHEL4 64 bit

In this example, BUILDRH is the name of our Red Hat 2.6 64-bit system that we cloned from. We made the following changes on BUILDRH each time we created a new system.

- Edited /etc/sysconfig/network-scripts/ifcfg-eth0 adding the new IP address.
- Edited /etc/hosts adding the new IP address and host name.
- Edited /etc/sysconfig/network adding the new host name.
- Ensured /etc/chandev.conf contains the proper network device.

On our VM admin account, we utilized the FLASHCOPY command to make the clone:

1. Link the disk to clone:

   ```
   ==> link buildrh 201 500 rr
   ```

2. Attach the new disk:

   ```
   ==> attach 5400 to * 5400
   ```

3. Copy the disk:

   ```
   ==> flashcopy 500 0 end 5400 0 end
   ```

4. Detach the clone disk:

   ```
   ==> det 500
   ```

5. Label the new disk:

   ```
   ==> cpfmtxa, label, 5400, LX5400
   ```

6. Detach the new disk:

   ```
   ==> det 5400
   ```

We issued the DIRMAINT command to get the existing system directory entry for the current production guest (in this case, LITNTP01).

```
==> dirm for litntp01 get
```

This file was stored on our “A” disk as ORIGNTP1 DIRECT. Then we copied ORIGNTP1 to LITNTP01, and added the device we cloned above, 5400. We also added a volume for /opt, 3112.

```
USER LITNTP01 XXXXXXXX 1024M 1536M GZ                                  0
   INCLUDE LINDFLT                                                     0
   CPU 0                                                               0
   CPU 1                                                               0
```

```
   IPL CMS PARM AUTOCR                                                  0
   MACHINE ESA 2                                                        0
   NICDEF 0700 TYPE QDIO LAN system PRVV71                              0
   MDISK 0191 3390 31 2 VM3017 RR ALL SOME FEW                          0
   MDISK 0200 FB-512 V-DISK 2048000 MR                                  0
   MDISK 0201 3390 DEVNO 5400 MR ALL ALL AL                             0
   MDISK 0202 3390 DEVNO 3112 MR ALL ALL AL                             0
```

We issued the following DIRMAINT command to add the directory entry.

```
==> dirm for litntp01 rep
```

Back on LITNTP01's console, we shutdown the production image and logged off. Logged back on to pick up the directory changes and ipl.

```
  ==> i 201 cl
```

From the new Linux system, we formatted the new DASD we added, /dev/dasdc, and moved the contents of /opt to it. Then we updated /etc/fstab with the new /opt and rebooted.

```
[root@litntp01 ~]# cat /etc/fstab
# This file is edited by fstab-sync - see 'man fstab-sync' for details
LABEL=/                 /                       ext3    defaults        1 1
none                    /dev/pts                devpts  gid=5,mode=620  0 0
none                    /dev/shm                tmpfs   defaults        0 0
none                    /proc                   proc    defaults        0 0
none                    /sys                    sysfs   defaults        0 0
/dev/dasdc1             /opt                    ext3    defaults        1 2
```

We now have the new image up for the original data to be restored on and verified.

RHEL3 31 bit Upgrade to RHEL4 31 bit

RHEL3 to RHEL4 Pre-Upgrade Tasks

Prepare the network init-scripts: We discovered a few problems with the upgrade process. The /etc/chandev.conf file is no longer used in RHEL4. RedHat has added several new parameters to the network init-script files to provide the information that had been contained in /etc/chandev.conf on RHEL3. The new parameters can be added to the RHEL3 init-scripts prior to upgrading to RHEL4 and will have no effect on their behavior while RHEL3 is still in use. The additional parameters are:

- SUBCHANNELS
- NETTYPE
- PORTNAME (eth and lcs only)
- CTCPROT (ctc only)

Note: There are other new parameters available for the RHEL4 init-scripts. This document only addresses those that supply information formerly contained in /etc/chandev/conf.

Extracting information from /etc/chandev.conf

Analyze the RHEL3 /etc/chandev.conf file to determine what information it contains and where it needs to be placed in order for RHEL4 to be able to support your configuration. Here is an example of the /etc/chandev.conf file:

```
[root@rhel3 root]# cat /etc/chandev.conf
noauto
ctc0,0x1b04,0x1b05,0
qeth0,0x09a0,0x09a1,0x09a2
```

The ctc0 parameter shows the read and write addresses of the CTC device and the protocol in effect for this connection.

```
ctcn, read_address, write_address, protocol
```

The qeth0 parameter shows the read, write, and control addresses of the QETH device.

```
qethn, read_address, write_address, control_address
```

Migrating a QETH init-script

Based on the sample /etc/chandev.conf file, in order to migrate a RHEL3 ifcfg-eth0 init-script for use on RHEL4, the following parameters need to be added to the RHEL3 ifcfg-eth0 file:

- SUBCHANNELS=0.0.09a0,0.0.09a1,0.0.09a2
- NETTYPE=qeth

Here are examples of the RHEL3 and RHEL4 init-scripts for a QETH device:

Table 16. RHEL3 and RHEL4 init-scripts for a QETH device

RHEL3	RHEL4
ifcfg-eth0:	ifcfg-eth0:
DEVICE=eth0	DEVICE=eth0
BOOTPROTO=static	BOOTPROTO=static
IPADDR=10.20.30.136	IPADDR=10.20.30.136
MTU=1492	MTU=1492
NETMASK=255.255.255.0	NETMASK=255.255.255.0
ONBOOT=yes	NETTYPE=qeth
	SUBCHANNELS=0.0.09a0,0.0.09a1,0.0.09a2
	TYPE=ethernet

Note: If you need to supply a port name for your QETH device you will need to add the PORTNAME parameter to your init-script file, with the NETTYPE set to qeth. If you have an LCS device you will need to use the PORTNAME parameter to pass the OSA port number, with the NETTYPE set to lcs.

Migrating a ctc init-script

Based on the sample /etc/chandev.conf file, in order migrate a RHEL3 ifcfg-ctc0 init-script for use on RHEL4 the following parameters need to be added to the RHEL3 ifcfg-ctc0 file:

- SUBCHANNELS=0.0.1b04,0.0.1b05
- NETTYPE=ctc
- CTCPROT=0 (optional parameter, default is 0)

Here are examples of the RHEL3 and RHEL4 init-scripts for a CTC device.

Table 17. RHEL3 and RHEL4 init-scripts for a CTC device

RHEL3	RHEL4
ifcfg-ctc0:	ifcfg-ctc0:
DEVICE=ctc0	DEVICE=ctc0
BOOTPROTO=static	BOOTPROTO=static
IPADDR=190.180.170.87	CTCPROT=0

Table 17. RHEL3 and RHEL4 init-scripts for a CTC device (continued)

MTU=1492	IPADDR=190.180.170.87
NETMASK=255.255.255.0	MTU=1492
ONBOOT=yes	NETMASK=255.255.255.0
REMIP=170.180.170.87	NETTYPE=ctc
TYPE=ctc	ONBOOT=yes
	SUBCHANNELS=0.0.1b04,0.0.1b05
	TYPE=ctc

Migrating init-scripts for other devices

Other interfaces would require similar modifications.

```
NETTYPE=(lcs / iucv)
```

See the RHEL4 Installation Guide for more information on the init-script files used for the various network interfaces.

```
http://www.redhat.com/docs/manuals/enterprise/RHEL-4-Manual/s390-multi-install-guide/
```

Appendix F Section 6 has information specific to each of the IBM Network Interfaces.

Migrating the contents of /etc/modules.conf (Bugzilla RHIT 68004)

RHEL4 does not use /etc/modules.conf. The upgrade process copies the entire contents of /etc/modules.conf to /etc/modprobe.conf. Most of the information contained in /etc/modules.conf can be used as copied. The exception is any zFCP (SCSI) related information.

All network related alias parameters along with any options parameters can be used as copied.

If you have zFCP connected devices in your configuration, you will need to migrate the zFCP related parameters to /etc/zfcp.conf. (Bugzilla RHIT 68153) Once again this was done on the copy of the RHEL3 system prior to the upgrade.

Unfortunately, this will not get recognized on the first boot. This is a post installation activity, see section Post Upgrade Tasks below.

RHEL3 /etc/modules.conf:

```
alias eth1 qeth
alias ctc0 ctc
options dasd_mod dasd=201,4b19,4b1a,4b1b
options scsi_mod max_scsi luns=50
options zfcp 'map="0x0100 0x1:0x5005076300ceafc4 0x0:0x572c000000000000;
0x0100 0x1:0x5005076300c2afc4 0x1:0x572d000000000000"'
```

RHEL4 /etc/modprobe.conf:

```
alias eth0 qeth
alias ctc0 ctc
alias scsi_hostadapter zfcp
options dasd_mod dasd=0.0.0201,0.0.4b19,0.0.4b1a,0.0.4b1b

/etc/zfcp.conf
0.0.0100 0x01 0x5005076300ceafc4 0x00 0x572c000000000000
0.0.0100 0x01 0x5005076300ceafc4 0x01 0x572d000000000000
```

Post Upgrade Tasks (Bugzilla RHIT 68154)

Adding support for zFCP (scsi) to initrd: You will need to add support for any zFCP devices to the initrd file after the upgrade. Here is an example of using the mkinitrd command to add the support.

```
mkinitrd -v --with=scsi_mod --with=zfcp --with=sd_mod initrd-2.6.9-5.EL.img 2.6.9-5.EL
```

Then run zipl and reboot your system.

RHEL3 31 bit Upgrade to RHEL4 31 bit Tasks: In this example, we made a copy of the production logger systems' (LITLOG02) boot volume and executed our OS upgrade on the copy under the same z/VM ID, so that during the upgrade, only the copy was active – the original LITLOG02 was shutdown. The reason we decided to take this approach was because we had another central log server that did the same thing, and while LITLOG02 was being updated LITLOG01 handled the logging.

On our VM account, we utilized the FLASHCOPY command to make the copy. First, we verified that nothing was active on the production system before executing the FLASHCOPY command on VM. The FLASHCOPY command executed in seconds.

1. Link the disk to clone:

   ```
   ==> link litlog02 201 500 rr
   ```

2. Attach the new disk:

   ```
   ==> attach 5500 to * 5500
   ```

3. Copy the disk:

   ```
   ==> flashcopy 500 0 end 5500 0 end
   ```

4. Detach the clone disk:

   ```
   ==> det 500
   ```

5. Label the new disk:

   ```
   ==> cpfmtxa, label, 5500, LX5500
   ```

6. Detach the new disk:

   ```
   ==> det 5500
   ```

We issued the DIRMAINT command to get the current system directory:

```
==> dirm for litlog02 get
```

This file was stored on our "A" disk as ORIGLOG2 DIRECT. Then we copied ORGILOG2 DIRECT to LITLOG02 DIRECT. This contains the device we copied above, 5500. Here we also added a SCSI volume, A209, so we could move our large log pool off of the 3390 devices

```
USER LITLOG02 XXXXXXXX 512M 1536M GZ                                0
   INCLUDE LINDFLT                                                  0
   CPU 0                                                            0
   CPU 1                                                            0
   IPL CMS PARM AUTOCR                                              0
   MACHINE ESA 2                                                    0
   NICDEF 0700 TYPE QDIO LAN system PRVV71                          0
   DEDICATE A209 A209                                               0
   MDISK 0191 3390 35 30 VM3017 MR ALL SOME FEW                     0
   MDISK 0200 FB-512 V-DISK 2048000 MR                              0
   MDISK 0201 3390 DEVNO 5500 MR ALL ALL AL                         0
   MDISK 0202 3390 DEVNO 532D MR ALL ALL AL                         0
   MDISK 0203 3390 DEVNO 532E MR ALL ALL AL                         0
   MDISK 0204 3390 DEVNO 532F MR ALL ALL AL                         0
   MDISK 0205 3390 DEVNO 5330 MR ALL ALL AL                         0
   MDISK 0206 3390 DEVNO 5331 MR ALL ALL AL                         0
   MDISK 0207 3390 DEVNO 5332 MR ALL ALL AL                         0
```

```
   MDISK 0208 3390 DEVNO 5333 MR ALL ALL AL                              0
   MDISK 0209 3390 DEVNO 5334 MR ALL ALL AL                              0
   MDISK 020A 3390 DEVNO 5335 MR ALL ALL AL                              0
   MDISK 020B 3390 DEVNO 5336 MR ALL ALL AL                              0
   MDISK 020C 3390 DEVNO 5337 MR ALL ALL AL                              0
   MDISK 020D 3390 DEVNO 5338 MR ALL ALL AL                              0
```

Then we issued the DIRMAINT command to add directory entry:

```
==> dirm for litlog02 rep
```

We logged onto LITLOG02 and brought up the image:

```
==> i 201 cl
```

We edited /etc/sysconfig/network-scripts adding RHEL4 info:

```
# IBM QETH
DEVICE=eth0
BOOTPROTO=static
IPADDR=192.168.71.110
MTU=1492
NETMASK=255.255.255.0
NETTYPE=qeth
ONBOOT=yes
SUBCHANNELS=0.0.0700,0.0.0701,0.0.0702
TYPE=Ethernet
```

Added /etc/modprobe.conf:

```
alias eth0 qeth
options dasd_mod dasd=0.0.0201,0.0.0200,0.0.0202-0.0.020d
```

Added SCSI statements to /etc/modules.conf (scsi device to move our large pool to):

```
alias eth0 qeth options dasd_mod dasd=201,200,202-20d
options scsi_mod max_scsi luns=50
options zfcp 'map="0xa209 0x1:0x5005076300c7afc4
0x0:0x5518000000000000"'
```

Added /etc/zfcp.conf (file that will be used after the RHEL4 upgrade):

```
0.0.a209 0x01 0x5005076300c7afc4 0x00 0x5518000000000000
```

Issued the following commands to add the scsi device:

```
# cd /boot
# mv initrd-2.4.21-27.EL.img orig.initrd-2.4.21-27.EL.img
# mkinitrd –v –with=scsi_mod –with=zfcp –with=sd_mod initrd-2.4.21-27.EL.img 2.4.21-27.EL
# zipl
```

Then we rebooted the system LITLOG02 and verified the files we edited and added did not affect the current system.

Now onto the OS upgrade.

We brought down the copied system. On LITLOG02's VM console, we FTPed the following RHEL4 files to the "A" disk and stored them as RHEL4 INITRD, RHEL4 IMG, and RHEL4 PARM, respectively.

- INITRD.IMG
- KERNEL.IMG
- GENERIC.PRM

We ran the following exec to start the upgrade:

```
/* REXX LOAD EXEC FOR RHEL LINUX S/390 VM GUESTS       */
/* LOADS RHEL LINUX S/390 FILES INTO READER            */
SAY ''
SAY 'LOADING FILES INTO READER...'
'CP CLOSE RDR'
'PURGE RDR ALL'
'SPOOL PUNCH * RDR'
'PUNCH RHEL4 IMG A (NOH'
'PUNCH RHEL4 PARM A (NOH'
'PUNCH RHEL4 INITRD A (NOH'
'CH RDR ALL KEEP NOHOLD'
'I 00C'
```

We entered in all the necessary system information on the console and then SSH'ed into the image.

On the System to Upgrade panel, we selected an existing Linux installation to upgrade. When the upgrade was complete, we rebooted the image and the upgrade to RHEL4 was successful.

As described in the Migration Summary above, due to limitations with the upgrade process, the scsi devices are not handled properly during the upgrade. Issued the following commands to add the device:

```
modprobe scsi_mod
modprobe zfcp
modprobe sd_mod
cd /boot
mv initrd-2.6.9-5.EL.img orig.initrd-2.6.9-5.EL.img
mkinitrd -v --with=scsi_mod --with=zfcp --with=sd_mod initrd-2.6.9-5.EL.img 2.6.9-5.EL
zipl
reboot
```

Migrating Linux Virtual Servers

Open Source Products

For the most part, migrating open source products involved backing up their configuration files on the 31bit system, upgrading/migrating the system according to procedures documented in the "Upgrade the OS" section above, verifying their functionality, and then finally restoring their configuration files after the upgrade/migration to 64 bit systems and verifying their functionality again. Depending on the server's functionality and impact to our workloads, we either created another Linux guest to perform the migration or performed backup of the current system followed by migration of the production system. In the former method, the production system is still running during the migration window, and after migration is done on the new system we took a short outage to bring the new system into production. In the latter method, we took a planned outage while migration was performed on the production system.

Firewalls and routers

For our firewalls, we saved our rules in /etc/fw.rules and our cleanup in /etc/fw.clear. We saved those files and used the 31-bit to 64-bit migration procedures documented in "Upgrade the OS" above to migrate the firewalls, then we restored the scripts and verified that it worked. Because our firewalls and routers were crucial to our workloads running successfully, we created separate Linux guests to perform the migration while our production firewalls and routers were running, and after the migration is done on the new systems we took a short outage to bring the new systems into production.

NTP server

We have a Network Time Protocol server in our environment for time synchronization. All of our servers sync their times with our NTP server. We chose not to sync our NTP server to an external NTP server. We are on a private LAN and we are trying to contain our traffic. However, if you want to sync your NTP server to an external NTP server and you are on a private LAN, you can use a proxy server for external NTP communication.

Migrating our NTP server was relatively painless. We first backed up /etc/ntp.conf and did the migration from 2.4 31-bit kernel to 2.6 64-bit kernel. Then on the upgraded system we restored the configuration file, restarted NTP, and verified with a NTP client that it worked. During the migration of our NTP server, we took a temporary outage of time syncing because it did not affect our workloads, and performed migration on top of our existing production NTP server.

Central log servers

We backed up /etc/syslogd.conf on the log servers. Then we used the 31-bit to 64-bit migration procedures documented in “Upgrade the OS” above to migrate the central log servers. Finally, we restored the configuration file on the upgraded systems and verified that they worked. Because we had two central log servers that did the same thing, we didn’t need to create separate Linux guests and migrated directly on one server while the other one was accepting incoming logs.

Nessus security scanner

The Nessus security scanner that came with SUSE LINUX Enterprise Server 9 is version 2.0.10a-17.a. The version we had on our SUSE LINUX Enterprise Server 8 SP3 was 1.2.3-54. Nessus doesn’t have migration procedures. Since Nessus isn’t running all the time like our application servers, we simply upgraded the Nessus system from 31-bit to 64-bit, and reinstalled Nessus from yast. Then we regenerated our certificates and re-configured Nessus for scanning. You can refer to our open source security white paper at

`ftp://ftp.software.ibm.com/eserver/zseries/misc/literature/pdf/whitepapers/gm130636.pdf`

and Nessus documentation at

`www.nessus.org.`

Samba server

The Samba server was installed as a basic part of the Red Hat Enterprise Server for Linux package. The Samba control files needed for migration were kept in the directory /etc/samba which we backed up to another system. The file system we used for Samba, /pub, resided on its own DASD volume and so we simply ported the volume to the new system and updated /etc/fstab with the appropriate information. We restored the /etc/samba directory to the new system and started the Samba server. We verified everything was working by logging onto the Samba server as a client, traversed many of the directories, and read and wrote to the file system with sample files. During the migration of our Samba server, we took a temporary outage because it did not affect our workloads, and performed migration on top of our existing production Samba server.

IBM Products

Our key goal was to run our WebSphere Trade3 benchmark application on the latest supported middleware for the 2.6 kernel in a 64-bit Linux distribution. Planning was very important in helping us decide on what releases of middleware we were capable of migrating to. We used the following product matrix as a guide:

`http://www.ibm.com/linux/matrix/linuxmatrixhwz.html`

The main objective was to migrate to the latest middleware without severely impacting our production workload environment. Once again, this is what the 2.4 to 2.6 Transition Guide recommended and we attempted to follow these guidelines where possible:

1. Check that the release and fix pack level of the middleware product supports both the 31-bit version of the older Linux distribution and the 64-bit version of the newer Linux distribution.
2. If the release and fix pack do support both, move on to step 3. If not, upgrade the middleware to the minimum level that does support both distributions. At this point, you are running the upgraded middleware and its applications on the 31-bit version of the older Linux distribution (at this point, we verified that our workloads still ran to see that the new version of the middleware did not break anything).
3. Perform a fresh install of the 64-bit version of the new Linux distribution (in our case, we cloned a 64-bit system).
4. Reinstall the middleware product on the 64-bit version of the new Linux distribution.
5. Move relevant applications which exploit the middleware product over to the new system. Now the upgraded middleware and the applications it supports are running on the 64-bit version of the new Linux distribution (at this point, we retested our workloads and halted the production system and brought up the cloned 64 bit system in its place).

Our existing middleware environment consists of the following versions:

Product Version	Distribution	Platform
WebSphere Application Server v5.1.0	SLES 8 SP3 31bit	zSeries
WebSphere Application Server Network Deployment v5.1.0	SLES 8 SP3 31bit	zSeries
DB2 Runtime Client v8.1.0.60 (FP6)	SLES 8 SP3 31bit	zSeries
DB2 Connect v8.1.0.60 (FP6)	SLES 8 SP3 31bit	zSeries
DB2 UDB v8.1.0.16 (FP2)	SLES 8 SP3 31bit	zSeries
WebSphere Application Server Network Deployment Edge Component Caching Proxy 5.1.0	SLES 8 SP2 31bit	zSeries
WebSphere Application Server Network Deployment Edge Component Load Balancer 5.1.0	SLES 8 SP2 31bit	zSeries
Apache 2.0.49	SLES 8 SP3 31bit	zSeries
Tivoli Storage Manager v5.2	SLES 8 SP3 31bit	zSeries
Tivoli Access Manager for e-business v5.1	SLES 8 SP3 31bit	zSeries

Ultimately, based on the matrix, we decided to migrate to the following middleware environment:

Product Version	Distribution	Platform
WebSphere Application Server v5.1.1	SLES 9 64bit	zSeries
WebSphere Application Server Network Deployment v5.1.1	SLES 9 64bit	zSeries
DB2 Runtime Client v8.1.0.89 (FP9)	SLES 9 64bit	zSeries
DB2 Connect v8.1.0.89 (FP9)	SLES 9 64bit	zSeries
WebSphere Application Server Network Deployment Edge Component Caching Proxy 5.1.1	SLES 9 31bit	zSeries
WebSphere Application Server Network Deployment Edge Component Load Balancer 5.1.1	SLES 9 31bit	zSeries
Apache 2.0.49	SLES 9 64bit	zSeries
Tivoli Storage Manager v5.3	SLES 9 SP1 64bit	zSeries
Tivoli Access Manager v5.1.13	SLES 9 64bit	zSeries

Since it is not possible to upgrade the Linux OS directly from 31-bit to 64-bit, we staged our migration in steps so that it would be at minimum impact to our running environment. This was described in the chapter earlier 'Upgrading the OS'. Below we will discuss in greater detail about what needs to be done in each stage for every product we migrated or transitioned.

The order of middleware products we chose to migrate so that it would have a minimum impact to our running Trade3 workload:
1. WebSphere Network Deployment Edge Components
2. DB2
3. WebSphere Network Deployment
4. WebSphere Application Server
5. IBM HTTP Server

Migrating WebSphere Network Deployment Edge Components

Migrating WebSphere Application Server Network Deployment Edge Component Caching Proxy v5.1 on SLES 8 SP3 31bit to v5.1.1 on SLES 9 31bit base: It was determined from the product matrix that the Caching Proxy (CP) can only run in a 31-bit distribution. CP cannot run in 31-bit compatibility mode on a 64-bit distribution.

Therefore, this was a less complicated migration since all we needed to do is upgrade the middleware version, and then upgrade the OS. Here are the steps that we took:
1. Performed backup.

   It is always good practice to perform backups of key files prior to any update.
   a. Backed up the Caching Proxy configuration file to our backup server (copied the file to another system).

      ```
      /opt/ibm/edge/cp/etc/en_US/ibmproxy.conf
      ```

b. Backed up the GSKit key database used for authentication to our backup server.

```
/opt/ibm/edge/cp/key/key.kdb
/opt/ibm/edge/cp/key/key.sth
/opt/ibm/edge/cp/key/key.crl
/opt/ibm/edge/cp/key/key.rdb
```

2. We made an exact copy of image LITCP01 to LITCP02 using the FLASHCOPY procedure as described in Upgrade the OS. Then we upgraded CP on the copied system to v5.1.1 using the upgrade procedure provided by the product. We downloaded the CP fixpack and upgrade documentation from the following website:

   ```
   http://www-1.ibm.com/support/docview.wss?rs=250&context=SSBQMN&dc=
   D400&uid=swg24007420&loc=en_US&cs=UTF-8&lang=en
   ```

   Here's what we did:
   a. Logged in as root
   b. Stopped the caching proxy: /etc/init.d/ibmproxy stop
   c. Changed to the installation source directory
   d. On Linux, installed the packages in the following format:

      ```
      rpm -iv --replacefiles package_name
       (where package_name is the name of the package)
      ```

      For example,

      ```
      rpm -iv --replacefiles WSES_Admin_Runtime-5.1.1-0.686.rpm
      ```

      The installation order of the packages for the fix pack:
      1) gskit (Global security kit)
      2) icu (ICU Runtime)
      3) admin (Administrative Runtime)
      4) cp messages (Caching Proxy messages)
      5) cp (Caching Proxy) f. documentation (optional)
      6) Web Server Plugins (optional)

      Note: Do not use the -U option. Note that the --replacefiles option is required for most packages. Using the option with packages that do not require it does not affect their installation. After installation, the previously installed versions of the new packages are still on the machine. Do not uninstall them.

      The CP RPMs on the system now consisted of the following:

      ```
      litcp02:/opt/ibm/edge/cp/etc/en_US # rpm -qa |grep WSES
      WSES_ICU_Runtime-5.1.0-0
      WSES_ICU_Runtime-5.1.1-0
      WSES_Admin_Runtime-5.1.0-0
      WSES_Admin_Runtime-5.1.1-0
      WSES_CachingProxy-5.1.0-0
      WSES_CachingProxy-5.1.1-0
      WSES_CachingProxy_msg_en_US-5.1.0-0
      WSES_CachingProxy_msg_en_US-5.1.1-0
      ```

      We hit a problem when verifying if the newly installed CP v5.1.1 worked with our existing environment. Our test was to try and create an SSL proxy type junction to our load balancer cluster backend on our WebSEAL system. Here's the command we ran on WebSEAL and the error we encountered:

      ```
      pdadmin sec_master> s t WebSeal1-webseald-littam02 create -t
      sslproxy -B -U wasadmin -W lnx4ltic -c iv-user -H
      litcp02.ltic.pok.ibm.com -P 80 -h litwasclx.ltic.pok.ibm.com -p
      443 -j /test
      DPWWA1222E   A third-party server is not responding.  Possible
      causes: the server is down, there is a hung application on the
      server, or network problems.  This is not a problem with the
      WebSEAL server.
      ```

```
DPWIV1216E   The junctioned server presented an invalid
certificate.

DPWWM1432W
NOTE: Ensure the CA root certificate used to sign the junctioned
server certificate is installed in the WebSEAL certificate key
database.
Created junction at /test
```

We found that there was a security enhancement added to CP v5.1.1 that would affect creating our SSL proxy junction. We had to make the following changes to the CP configuration file - /etc/ibmproxy.conf like so. Change:

```
Enable    CONNECT
```

to

```
Enable    CONNECT OutgoingPorts all
```

Note: This statement in the CP configuration file was needed for CP to act as a SSL proxy that tunneled SSL web traffic between our WebSEAL server and our backend WAS cluster – please see the zSeries Platform Test Report June 2005 edition Part 3 for details on our CP configuration

Then we recycled CP and succeeded in creating the SSL proxy junction on WebSEAL.

3. Now that we knew CP v5.1.1 worked on SLES 8 SP3 31-bit, we upgraded to SLES 9 31-bit on LITCP02 following procedures in “Upgrade the OS –> SLES8 31-bit upgrade to SLES9 31-bit".

   ```
   litcp02:~ # uname -a
   Linux litcp02 2.6.5-7.97-s390 #1 SMP Fri Jul 2 14:21:59 UTC 2004
   s390 s390 s390 GNU/Linux
   ```

   We verified that CP still works.

   Now that we had a working CP v5.1.1 on SLES 9 31-bit. We took a small outage to change LITCP02 to LITCP01 as the new production image/guest under z/VM.

   We did this so that we wouldn’t have to make changes on other systems that referenced the original CP system.

Migrating WebSphere Application Server Network Deployment Edge Component Load Balancer v5.1 on SLES 8 SP3 31-bit to v5.1.1 on SLES 9 31-bit base: Like Caching Proxy, Load Balancer (LB) is only supported on a 31-bit distribution. We used the same procedure as Caching Proxy; upgrade the middleware version, and then upgrade the Linux OS.

1. We backed up our LB configuration file to our backup server by copying it to the backup server. Our LB configuration file is nothing other than a script file we wrote with LB commands to setup our LB. A sample of this script can be found in the June zSeries Platform Evaluation Test Report.
2. We made an exact copy of image LITLB01 to LITLB02 using the FLASHCOPY procedure as described in Upgrade the OS. We took down the production server and we upgraded LB on the copied system to v5.1.1 using the upgrade procedure provided by the product. The reason we took an outage on our production server was because during the upgrade process we needed to perform verification of the load balancer which would interfere with the production server if it was running as well. We downloaded the LB fixpack and upgrade documentation from the following website:

   ```
   http://www.ibm.com/support/docview.wss?rs=250&context=SSBQMN&dc=
   D400&uid=swg24007420&loc=en_US&cs=UTF-8&lang=en
   ```

Note: If you do not already have a v5.1 Load Balancer component installed on your system, you are only required to install the Load Balancer v5.1 license file (nd51Full.LIC) prior to installing the fix pack. The license can be obtained by installing just the Load Balancer license package of the v5.1 GA.

We used the following steps to install the fix pack:

a. Logged on a command prompt with root authority.
b. Obtained the Load Balancer Fix Pack and placed it in a temporary directory.
c. Uncompressed and untarred the build package. This resulted in a number of separate filesets.
d. Installed the software:

```
rpm -iv --nodeps --replacefiles ibmlb-base-5.1.1-0.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-admin-5.1.1-0.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-lic-5.1.1-0.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-disp-5.1.1-0.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-ms-5.1.1-0.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-ss-5.1.1-0.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-cbr-5.1.1-0.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-cco-5.1.1-0.s390.rpm
```

When we installed on top of an existing LB, it continued to use the original configuration.

e. Starting LB succeeded and verified it was balancing web traffic between our two backend web servers using the LB report command

```
litlb01:~ # dscontrol server report 192.168.71.98::
Cluster: 192.168.71.98 Port: 80
--------------------------------------------------------------------------------
| Server         | CPS |    KBPS   |    Total   | Active | FINed | Comp   |
--------------------------------------------------------------------------------
| 192.168.71.119 |   0 |         0 |          5 |      0 |      0 |      1 |
| 192.168.71.32  |   0 |         0 |          4 |      0 |      0 |      2 |
--------------------------------------------------------------------------------
```

3. Now that we knew LB v5.1.1 worked on SLES 8 SP3 31-bit. We upgraded to SLES 9 31-bit on LITLB02 following procedures in Upgrade the OS – SLES8 31-bit upgrade to SLES9 31-bit.

   We hit a problem after we migrated to SLES 9 31-bit. The load balancer server failed to start.

   We found that this copy of LB v5.1.1 did not provide ibmnd modules for the 2.6 kernel. Specifically it did not have a module for kernel 2.6.5-7.97 as you can see from the listing:

```
litlb02:/opt/ibm/edge/lb/servers/bin # ll
ibmnd-2.4.19-3suse-SMP
ibmnd-2.4.19-3suse-SMP-70
ibmnd-2.4.19-4suse-SMP
ibmnd-2.4.21-15.EL-s390
ibmnd-2.4.21-216-default
ibmnd-2.4.21-4.EL-s390
ibmnd-2.4.21-83-default
ibmnd-2.4.21-9.0.3.EL-s390
ibmnd-2.4.21-9.EL-s390
lbpd
loadoutput
lxexecutor
```

   We investigated and learned that the initial version 5.1.1 of Load Balancer did not provide support on 2.6. We had to obtain the latest copy of LB. We installed LB v5.1.1.41:

```
rpm -ivh --nodeps --replacefiles ibmlb-base-5.1.1-41.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-admin-5.1.1-41.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-lic-5.1.1-41.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-disp-5.1.1-41.s390.rpm
```

```
rpm -ivh --nodeps --replacefiles ibmlb-ms-5.1.1-41.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-ss-5.1.1-41.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-cbr-5.1.1-41.s390.rpm
rpm -ivh --nodeps --replacefiles ibmlb-cco-5.1.1-41.s390.rpm
```

After the installation we discovered that it installed the following modules, the number between ibmnd and s390 in each module represents the kernel level it supports:

```
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.111-s390.ko
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.135-s390.ko
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.139-s390.ko
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.145-s390.ko
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.151-s390.ko
```

We investigated and learned that the initial version 5.1.1 of Load Balancer did not provide support on 2.6. We had to obtain the latest copy of LB. We installed LB v5.1.1.41:

```
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.111-s390.ko
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.135-s390.ko
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.139-s390.ko
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.145-s390.ko
/opt/ibm/edge/lb/servers/bin/ibmnd-2.6.5-7.151-s390.ko
```

However, this build did not provide a module for the base SLES 9 kernel that we were on - 2.6.5-7.97. We determined what kernel releases these modules belonged to:

```
ibmnd-2.6.5-7.111-s390.ko - Some intermediate security update after SLES 9 GA
ibmnd-2.6.5-7.135-s390.ko - Some intermediate security update after SLES 9 GA
ibmnd-2.6.5-7.139-s390.ko - SLES 9 SP1
ibmnd-2.6.5-7.145-s390.ko - SP1 Security Update
ibmnd-2.6.5-7.151-s390.ko - SP1 Security Update
```

Since the SLES 9 base was not supported, we had to upgrade to one of the supported levels. We chose to upgrade to the latest kernel - 2.6.5-7.151.

After the upgrade, we verified that the ibmnd module was loaded when starting load balancer, and verified web traffic was evenly distributed between our web servers using load balancer's status report.

4. Now that we had a working LB v5.1.1 on SLES 9 31-bit. We took a small outage to change LITLB02 to LITLB01 as the new production image/guest under z/VM. We did this so that we wouldn't have to make changes on other systems that referenced the original LB system.

Migrating and Transitioning DB2 Runtime Client, DB2 Connect EE, and DB2 UDB to FP9a

Our new DB2 configuration: Before we discuss the details about our migration of DB2, we will talk about some changes we made to our environment. Our original DB2 environment consisted of DB2 Connect on every Linux application server going to DB2 UDB on z/OS. At the time, we did not have the DB2 Runtime client installed on our WebSphere Application Servers. We wanted to create a single DB2 Connect image to act as a synch point manager to alleviate the redundancy of having it on every application server, and make use of DB2 Runtime clients to communicate with the single DB2 Connect. This way, we still have DB2 Connect in place to help route traffic to the appropriate DB2 member in a sysplex DB2 datasharing group. Prior to the migration, we completed the following:

1. Installed DB2 Connect EE v8.1 Fixpack 6 on a new SLES 8 31-bit image litdbcon.
2. Made DB2 Connect a synch point manager using the following technique;

   From the DB2 instance (db2inst1), issue the following:

   ```
   db2 update dbm cfg using SPM_NAME litdbcon
   ```

litdbcon is the shortname of the system hostname where DB2 Connect EE was installed.

3. Installed DB2 Runtime Client v8.1 Fixpack 6 on our WebSphere Application Server nodes.
4. Reconfigured our Trade3 application's datasource for WebSphere Application Servers to use Type 4 JDBC driver. From the WebSphere Admin console –

   ```
   http://adminconsole:9090/admin
   ```

   Resources -> JDBC Providers -> DB2 JDBC Provider (XA)
   - Edit CLASSPATH to

     ```
     /opt/IBM/db2/V8.1/java/db2jcc.jar
     /opt/IBM/db2/V8.1/java/db2jcc_license_cu.jar
     /opt/IBM/db2/V8.1/java/db2jcc_license_cisuz.jar
     ```

   - Edit Implementation Classname

     ```
     com.ibm.db2.jcc.DB2ConnectionPoolDataSource
     ```

   Resources -> JDBC Providers -> DB2 JDBC Provider (XA) -> Data Sources -> TradeDataSource -> Custom Properties
   - Add/Edit for

     ```
     driverType
      value = 4
      Required = False
     serverName
      value = IP@ of your new DB2 Connect EE Server
      Required = False
     portNumber
      value = 50001
      Required = False
     ```

Migration: After changing our DB2 configuration, we proceeded with the migration of DB2.

We concluded that it's best to upgrade the DB2 products starting with the Client, Connect, and lastly UDB. This was a staged transitioning procedure to go from a 31-bit DB2 running on 31-bit distribution to 64-bit DB2 running on 64-bit distribution.

A summary of the steps we performed:

1. Perform backup on DB2 images and current database entries
   a. backed up database and catalogs
   b. tested that it's a valid backup by doing a restore
   c. dropped instance (but not database)
2. Upgraded to DB2 v8 fixpack 9 (DB2 v8.2). Tested to confirm this level worked.
3. Installed a new Linux distribution – SLES 9 64bit
4. Installed DB2 v8 fixpack 9 (DB2 v8.2) on our new SLES 9 64 bit
   a. created instance
   b. restored database and catalogs from backup

Here is a detailed list of our original DB2 levels:

1. DB2 Runtime Client running on SLES 8 31-bit SP3

   ```
   db2inst1@litwas01:~> db2level
   DB21085I  Instance "db2inst1" uses "32" bits and DB2 code release
   "SQL08016"
   with level identifier "02070106".
   Informational tokens are "DB2 v8.1.0.60", "s041214", "MI00115", and
   FixPak "6".
   Product is installed at "/opt/IBM/db2/V8.1".
   ```

2. DB2 Connect EE running on SLES 8 31-bit SP3

```
db2inst1@litdbcon:~> db2level
DB21085I  Instance "db2inst1" uses "32" bits and DB2 code release
"SQL08016"
with level identifier "02070106".
Informational tokens are "DB2 v8.1.0.60", "s041214", "MI00115", and
FixPak "6".
Product is installed at "/opt/IBM/db2/V8.1".
```

3. DB2 UDB Enterprise Server Edition (ESE) running on SLES 8 31-bit SP3

```
db2db2inst1@litdata01:~> db2level
DB21085I  Instance "db2inst1" uses "32" bits and DB2 code release
"SQL08012"
with level identifier "02030106".
Informational tokens are "DB2 v8.1.0.16", "s030508", "MI00049", and
FixPak "2".
Product is installed at "/opt/IBM/db2/V8.1".
```

Backup our DB2 data: Our DB2 data included our trade3db and catalog entries. A small outage was required during this stage, since we did not want data being updated/modified while the backup routine was run.

DB2 image - backup*:* We made exact copies of our DB2 images using the FLASHCOPY procedure as described in “Upgrading the OS”.

```
DB2 ESE: litdat01.ltic.pok.ibm.com -  litdat10.ltic.pok.ibm.com
DB2 Connect: litdbcon.ltic.pok.ibm.com - litdbcon10.ltic,pok.ibm.com
DB2 Runtime Client: litwas01.ltic.pok.ibm.com -  litwas10.ltic.pok.ibm.com,
litwas02.ltic.pok.ibm.com - litwas20.ltic.pok.ibm.com,
litwas03.ltic.pok.ibm.com - litwas30.ltic.pok.ibm.com,
and litwas04.ltic.pok.ibm.com - litwas40.ltic.pok.ibm.com
```

DB2 UDB – backup*:*

1. Logged on as db2inst1 and stopped DB2

   ```
   # db2stop force
   ```

   By stopping DB2, we made sure that all connections from WAS to DB2 were severed, so that the database was in a clean state.
2. Restarted DB2

   ```
   # db2start
   ```
3. Connected to the trade database

   ```
   # db2 connect to trade3ph
   ```
4. Created a directory for the database contents to be stored

   ```
   # db2inst1@litdata01:~> mkdir TRADE3PH.BACKUP
   ```
5. Issued the backup

   ```
   # db2inst1@litdata01:~> db2 backup db TRADE3PH to \
   /home/db2inst1/TRADE3PH.BACKUP
   ```

   Backup was successful. The timestamp for this backup image was 20050630144054.
6. Checked the directory that it backed up to

   ```
   db2inst1@litdata01:~> ll TRADE3PH.BACKUP/
   total 24624
   -rw-r-----    1 db2inst1 db2grp1  25186304 2005-07-06 20:32
   TRADE3PH.0.db2inst1.NODE0000.CATN0000.20050706203152.001
   ```

   Note: Be aware that if you restore over an existing database, any performance tuning tasks on that existing database are lost.
7. Tested out the database restore
   a. Dropped database

      ```
      db2inst1@litdata01:~> db2 drop db trade3ph
      DB20000I  The DROP DATABASE command completed successfully.
      ```
   b. Restored trade3 database

```
db2inst1@litdata01:~> db2 restore db trade3ph from
/home/db2inst1/TRADE3PH.BACKUP replace existing
DB20000I  The RESTORE DATABASE command completed
successfully.
```

c. Tested that 'Connect to database' works from the WAS admin console as follows: Pointed a browser to

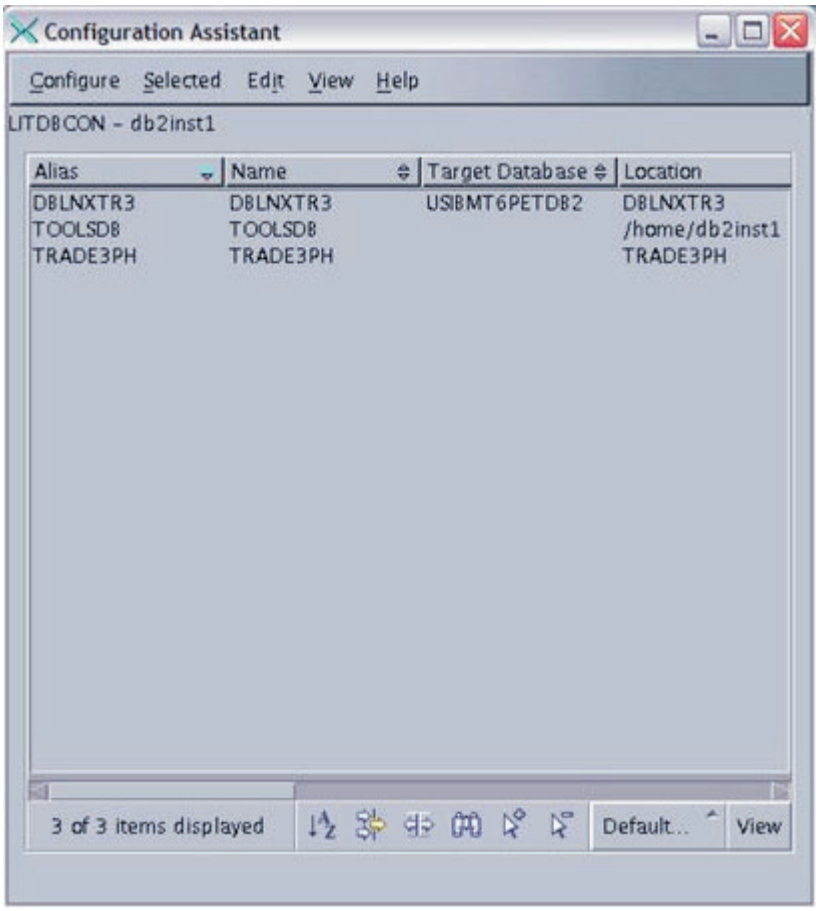
```
http://adminconsole-hostname:9090/admin
```

and selected Resources -> JDBC Providers -> DB2 JDBC Provide (XA) -> Data Sources -> TradeDataSource and clicked the "Test Connection" button. It was successful.

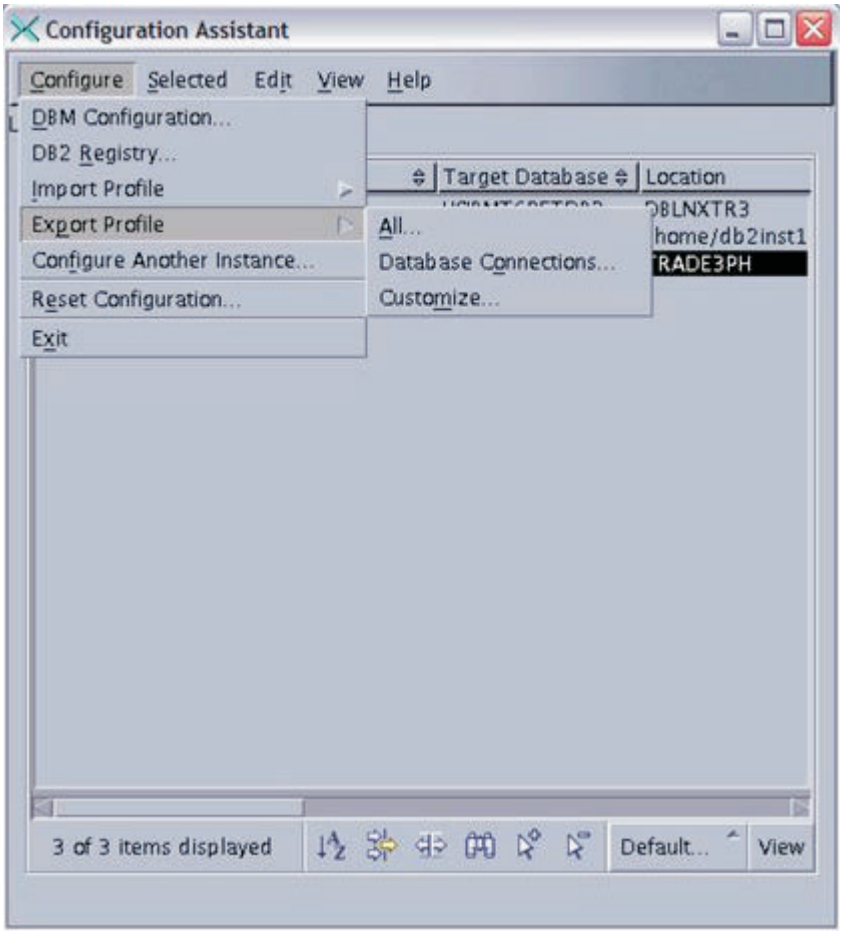
DB2 Connect – backup*:* We used the Configuration Assistant (CA) to export the client profiles and connections.

1. Logged onto the system with a valid DB2 user ID, such as db2inst1.
2. We started the CA, exporting our $DISPLAY variable because it's a graphical interface.

```
db2inst1@litdbcon:~> db2ca
XTEST extension not installed on this X server: Success
```



From the Configure menu, we selected Export Profile.



Now you need to select one of the following options:

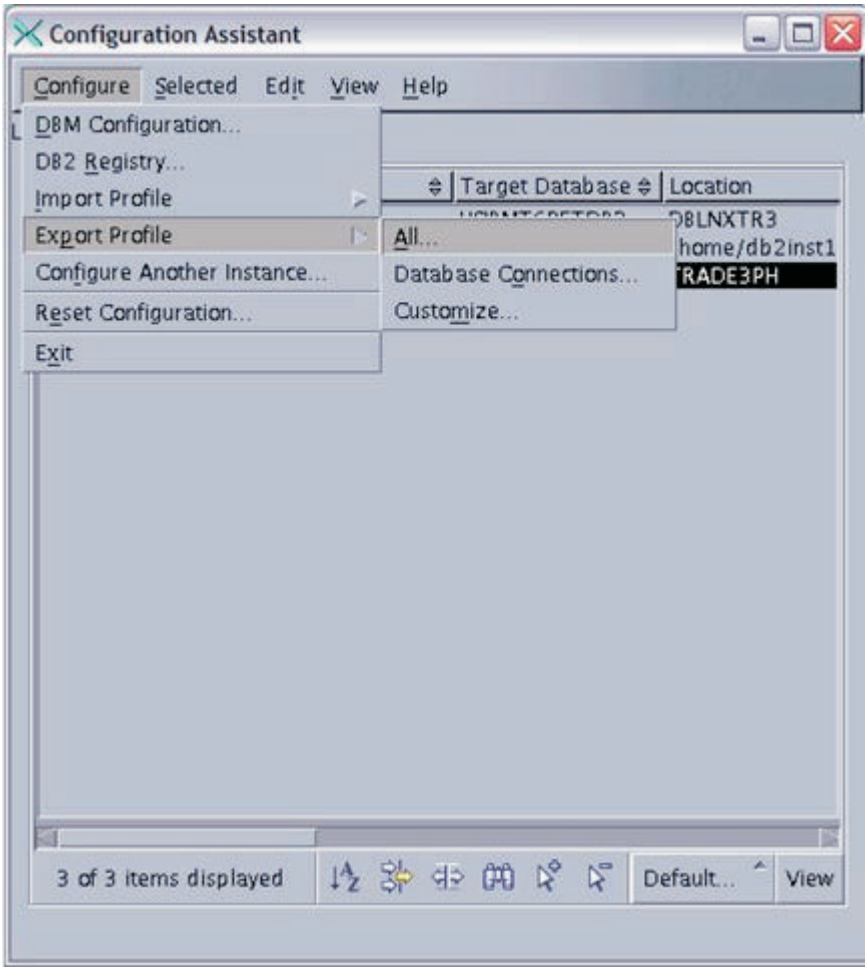
All If you want to create a profile that contains all of the databases cataloged on your system, and all of the configuration information for this client. Type a name for your client profile and click Save.

Database Connections
If you want to create a profile that contains all of the databases cataloged on your system without any of the configuration information for this client. Type a name for your client profile and click Save.

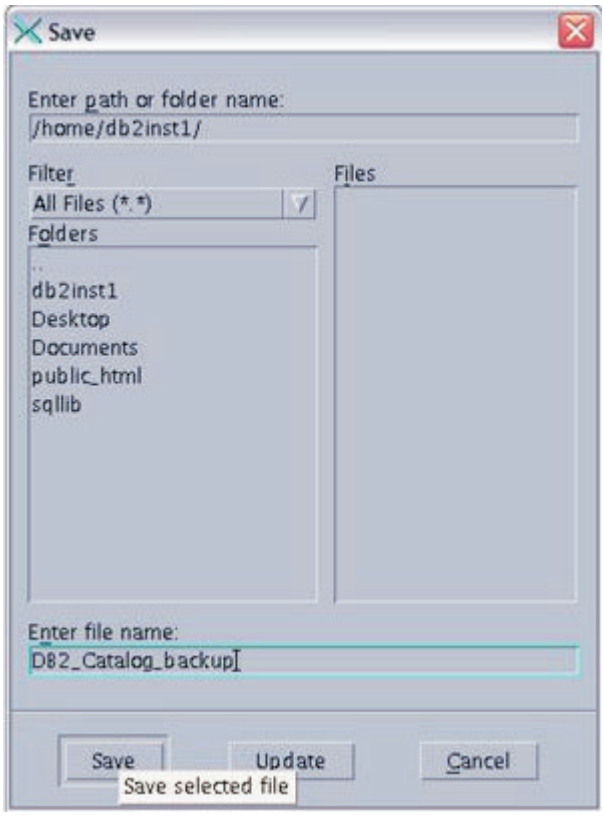
Customize
If you want to select a subset of the databases that are cataloged on your system, or a subset of the configuration information for this client. In the Customize Export Profile window:

a. Type a name for your client profile.
b. Select the Database connections checkbox to include database connections in the client profile you want to export.
c. From the Available database aliases box, select the databases to be exported and click > to add them to the Selected database aliases box. To add all of the available databases to the Selected database aliases box, click >>.
d. Select the check boxes that correspond to the options that you want to set up for the target client.
e. Click Export to complete this task.
f. Check your results displayed in the Results tab.

We chose to Save it All:



We specified a file name for the backup - DB2_Catalog_backup:



Export completed successfully.

DB2 Runtime Client – backup*:* The DB2 Runtime Client did not have anything to back up since its connection info was kept in the JDBC data source under WebSphere Application Server v5.1.

Upgrading DB2 to FP10:

STAGE 1 – We upgraded our current 31-bit DB2 to latest available fixpack level: We used fixpack 10 to upgrade the DB2 Runtime Client, DB2 Connect and DB2 UDB Enterprise Server Edition (ESE).

We downloaded FP10 (FP10_MI00144.tar) for Connect and UDB, and FP10 (FP10_MI00144_RTCL.tar) for Runtime Client from the following website:

```
http://www.ibm.com/software/data/db2/udb/support/downloadv8_linuxs390z31bit.html
```

We performed the following steps to upgrade our current DB2.

1. Installed the fixpack
   a. Logged onto a command prompt with root authority.
   b. Made sure DB2 instance(s) were stopped.
   c. Untarred the build package into a temporary directory
   d. Installed the software by running ./installFixPak -y
2. After running the installFixPak script, we needed to update the db2 instance:

```
litdata01:/opt/IBM/db2/V8.1/instance # ./db2iupdt -u db2fenc1 -e
db2inst1
DBI1070I Program db2iupdt completed successfully.
```

3. For DB2 UDB, we also needed to update the administrative user:

```
litdata01:/opt/IBM/db2/V8.1/instance # ./dasupdt dasusr1
SQL4407W  The DB2 Administration Server was stopped successfully.
SQL4406W  The DB2 Administration Server was started successfully.
DBI1070I Program dasupdt completed successfully.
```

4. Restarted DB2 and checked to see the new level was applied:

```
db2inst1@litdata01:~> db2start
07/06/2005 15:37:33     0   0   SQL1063N  DB2START processing was
successful.
SQL1063N  DB2START processing was successful.
db2inst1@litdata01:~> db2level
DB21085I  Instance "db2inst1" uses "32" bits and DB2 code release
"SQL08023"
with level identifier "03040106".
Informational tokens are "DB2 v8.1.0.96", "s050811", "MI00144",
and FixPak
"10".
Product is installed at "/opt/IBM/db2/V8.1".
```

5. Verified that DB2 connections still worked by using the test connection function from WAS admin console. See the procedure for this in the DB2 backup section.

We encountered some interesting details during this stage of the testing:

DB2 Connect EE must be at the same FP level or higher than DB2 UDB ESE in order to run our Trade3 application. It was possible to connect to the database from Connect, but our test connection application via the data source resulted in errors in WAS's SystemOut.log:

```
[7/7/05 19:22:31:845 EDT] 3b421f1f WSRdbManagedC W DSRA0180W: Exception
detected during ManagedConnection.destroy().  The exception is:
com.ibm.ws.exception.WsException: DSRA0080E: An exception was received
by the Data Store Adapter. See original exception message: invalid
operation: connection closed.
```

After we brought DB2 Connect EE to the same FP level as our DB2 UDB ESE, we were able to run test connection without any errors.

STAGE 2 - Installed 64-bit DB2 FP10 products on SLES9 64-bit: Now we knew FP10 worked with our existing Trade3 application on SLES8 31-bit. We went ahead and installed the latest 64-bit DB2 fixpack product levels on SLES9 64bit.

Note: In our environment we were using a 31-bit application (WAS) with the JDBC Type 4 driver provided by 64-bit DB2 Runtime client. Because we were not relying on WAS to use the DB2 client to make cataloged connections, our configuration was (and is) supported. However, if you are using local catalogs on your WAS server, you need to install the 31-bit DB2 Runtime client. This support is available in DB2 Runtime client V8.1 FP10. You can download the 31-bit version of DB2 Runtime client from

```
http://www.ibm.com/software/data/db2/udb/support.html
```

The DB2 products were installed on new SLES9 64-bit images. There was no specific order to the installation. We first installed UDB ESE, then Connect and Runtime Client. For purposes of understanding here's our new hostname setup:

```
DB2 ESE - litdat10.ltic.pok.ibm.com
DB2 Connect - litdbcon10.ltic.pok.ibm.com
DB2 Runtime Client - litwas10.ltic.pok.ibm.com, litwas20.ltic.pok.ibm.com,
litwas30.ltic.pok.ibm.com, litwas40.ltic.pok.ibm.com
```

1. We obtained and installed full install versions of DB2 UDB ESE, DB2 Connect EE, and DB2 Runtime Client. We downloaded the install source from Extreme Leverage Software Download. You will need a valid db2 license for them all.
2. We used the following DB2 support site to download the 64-bit DB2 product fixpacks:

   ```
   http://www.ibm.com/software/data/db2/udb/support/downloadv8_linuxs390z64bit.html
   ```

   Then we applied fixpack 10 (FP10_MI00145.tar) to DB2 ESE and DB2 Connect, and fixpack 10 (FP10_MI00144_RTCL.tar) to the Runtime Client using the same procedure as in the previous section.
3. After the fixpacks were installed, we ran the updates for admin and instance on DB2 ESE, Connect and Runtime Client.

   ```
   litdbcon:/opt/IBM/db2/V8.1/instance # ./dasupdt dasusr
   SQL4407W  The DB2 Administration Server was stopped successfully.
   SQL4409W  The DB2 Administration Server is already active.
   DBI1070I Program dasupdt completed successfully.


   litdbcon:/opt/IBM/db2/V8.1/instance # ./db2iupdt -u db2fenc1 -e
   db2inst1
   DBI1070I Program db2iupdt completed successfully.
   ```

We were now at the following DB2 levels:

1. DB2 Runtime Client running on SLES 9 64-bit base

   ```
   db2inst1@litwas10:~> db2level
   DB21085I  Instance "db2inst1" uses "64" bits and DB2 code release
   "SQL08023"
   with level identifier "03040106".
   Informational tokens are "DB2 v8.1.0.96", "s050811", "MI00145", and
   FixPak
   "10".
   Product is installed at "/opt/IBM/db2/V8.1".
   ```

2. DB2 Connect EE running on SLES 9 64-bit base

   ```
   db2inst1@litdbcon10:~> db2level
   DB21085I  Instance "db2inst1" uses "64" bits and DB2 code release
   "SQL08023"
   with level identifier "03040106".
   Informational tokens are "DB2 v8.1.0.96", "s050811", "MI00145", and FixPak
   "10".
   Product is installed at "/opt/IBM/db2/V8.1".
   ```

3. DB2 UDB Enterprise Server Edition (ESE) running on SLES 9 64-bit base

   ```
   db2db2inst1@litdat10:~> db2level
   DB21085I  Instance "db2inst1" uses "64" bits and DB2 code release
   "SQL08023"
   with level identifier "03040106".
   Informational tokens are "DB2 v8.1.0.96", "s050811", "MI00145", and
   FixPak
   "10".
   Product is installed at "/opt/IBM/db2/V8.1".
   ```

4. Now it was time to restore Trade3 database on LITDAT10. As user db2inst1, we downloaded the backup data from the existing LITDAT01 image to LITDAT10:

   ```
   litdat01:~ # su - db2inst1
   db2inst1@litdat10:~/> mkdir TRADE3PH.BACKUP
   db2inst1@litdat10:~/TRADE3PH.BACKUP> scp
   192.168.71.104:/home/db2inst1/TRADE3PH.BACKUP/* .

   db2inst1@litdat10:~/TRADE3PH.BACKUP> ll
   total 44248
   -rw-r-----  1 db2inst1 db2grp1 45260800 2005-07-11 18:01
   ```

```
TRADE3PH.0.db2inst1.NODE0000.CATN0000.20050711215940.001

db2 restore db trade3ph from /home/db2inst1/TRADE3PH.BACKUP
```

5. On LITDAT10, we checked to see if we could connect to the database:

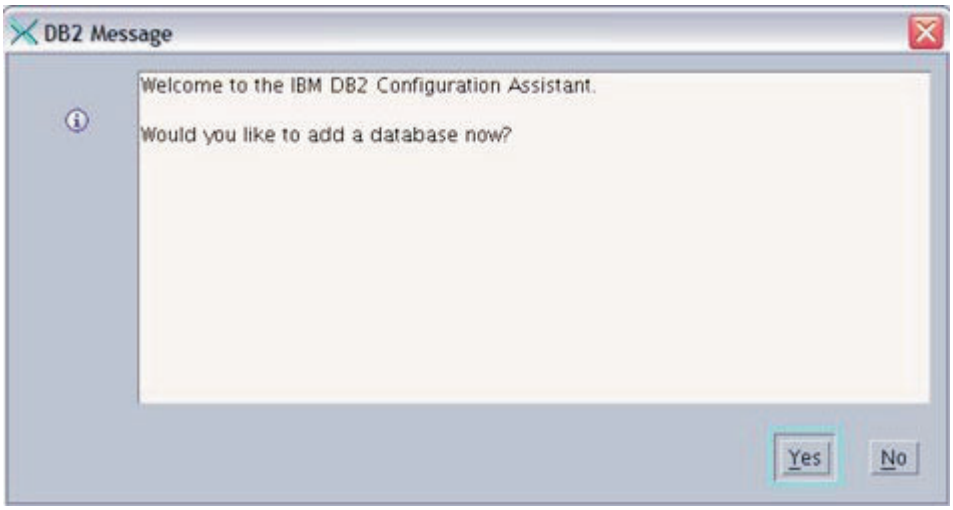
```
db2inst1@litdat01:~> db2 connect to trade3ph

   Database Connection Information

 Database server        = DB2/LINUXZ64 8.2.2
SQL authorization ID   = DB2INST1
Local database alias   = TRADE3PH
```

6. Now, we restored catalog entries on LITDBCON10. As user db2inst1, we downloaded the backup file (DB2_Catalog_backup) made from earlier to LITDBCON10:/home/db2inst1, and used the DB2 Configuration Assistant to perform the restore.

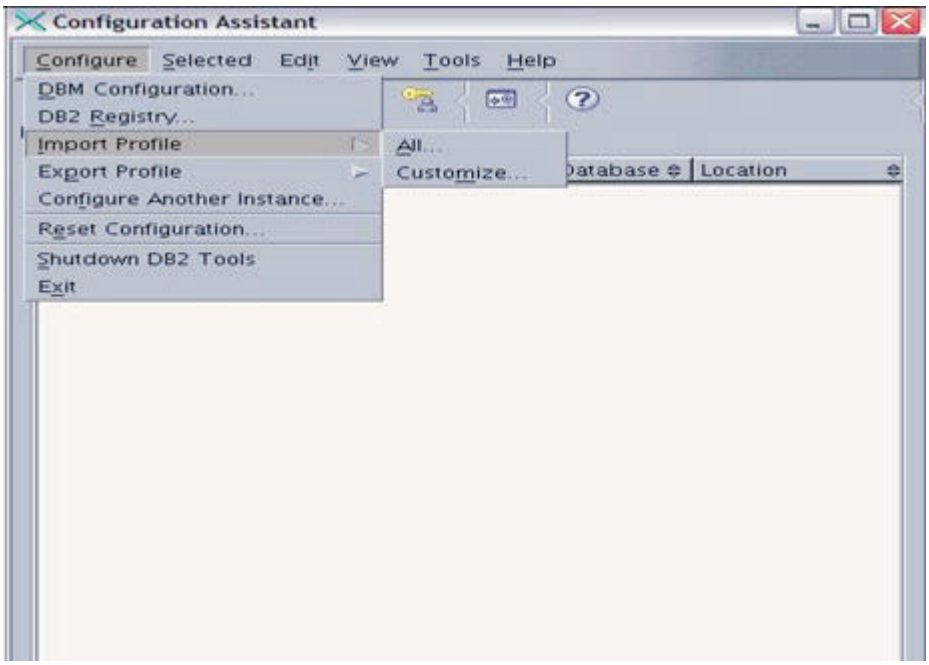
   Started the db2 configuration assistant:

```
db2inst1@litdbcon:~> db2ca
```

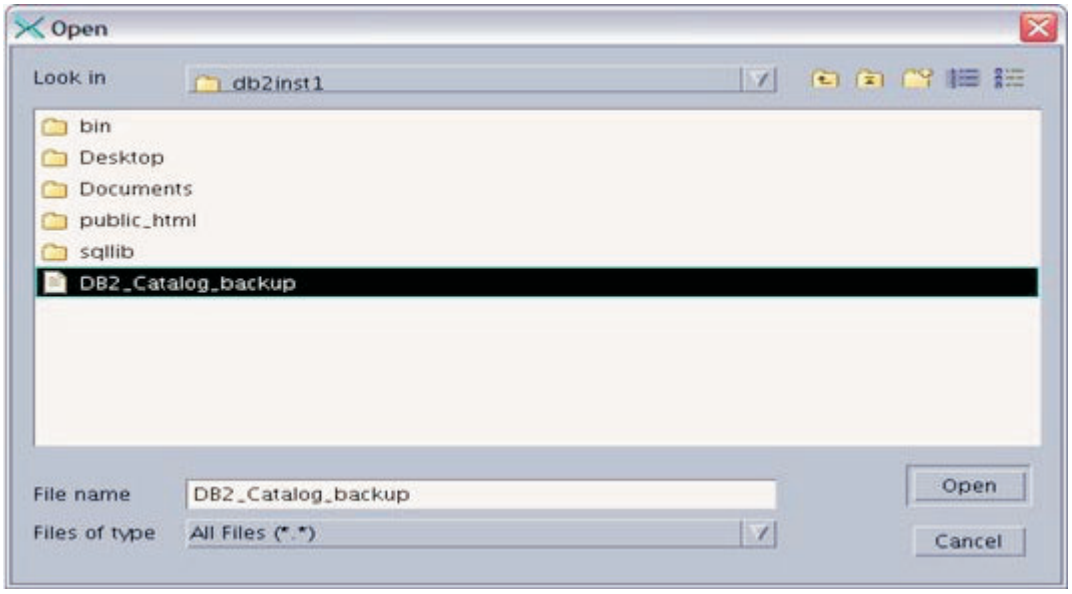
   Selected NO for the following screen:



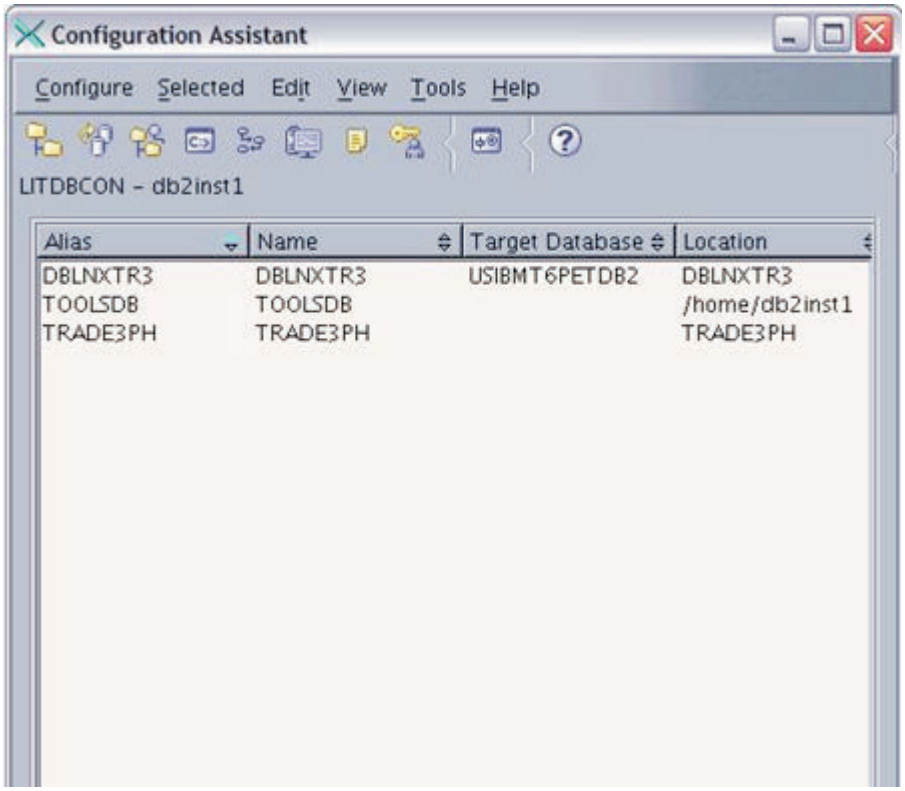
   Selected CONFIGURE-IMPORT PROFILE-ALL:



Selected the backup file - DB2_Catalog_backup and hit OPEN:



Import completed successfully. We now could see the catalog on the CA:



7. After exiting from CA, from a db2inst1 session, we checked to see if the catalog entries were indeed restored:

```
db2inst1@litdbcon:~> db2 list db directory

...
Database 2 entry:

 Database alias                       = TRADE3PH
 Database name                        = TRADE3PH
 Node name                            = TRADE3PH
 Database release level               = a.00
 Comment                              =
 Directory entry type                 = Remote
 Authentication                       = SERVER
 Catalog database partition number    = -1
 Alternate server hostname            =
 Alternate server port number         =
...
```

8. At this point, we'd verified that DB2 UDB ESE and Connect have successfully transitioned over to 64-bit. We would confirm if the Runtime Client was successful after we transitioned the WebSphere Application Server nodes and the Network Deployment Manager server to version 5.1.1.

Migrating WebSphere Application Server Network Deployment and Application Server v5.1 on SLES8 SP3 31-bit to v5.1.1 on SLES9 64-bit

Following our migration strategy, we chose to migrate our current WebSphere environment from version 5.1 to version 5.1.1 since that level is supported on both SLES 8 SP3 31bit and SLES 9 base 64bit. We then installed WAS v5.1.1 on new SLES9 base 64-bit images. Lastly, we migrated the configuration data from SLES8 to SLES9. This process involved a total of 8 images (4 current, 4 new images).

To outline the tasks ahead, we divided them into the following stages:

STAGE 1
Backed up our existing WebSphere environment

STAGE 2
Upgraded our current WebSphere Application Server and Network Deployment Manager from version 5.1 to version 5.1.1

STAGE 3
Installed WebSphere Application Server and Network Deployment Manager version 5.1.1 on new SLES 9 64-bit images

STAGE 4
Migrated the Trade3 application to the new SLES9 64-bit images running version 5.1.1

Original SLES8 images:
- WAS - litwas01.ltic.pok.ibm.com (VM guest ID: LITWAS01)
- WAS - litwas02.ltic.pok.ibm.com (VM guest ID: LITWAS02)
- WAS - litwas03.ltic.pok.ibm.com (VM guest ID: LITWAS03)
- WAS ND - litwas04.ltic.pok.ibm.com (VM guest ID: LITWAS04)

New SLES9 images:
- WAS - litwas01.ltic.pok.ibm.com (VM guest ID: LITWAS10)
- WAS - litwas02.ltic.pok.ibm.com (VM guest ID: LITWAS20)
- WAS - litwas03.ltic.pok.ibm.com (VM guest ID: LITWAS30)
- WAS ND - litwas04.ltic.pok.ibm.com (VM guest ID: LITWAS40)

Note: We used the same hostnames for the new images, even though on VM the guest IDs had to be different. WebSphere hardcodes the node and cell names using the hostname during installation. Our Trade application was very dependent on the existing hostnames, any changes to that would cause it to no longer work. We chose to use the same hostnames on the new SLES9 images as it would minimize problems at the application level. It wasn't until after our testing that we found that you can alter the hostname after the WebSphere Application Server is installed using the following guide -

```
http://www-1.ibm.com/support/docview.wss?uid=swg27005391&aid=1
```

We recommend using the guide, but we will still explain the steps we followed.

To minimize any confusion in the description that follows, we will refer to the old WAS images with the prefix 'old-' and the new WAS images with prefix 'new-'.

```
litwas01.ltic.pok.ibm.com (VM Guest ID: LITWAS01) will be called old-
litwas01.ltic.pok.ibm.com or old-litwas01
litwas01.ltic.pok.ibm.com (VM Guest ID: LITWAS10) will be called new-
litwas01.ltic.pok.ibm.com or new-litwas01
```

The above was also possible because we weren't using a DNS. We made sure the IP addresses specified in /etc/hosts pointed to the correct group of WebSphere servers.

Get the 5.1.1 fixpacks: We downloaded WAS 5.1 fixpack 1 for our Application Servers and WAS ND 5.1 fixpack 1 for our Network Deployment Manager. We obtained the install sources from the following WebSphere support website:

```
http://www-1.ibm.com/support/docview.wss?rs=180&context=SSEQTP&dc=D400&amp;
q1=Fixpack+1+for+5.1&uid=swg24007195&loc=en_US&cs=utf-8&lang=enWAS v.5.1 fixpack 1 -
was51_fp1_linux390.tar


WAS v.5.1 fixpack 1 - was51_fp1_linux390.tar
WAS ND v5.1 fixpack 1 - was51_nd_fp1_linux390.tar
```

STAGE 1 – Backed up our existing WebSphere environment: Before we started, we backed up the existing AppServer and Network Deployment configuration by running the WebSphere backupConfig.sh script.

```
litwas04:/opt/WebSphere/DeploymentManager/bin # ./backupConfig.sh
litwas04NDconfig.backup -nostop
ADMU0116I: Tool information is being logged in file
           /opt/WebSphere/DeploymentManager/logs/backupConfig.log
ADMU5001I: Backing up config directory
           /opt/WebSphere/DeploymentManager/config
           to file
           /opt/WebSphere/DeploymentManager/bin/litwas04config.backup
.....................................................................
.....................................................................
.....................................................................
.................................
ADMU5002I: 268 files successfully backed up
```

We issued backupConfig.sh for all remaining AppServers, and they were saved as:

```
litwas04ASconfig.backup
litwas03ASconfig.backup
litwas02ASconfig.backup
litwas01ASconfig.backup
```

STAGE 2 - Upgraded our current WebSphere Application Server and Network Deployment version 5.1 to version 5.1.1: To avoid complications, we stopped our WAS cluster and nodes before issuing any update.

We first installed the update for the current WebSphere Application Server Network Deployment Server - was51_nd_fp1_linux390.tar. Then we restarted the nodes and the cluster and accessed the Trade3 page to verify that everything was still working.

Note: If you plan to have the Application Servers (nodes) run at v5.1.1, your Network Deployment must be at v5.1.1 first. The nodes are not downward compatible, they will not be able to communicate or be in full sync with one another if ND is not at the same version level. However, Network Deployment running at v5.1.1 will be able to work with both v5.1 and v5.1.1 Application Server nodes.

Once we determined that our Trade3 cluster was still operational, we proceeded to upgrade the WebSphere Application Server nodes (old-LITWAS01, old-LITWAS02, and old-LITWAS03), selecting was51_fp1_linux390.tar as the fixpack to install. We made sure to stop our cluster and nodes before we did the upgrade

After the installation succeeded, we restarted the nodes and cluster once again. We verified that the Trade3 application was still operational.

At this point, we had migrated and verified that our existing application ran on WebSphere Application Server v5.1.1.

STAGE 3 - Installed WebSphere Application Server and Network Deployment version 5.1.1 on new SLE 9 64-bit images: In order to have v5.1.1 installed, you must have v5.1 installed first. Since v5.1 is not supported on SLES 9 (31 or 64 bit), we needed to follow a few workarounds in order to proceed with the installation. Follow this doc:

```
http://www-1.ibm.com/support/docview.wss?rs=727&uid=swg21182138.
```

In summary, we set the following in our session before running the install. We set the LANG environment variable to work around an embedded messaging issue:

```
litwas04:~/WAS51/linuxs390 # export LANG=$LC_CTYPE
```

We set the maximum stack size for each process to work around a JDK 1.4.1 SR1 issue as follows:

```
litwas04:~/WAS51/linuxs390 # ulimit -s 8196
```

Along with the environment variables, we created and modify the following users:

```
litwas04:~ # groupadd mqm
litwas04:~ # groupadd mqbrkrs
litwas04:~ # useradd mqm -g mqm
litwas04:~ # usermod -g root -G mqm,mqbrkrs root
```

We followed the WebSphere installation procedure as normal from this point on:

```
litwps40:/opt/WAS511/linuxs390 # ./install
InstallShield Wizard

Initializing InstallShield Wizard...

Searching for Java(tm) Virtual Machine...
.......
```

After successfully installing v5.1, we set additional ND environment variables by running . /opt/WebSphere/DeploymentManager/bin/setupCmdLine.sh

We checked the return of the command uname –m and it returned s390x. So we did the following to work around the script-checking issue:

1. Changed to the directory (cd) from which we extracted the 5.1.1 PTF:

   ```
   cd /root/WAS511
   ```

2. Set LD_LIBRARY_PATH=$PWD/lib/linux/s390/:$LD_LIBRARY_PATH: export LD_LIBRARY_PATH=$PWD/lib/linux/s390/:$LD_LIBRARY_PATH

Now, we applied fixpack 5.1.1 to new-litwas01, new-litwas02, new-litwas03, and new-litwas04, using the same procedure as outlined in STAGE 2.

We were now running WebSphere Application Server and Network Deployment at v5.1.1 in 31-bit compatibility mode on SLES9 64-bit.

STAGE 4 - Migrated the Trade3 application to the new SLES9 64-bit images running version 5.1.1:

1. We first needed to federate all the new nodes (new-litwas01, new-litwas02, new-litwas03, and new-litwas04) to our Network Deployment Manager with the addNode.sh command:

   ```
   litwas04:/opt/WebSphere/AppServer/bin # ./addNode.sh
   litwas04.ltic.pok.ibm.com 8879

   ADMU0116I: Tool information is being logged in file
              /opt/WebSphere/AppServer/logs/addNode.log
   ADMU0001I: Begin federation of node litwas04 with Deployment
   ```

```
Manager at
           litwas04.ltic.pok.ibm.com:8879.
ADMU0009I: Successfully connected to Deployment Manager Server:
           litwas04.ltic.pok.ibm.com:8879
ADMU0505I: Servers found in configuration:
ADMU0506I: Server name: server1
ADMU2010I: Stopping all server processes for node litwas04
ADMU0512I: Server server1 cannot be reached. It appears to be stopped.
ADMU0024I: Deleting the old backup directory.
ADMU0015I: Backing up the original cell repository.
ADMU0012I: Creating Node Agent configuration for node: litwas04
ADMU0014I: Adding node litwas04 configuration to cell: litwas04Network
ADMU0016I: Synchronizing configuration between node and cell.
ADMU0018I: Launching Node Agent process for node: litwas04
ADMU0020I: Reading configuration for Node Agent process: nodeagent
ADMU0022I: Node Agent launched. Waiting for initialization status.
ADMU0030I: Node Agent initialization completed successfully. Process id is:
           21335
ADMU0523I: Creating Queue Manager for node litwas04 on server jmsserver
ADMU0525I: Details of Queue Manager creation may be seen in the file:
           createMQ.litwas04_jmsserver.log
ADMU9990I:
ADMU0300I: Congratulations! Your node litwas04 has been successfully
           incorporated into the litwas04Network cell.
ADMU9990I:
ADMU0306I: Be aware:
ADMU0302I: Any cell-level documents from the standalone litwas04 configuration
           have not been migrated to the new cell.
ADMU0307I: You might want to:
ADMU0303I: Update the configuration on the litwas04Network Deployment Manager
           with values from the old cell-level documents.
ADMU9990I:
ADMU0306I: Be aware:
ADMU0304I: Because -includeapps was not specified, applications installed on
           the standalone node were not installed on the new cell.
ADMU0307I: You might want to:
ADMU0305I: Install applications onto the litwas04Network cell using wsadmin
           $AdminApp or the Administrative Console.
ADMU9990I:
ADMU0003I: Node litwas04 has been successfully federated.
```

2. Then we downloaded the backup files saved from backupConfig.sh in Stage 1 and ran restoreConfig.sh on them all in the following order:

   ```
   litwas04NDconfig.backup
   litwas04ASconfig.backup
   litwas03ASconfig.backup
   litwas02ASconfig.backup
   litwas01ASconfig.backup
   ```

   For example, to restore the configurations on new-litwas04, we ran:

   ```
   litwas04:/opt/WebSphere/DeploymentManager/bin # ./restoreConfig.sh
   litwas04NDconfig.backup ADMU0116I: Tool information is being logged in
   file

   /opt/WebSphere/DeploymentManager/logs/restoreConfig.log
   ADMU0505I: Servers found in configuration:
   ADMU0506I: Server name: dmgr
   ADMU2010I: Stopping all server processes for node litwas04Manager
   ADMU0510I: Server dmgr is now STOPPED
   ADMU5502I: The directory /opt/WebSphere/DeploymentManager/config already
              exists; renaming to /opt/WebSphere/DeploymentManager/config.old
   ADMU5504I: Restore location successfully renamed
   ADMU5505I: Restoring file litwas04NDconfig.backup to location
              /opt/WebSphere/DeploymentManager/config
   ......................................................................
   ```

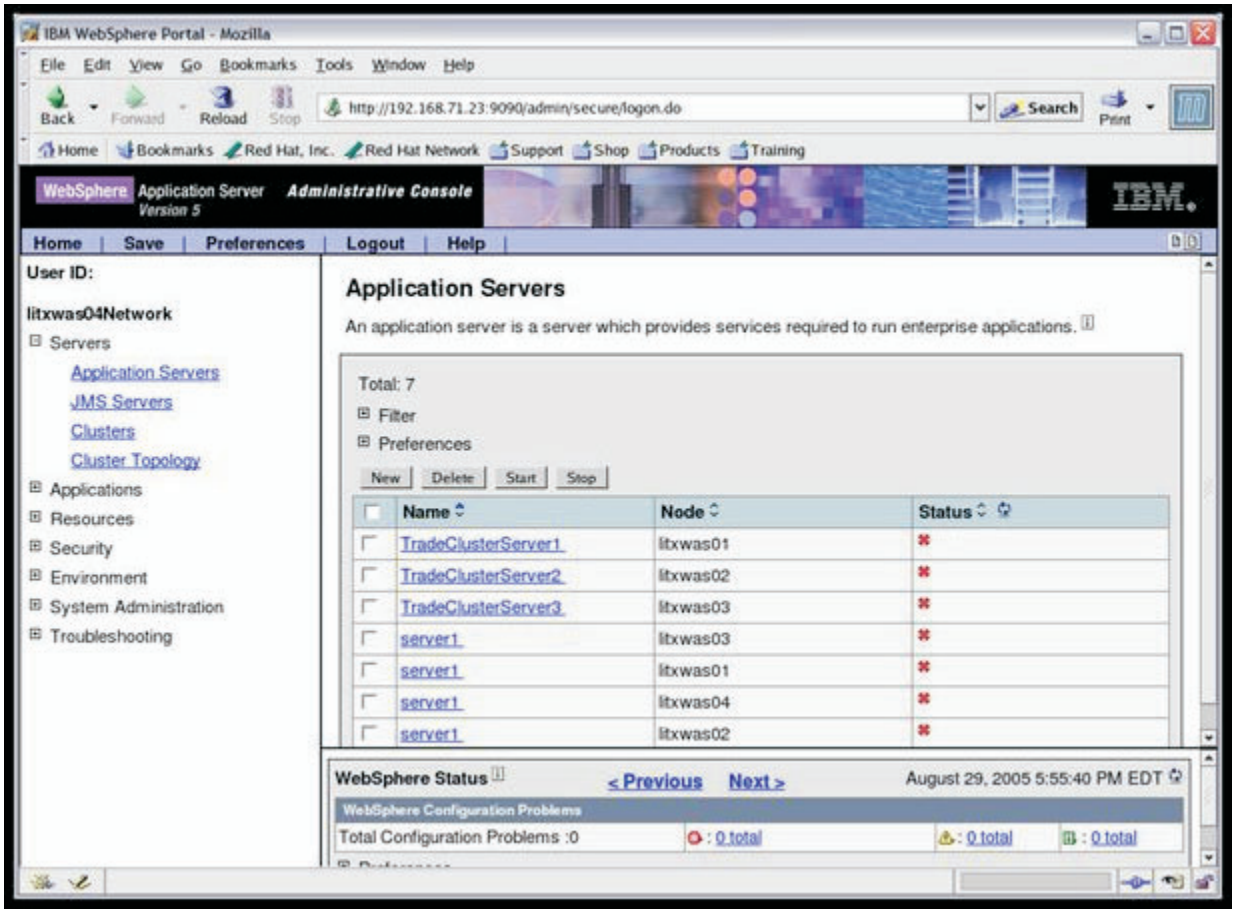
```
.....................................................................
ADMU5506I: 268 files successfully restored
ADMU6001I: Begin App Preparation -
ADMU6009I: Processing complete.
```

3. Restarted the Deployment Manager and Application Server Nodes.
4. One way to determine if the restore worked is to check if the Application Servers are present in the admin console. We accessed the WAS Network Deployment Manager Admin Console at:

   ```
   http://new-litwas04:9090/admin
   ```

   We logged in, and selected Servers -> Application Servers in the left panel,

   The right panel had the following information indicating the application servers were restored successfully:



Test DB2 Runtime Client*:* Now we could test the DB2 Runtime Client from the WebSphere admin console to see if the JDBC Type 4 driver that came with DB2 Runtime Client V8.1 fixpack 10 would work with the DB2 Connect and DB2 UDB ESE that we'd migrated earlier.

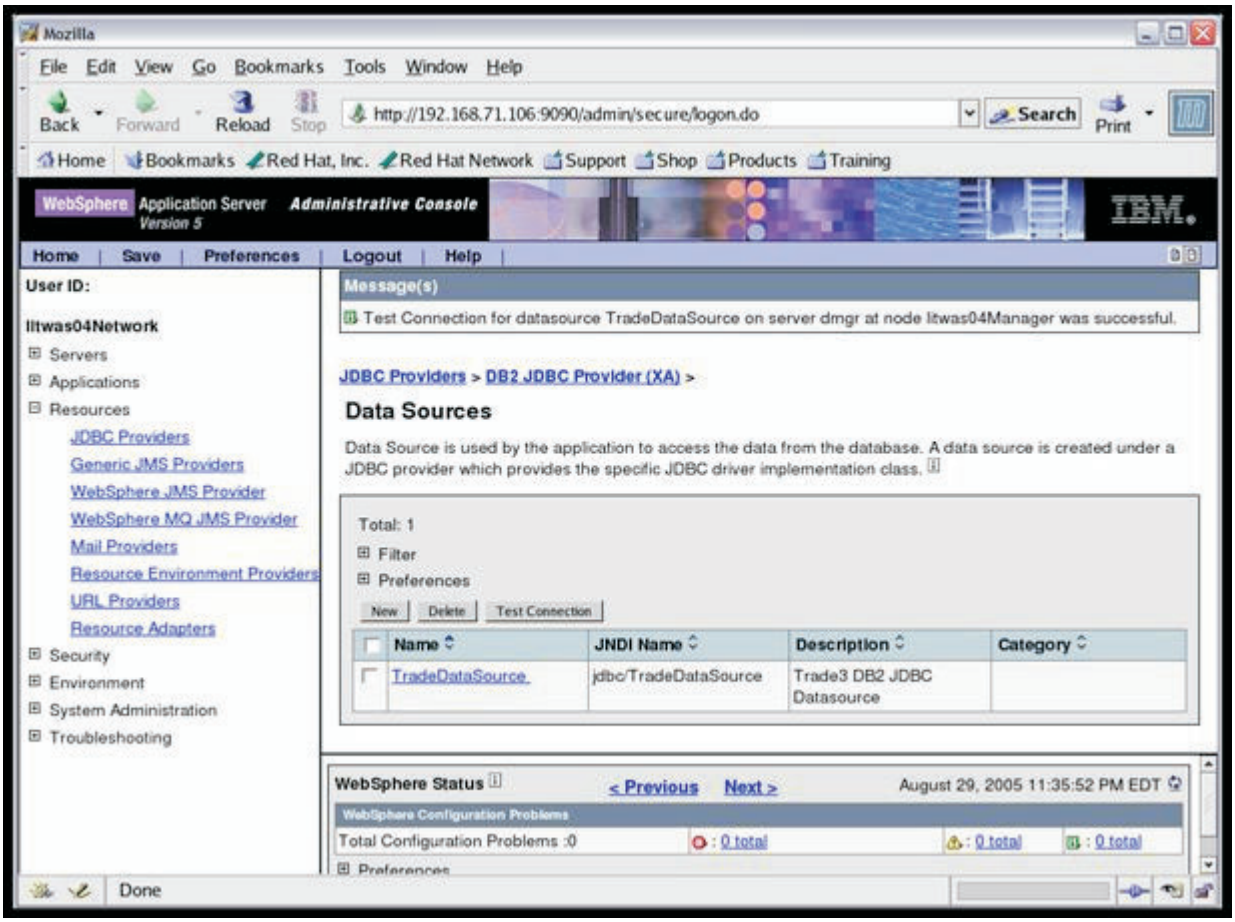
Note: In our environment we were using a 31-bit application (WAS) with the JDBC Type 4 driver provided by 64-bit DB2 Runtime client. Because we were not relying on WAS to use the DB2 client to make cataloged connections, our configuration was (and is) supported. However, if you are using local catalogs on your WAS server, you need to install the 31-bit DB2 Runtime client. This support is available in DB2 Runtime client V8.1 FP10. You can download the 31-bit version of DB2 Runtime client from

http://www.ibm.com/software/data/db2/udb/support.html.

In order to test the connection, we first had to make a change in the location of the database. The backup configuration files for WebSphere still referenced the old DB2 database (trade3ph running on SLES8 31-bit).

From the admin console, we selected Resources -> JDBC Providers -> DB2 JDBC Provide (XA) -> Data Sources -> TradeDataSource -> Custom Properties -> selected serverName and changed the value to point to the new DB2 Connect Server - 192.168.71.114 (litdat10). Saved changes and synchronized with the cluster members.

We could now test the connection, from Resources -> JDBC Providers -> DB2 JDBC Provide (XA) -> Data Sources -> checked off TradeDataSource and selected the Test Connection button.



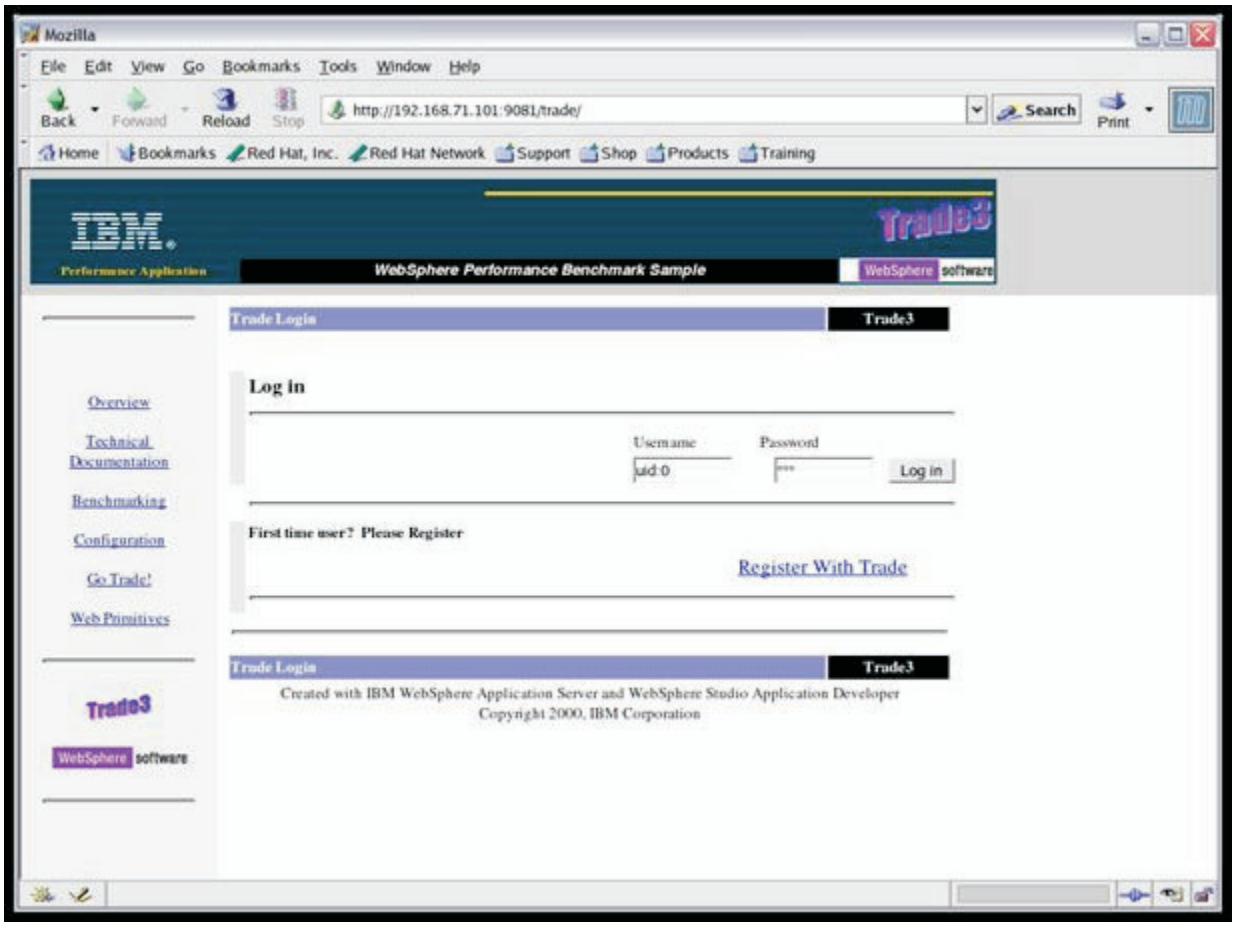
This confirmed that the DB2 Runtime Client was working on SLES 9 64-bit.

- Test the application

  We could now start the Trade3 cluster. From Servers -> Clusters -> we chose LITWAS_CLZ and selected Start.

  Now that the cluster was started, we could verify if the Trade3 Application worked. We tested access to the main Trade3 page without going through the web server. Simply access any one of three nodes at port 9081:

  http://litwas01.ltic.pok.ibm.com:9081/trade



We logged in with the default ID, and verified the account info. Then we issued a few trades to verify that it can commit transactions to DB2. At this point, we had now verified that our Trade3 application was operational in the WebSphere Cluster, and updates to the backend DB2 database could be established.

- **Put the new servers into production**

  We shut down the old servers and changed the new servers' IP addresses to the old ones and put them into production. That was all we had to do since we used the same hostname for the new servers as the old ones.

  The server that needs further changes when going into production is DB2 UDB ESE. We changed the IP address and hostname from *litdat10.ltic.pok.ibm.com* to *litdat01.ltic.pok.ibm.com*. A more important step is to modify the file referencing the original hostname that it was installed with in file */home/db2inst1/sqllib/db2nodes.cfg*.

  Edit the following from:

```
db2inst1@litdat01:~> cat /home/db2inst1/sqllib/db2nodes.cfg
0 litdat10 0
```

  to this:

```
db2inst1@litdat01:~> cat /home/db2inst1/sqllib/db2nodes.cfg
0 litdat01 0
```

  If not changed, you'll receive an error when starting DB2 such as this:

```
db2inst1@litdat01:~> db2start
SQL6048N  A communication error occurred during START or STOP DATABASE MANAGER processing.
```

Once we made sure they worked with all our other middleware components, we retired the old servers for good.

Tivoli Storage Manager

Introduction

The Tivoli Storage Manager (TSM) Version 5.2 was running on a 31 bit SLES8 system (littsm01). The objective was to migrate the TSM server machine to a 64 bit SLES9 platform and all the TSM client machines to their respective 64 bit SLES9 counterparts. See “SLES8 31-bit Migration to SLES9 64-bit“ for information on how the base OS was migrated. The first part of our discussion is on the migration of the TSM server. The second part covers the migration of the TSM clients. As part of the migration, the Administration Center was established on a Windows 2000 platform. Since the primary objective was to provide data backup for other systems in the network and not to provide new function, we decided to migrate to TSM 5.3 and SLES9 in a single step. This would also validate that the single move could be made.

Migrating the Tivoli Storage Manager Server

Overview: We used the TSM online help web pages to direct the migration. The help website is

`http://publib.boulder.ibm.com/infocenter/tivihelp/v1r1/index.jsp`

It contains a dynamic index and cross reference of all the TSM manuals. Of particular interest for the migration of the server was the Storage Manager for the Linux Server section. It contained the Installation Guide, Administrators Guide, and the Administrator’s Reference.

The migration procedure was the following:

1. Investigated the Existing System
2. Saved all the required information to tape and disk files
3. Installed the new OS system
4. Moved disk data volumes from the original system
5. Installed and configured the tape support
6. Downloaded the TSM installation packages
7. Installed the new version of TSM
8. Registered the product
9. Started the server for the first time
10. Defined an administrator to TSM
11. Renamed the server
12. Installed the Administration Center on a Windows machine
13. Added the tape drive to the server
14. Reloaded the database
15. Started the server again
16. Verified the resulting system.

Investigated the Existing System: The old TSM server system contained the following key pieces:

1. The TSM system had the base directory /opt/tivoli/tsm
2. The control files and executables were in /opt/tivoli/tsm/server/bin
3. The “database”, which is TSM’s collection of control files and configuration information and is called “the database”, consisted of 10 volumes which needed to be saved to tape for the migration. This was done using a utility called dsmserv dumpdb.
4. The additional disks used by TSM were listed in dsmserv.dsk

5. There was a system options file dsmserv.sys in the bin directory that needed to be saved
6. There was a 3583 Linear Tape Open (LTO) Ultrium tape library associated with the system for backup and archiving. The tapes special files were

```
IBMchanger0  IBMtape0     IBMtape1     IBMtape2     IBMtape3
IBMtape      IBMtape0n    IBMtape1n    IBMtape2n    IBMtape3n
```

   The IBMchanger0 was the tape library selection mechanism. The difference between IBMtape0 and IBMtape0n was whether you wanted the tape rewound when finished ("tape0" means "rewind"). The tape drives in rewind mode were defined to TSM.
7. The tapes were defined in TSM under the UTL1 library and were called DRIVE0, DRIVE1, DRIVE2, and DRIVE3
8. There were 6 disk pool volumes located at /opt/tivoli/tsm/diskpool and numbered 1-6. These volumes needed to be configured in the new system at the same location.
9. The new system, Tivoli Storage Manager Version 5.3, replaced the Administrator Console web interface, which used the HTTPPORT, with a new interface. The new interface is called the Administration Center and runs under the Integrated Solutions Console (ISC). Both are driven from a Windows machine.
10. The TSM administrator's id was ADMIN.

The basic directory: The contents of /opt/tivoli/tsm/server/bin:

```
/opt/tivoli/tsm/server/bin # ls
.                 db_v9.dsm        emcsymr3.lic    msexch.lic
..                devcnfg.out      en_US           mssql.lic
CommandLine.class devconfig.1      ess.lic         ndmp.lic
NODELOCK          devconfig.2      essr3.lic       ndmpspi
README            devconfig.file   ibmtsm.baroc    oracle.lic
README.LIC        domino.lic       ibmtsm.mac      r3.lic
WebConsole.class  dsmen_US.txt     ibmtsm.rls      spacemgr.lic
archive.dsm       dsmfmt           informix.lic    start
backup.dsm        dsmreg.sl        itsmdpex.baroc  tsmtrcfmt
db.dsm            dsmserv          itsmuniq.baroc  userExitSample.c
db_v2.dsm         dsmserv.dsk      library.lic     userExitSample.h
db_v3.dsm         dsmserv.err      libshare.lic    userExitSample.mak
db_v4.dsm         dsmserv.idl      lnotes.lic      volhist.out
db_v5.dsm         dsmserv.opt      log.dsm         volhistory.file
db_v6.dsm         dsmserv.opt.smp  log_v2.dsm      was.lic
db_v7.dsm         dsmsnmp          mgsyslan.lic
db_v8.dsm         emcsymm.lic      mgsyssan.lic
```

The Database: The database was constructed from the files: db.dsm, db_v2.dsm, ..., db_v9.dsm. These files were logically connected internally by TSM.

Added DASD for TSM: The additional disks used by TSM were listed in dsmserv.dsk:

```
#dsk_comment#page_shadow_token:1050805202625
/opt/tivoli/tsm/server/bin/log.dsm
/opt/tivoli/tsm/server/bin/db.dsm
/opt/tivoli/tsm/server/bin/db_v2.dsm
/opt/tivoli/tsm/server/bin/log_v2.dsm
/opt/tivoli/tsm/server/bin/db_v3.dsm
/opt/tivoli/tsm/server/bin/db_v4.dsm
/opt/tivoli/tsm/server/bin/db_v5.dsm
/opt/tivoli/tsm/server/bin/db_v6.dsm
/opt/tivoli/tsm/server/bin/db_v7.dsm
/opt/tivoli/tsm/server/bin/db_v8.dsm
/opt/tivoli/tsm/server/bin/db_v9.dsm
```

The Options File: The options file, /opt/tivoli/tsm/server/bin/dsmserv.opt, contained the following:

```
*** IBM TSM Server options file
*** Refer to dsmserv.opt.smp for other options
COMMMETHOD TCPIP
TCPPORT 1500

COMMMETHOD HTTP
HTTPPORT 1580

DEVCONFIG devcnfg.out
VOLUMEH volhist.out
```

The Storage Pools: The list of disk volumes used as a storage pool could be found by issuing the following command from the TSM server console command line:

```
TSM:SERVER2> q volume
ANR2017I Administrator SERVER_CONSOLE issued command: QUERY VOLUME

Volume Name              Storage      Device      Estimated    Pct   Volume
                         Pool Name    Class Name   Capacity   Util   Status
-----------------------  -----------  ----------  ---------  -----  --------
/opt/tivoli/tsm/diskpoo-  BACKUPPOOL   DISK          2,300.0   28.6  On-Line
 l/1/pool1
/opt/tivoli/tsm/diskpoo-  BACKUPPOOL   DISK          2,300.0   10.4  On-Line
 l/2/pool2
/opt/tivoli/tsm/diskpoo-  BACKUPPOOL   DISK          2,300.0    9.8  On-Line
 l/3/pool3
/opt/tivoli/tsm/diskpoo-  BACKUPPOOL   DISK          2,300.0    9.8  On-Line
 l/4/pool4
/opt/tivoli/tsm/diskpoo-  BACKUPPOOL   DISK          2,300.0   29.6  On-Line
 l/5/pool5
/opt/tivoli/tsm/diskpoo-  BACKUPPOOL   DISK          2,300.0    7.4  On-Line
 l/6/pool6
/opt/tivoli/tsm/server/-  ARCHIVEPOOL  DISK              5.0    0.1  On-Line
 bin/archive.dsm
/opt/tivoli/tsm/server/-  BACKUPPOOL   DISK             10.0   97.9  On-Line
 bin/backup.dsm
TSM:SERVER2>
```

Saved the Current System

In order to accomplish the migration, we ported some of the original disks to the new system and configured them into the same location as on the old system. The database itself needed to be dumped to tape and later restored to the new system.

In order to dump the database we began by following the instructions in the installation guide and quickly found it was a little more involved than it first appeared. The installation guide recommendation was to use the command:

```
dsmserv  dumpdb  devclass=xxx
```

where xxx is a MANUAL device class, to dump the database to tape.

We brought up the old TSM Server, logged on to the Administrator's Console on a Windows 2000 machine, and found that we did not have a MANUAL device class defined to TSM. We had to define a new device class.

Defined a MANUAL tape device class for the dump: To accomplish this requirement we did the following:

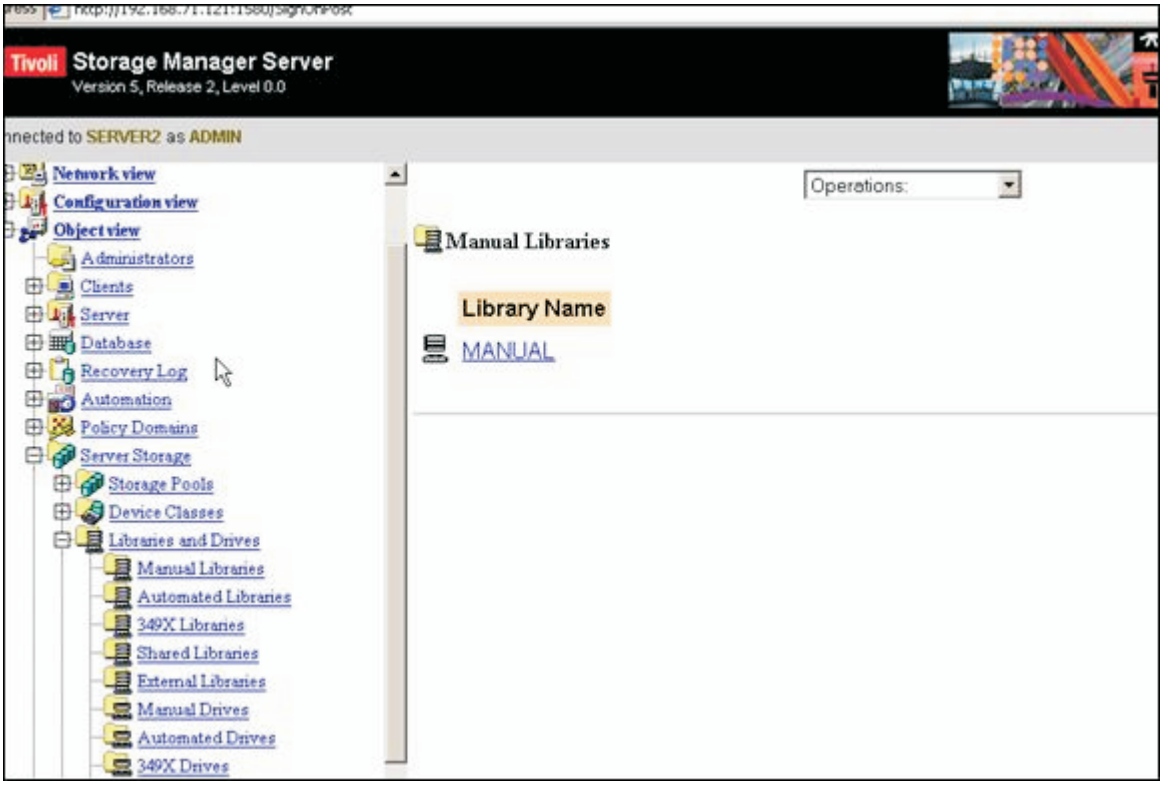
1. Went to the Windows 2000 machine which acted as the Administration Console and logged in as ADMIN. The Administrators console for the old system was at

   `http:/192.168.71.121:1580`

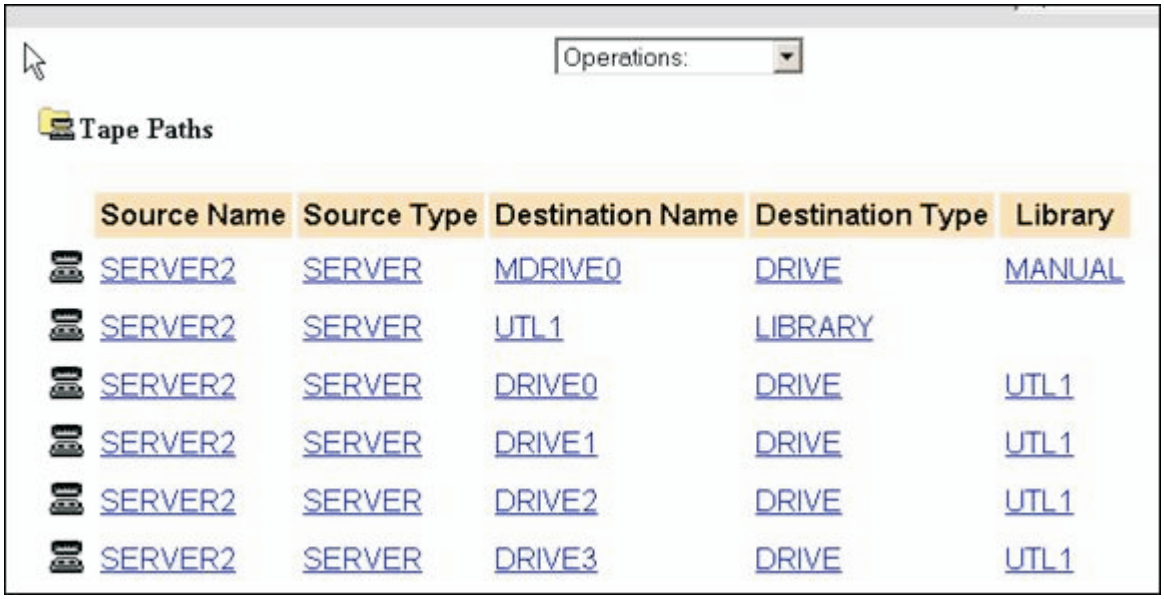
2. Clicked on

   ```
   Object view -> Manual Libraries -> operations -> create
   ```

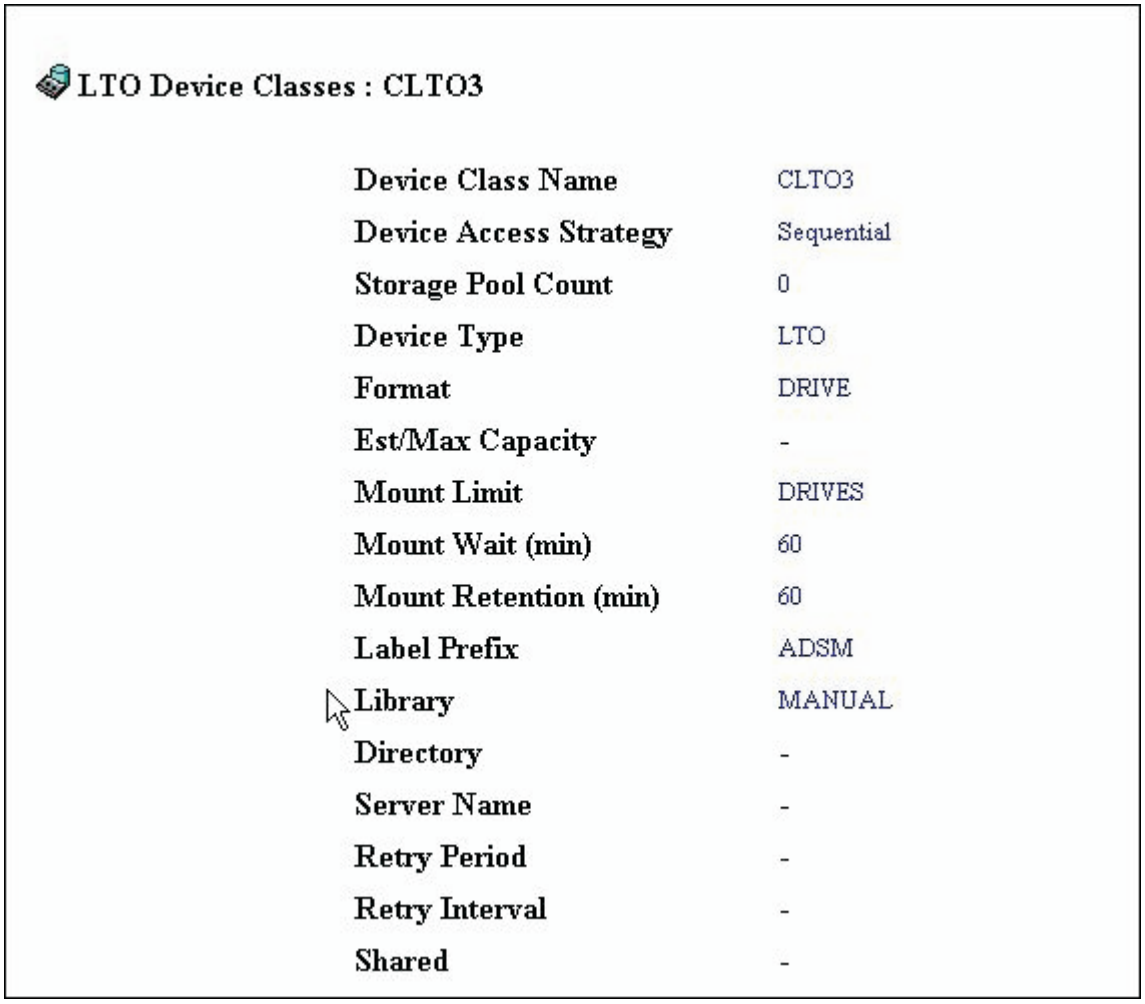
   and filled in the required fields, ending up with the library MANUAL



3. Created a device for the library called MDRIVE0 which matched DRIVE0 (already defined) and anchored at /dev/IBMtape0.
4. Defined a PATH to map the drive name to the physical device:



5. Defined a new device class for the tape: CLTO3.



Dumped the TSM Database:

1. We brought the TSM server down by issuing a HALT QUIESE command from the server console.

```
TSM:SERVER2>
Halt q
  . . . . . .
ANR7822I Thread 42 terminated in response to server shutdown.
ANR7822I Thread 43 terminated in response to server shutdown.
ANR7822I Thread 44 terminated in response to server shutdown.
ANR7822I Thread 45 terminated in response to server shutdown.
ANR7822I Thread 46 terminated in response to server shutdown.
ANR7822I Thread 47 terminated in response to server shutdown.
ANR7822I Thread 49 terminated in response to server shutdown.
ANR0991I Server shutdown complete.
littsm01:/opt/tivoli/tsm/server/bin #
```

2. We then dumped the TSM database.

```
/opt/tivoli/tsm/server/bin #
 ./dsmserv dumpdb devclass=clto3 scratch=yes

Version 5, Release 2, Level 0.0

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. . . . . .
ANR7800I DSMSERV generated at 10:36:22 on Jun 13 2003.
ANR4031I DUMPDB: Copied 138023 database pages.
ANR4033I DUMPDB: Copied 116 bit vectors.
ANR4034I DUMPDB: Encountered 0 bad database pages.
ANR4036I DUMPDB: Copied 5453768 database entries.
ANR4037I DUMPDB: 391 Megabytes   copied.
ANR4001I DUMPDB: Database dump process completed.
littsm01:/opt/tivoli/tsm/server/bin #
```

Saved Other Key Files:

1. Captured the devcnfg.out and volhist.out files.

```
TSM:SERVER2>
backup devconfig
ANR2017I Administrator SERVER_CONSOLE issued command: BACKUP DEVCONFIG
ANR2394I BACKUP DEVCONFIG: Server device configuration information was written
to all device configuration files.
TSM:SERVER2>
backup volhist
ANR2017I Administrator SERVER_CONSOLE issued command: BACKUP VOLHISTORY
ANR2463I BACKUP VOLHISTORY: Server sequential volume history information was
written to all configured history files.
TSM:SERVER2>
```

2. Saved the key files to another system for later use.

```
littsm01:/opt/tivoli/tsm/server/bin #
scp devcnfg.out root@192.168.71.108:/root/tsmhold/.
root@192.168.71.108's password:
devcnfg.out      100% |**********************|  1676       00:00
littsm01:/opt/tivoli/tsm/server/bin #
scp volhist.out root@192.168.71.108:/root/tsmhold/.
root@192.168.71.108's password:
volhist.out      100% |**********************|  1134       00:00
littsm01:/opt/tivoli/tsm/server/bin #
scp dsmserv.opt root@192.168.71.108:/root/tsmhold/.
root@192.168.71.108's password:
dsmserv.opt      100% |**********************|   158       00:00
littsm01:/opt/tivoli/tsm/server/bin #
```

```
scp dsmserv.dsk root@192.168.71.108:/root/tsmhold/.
root@192.168.71.108's password:
dsmserv.dsk      100% |**********************|   486       00:00
littsm01:/opt/tivoli/tsm/server/bin #
```

We were ready to start the migration.

Installed the OS on the New Hardware

The new 64bit SuSE Linux Enterprise Server 9 system which would become the TSM server was built as described in the “SLES8 31-bit Migration to SLES9 64-bit” section of this document. It has the same name and IP address as the original.

Moved some of the Original DASD

In addition to the construction of the new system, some of the disks from the original system were moved to the new system and placed at the same mount points as the original. This included the diskpool volume set.

The moved disks included:

```
/opt/tivoli/tsm/diskpool/1/pool1
/opt/tivoli/tsm/diskpool/2/pool2
/opt/tivoli/tsm/diskpool/3/pool3
/opt/tivoli/tsm/diskpool/4/pool4
/opt/tivoli/tsm/diskpool/5/pool5
/opt/tivoli/tsm/diskpool/6/pool6
```

And /etc/fstab was updated to include the new disks:

```
/dev/dasdb1     /                    reiserfs   acl,user_xattr        1 1
/dev/dasda1     swap                 swap       pri=42                0 0
devpts          /dev/pts             devpts     mode=0620,gid=5       0 0
proc            /proc                proc       defaults              0 0
sysfs           /sys                 sysfs      noauto                0 0
/dev/dasdc1     /opt                 reiserfs   defaults              1 2
/dev/dasdd1     /opt/tivoli/tsm/diskpool/1 reiserfs  defaults         1 3
/dev/dasde1     /opt/tivoli/tsm/diskpool/2 reiserfs  defaults         1 3
/dev/dasdf1     /opt/tivoli/tsm/diskpool/3 reiserfs  defaults         1 3
/dev/dasdg1     /opt/tivoli/tsm/diskpool/4 reiserfs  defaults         1 3
/dev/dasdh1     /opt/tivoli/tsm/diskpool/5 reiserfs  defaults         1 3
/dev/dasdi1     /opt/tivoli/tsm/diskpool/6 reiserfs  defaults         1 3
```

Installed the new tape support

In reviewing the requirements for the new system, we identified that for our IBM 3580 tape library, we had to install the latest version of the device driver for Linux on zSeries before we install TSM. We found the following support Web site to be helpful:

```
http://www.ibm.com/support/docview.wss?rs=543&context=STCVQ6R&dc=
D430&uid=ssg1S4000358&loc=en_US&cs=utf-8&lang=en
```

From there, we downloaded:

- The Installation and Users Guide
- Device driver Programming Reference
- Platform independent README
- zSeries README
- IBMtape for zSeries 64 bit
- Tapeutil for zSeries 64bit

Installed the IBMTape Support Package

We copied the IBMtape rpm to a /root/downloads/3580tape directory on littsm01. Then, from the root userid we initiated the rpm:

```
# rpm -i IBMtape-2.0.6-2.6.5-7.151.s390x.rpm
The kernel level is 2.6.5-7.97-s390x on your system
The current level of IBMtape supports Kernel 2.6.5-7.151-s390x only.
Exiting the installation.
error: %pre(IBMtape-2.0.6-0) scriptlet failed, exit status 100
error:   install: %pre scriptlet failed (2), skipping IBMtape-2.0.6-0
```

THE INSTALLATION FAILED.

The kernel was at the wrong level for the installation. We had installed the GA version of the system but it was not enough. After some investigation we found that the tape driver was built on a post-GA version of the system and we needed to install some patches before we could install the driver. We had to install SP1 on littsm01 to bring the kernel to the 151 level. That installation is not covered in this description.

After the kernel was upgraded to the 151 level we tried the install again.

```
littsm01:~/downloads/3580Tape # rpm -U IBMtape-2.0.6-2.6.5-7.151.s390x.rpm
Installing IBMtape
IBMtape loaded
littsm01:~/downloads/3580Tape #
```

This time the installation worked. We now had to reboot the system to include the changes.

Installed the Utilities Package

We untared the IBMtapeutil file to /root/downloads/3580tape and followed the README to successfully install the utilities, and then configured the tapes using IBMtapeconfig.

Installed the Server Package

We followed the README installation instructions and successfully installed the TSM server code.

Registered the Product

We successfully we registered the product by following the README instructions.

Started and stopped the TSM Server

Starting the TSM server involves logging on the server system as root and moving to the server's basic directory. Because this became a regular operation we created a little script to get us to this point.

```
runtsm
# added for running tsm
# switch to tsm working directory
cd /opt/tivoli/tsm/server/bin
```

We modified the .bashrc file to include the directory as part of the PATH statement.

```
.bashrc
  # added for running TSM
  export PATH=$PATH:/opt/tivoli/tsm/server/bin:.
```

The .bashrc script is run automatically as part of the logon process. To switch to the TSM directory you issue the command

```
 runtsm
```

We started the server by running the following sequence:

```
runtsm
dsmserv
```

The only indication that the TSM server is up and running is to see that the dsmserv process is active. To test if TSM is running:

```
ps –ef  | grep  dsmserv
```

And see if you get a hit.

So we made a script tsmup to do that for the root user.

From root's home directory we could now check if TSM is active by running:

```
littsm01:~ # tsmup
root     10910 10834  0 Aug22 pts/2    00:00:21 dsmserv
root     15569 15567  0 01:59 pts/3    00:00:00 grep dsmserv
littsm01:~ #
```

To stop the TSM server, from the server console, issue:

```
halt   - to stop the server immediately
halt quiese - to stop all new activity and end after existing activity has quiesed
```

The second form should be used before any dumping of the database.

Defined an Administrator to the TSM Server

We needed an administrator to TSM with full authority so that we could continue with the configuration. To do this we started the TSM server and attempted to register an administrator and give it system authority. We needed to use the same administrator that was defined in the old system and give it the same password. We found out, as seen below, that the ADMIN user ID was already defined to TSM and had system authority, but we reset the password.

This user ID and password were critical because they were needed for the restore of the TSM database.

Renamed the Server

After reviewing the material above, we realized we had allowed the server to have the incorrect name. The original server name was SERVER2 and our system was defined as SERVER1. To avoid any problems with the restore of the database, we renamed the new system SERVER2 by issuing the following TSM command from the server console:

```
set servername SERVER2
```

We brought the TSM server down and restarted it to make the changes effective.

See the section "Started and stop the TSM Server" for how to stop and start the server.

Installed the Administration Center for TSM

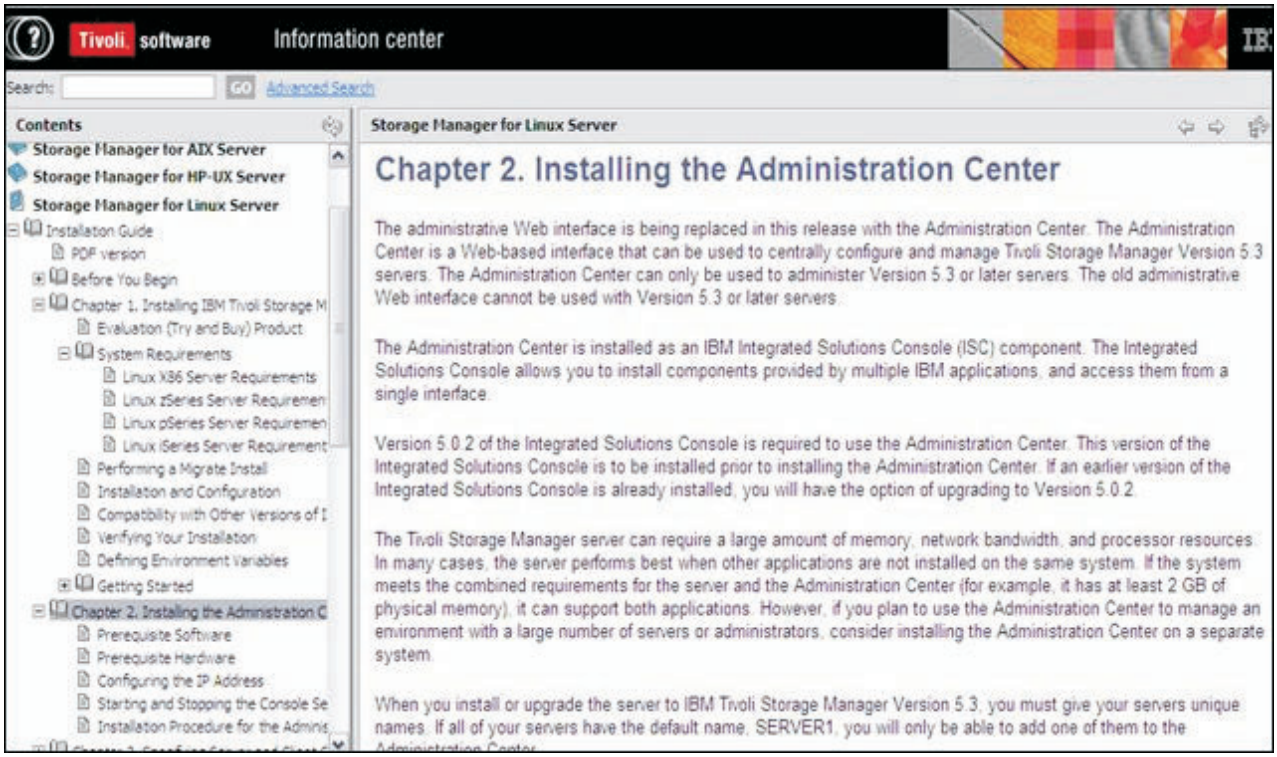
The Administration Center replaced the Administrator Console from previous versions of TSM. It runs on various platforms, but does not run on Linux on zSeries, so we needed to install it on a Windows machine and communicate with the TSM Server via the web. The Administration Center is based on the Integrated Solutions Console (ISC) web interface and requires that package be installed and configured prior to installing the Administration Center. We installed the Administration Center at this time so we could configure the server enough to allow the restore of the database. The server can also be configured using the server console interface. We used the Administration Center because, once set up, the center is easier to use

than the console for this work and it must be set up in any case. Our immediate need was to define the MANUAL tape drive to the new system so that we could do the restore.

From the TSM InfoCenter at:

`http://publib.boulder.ibm.com/infocenter/tivihelp/index.jsp`

Under Storage Manager for Linux Server manual we found the directions on the installation of the Administration Center as Chapter 2.



In this chapter they discussed the required level of Operating Systems, hardware, and software requirements for the Administration Center. We will not go into any detail on this except to identify that the DNS for the system must be able to resolve the network name and IP address of the TSM server, and the Administration Center must have a fully qualified host name for itself.

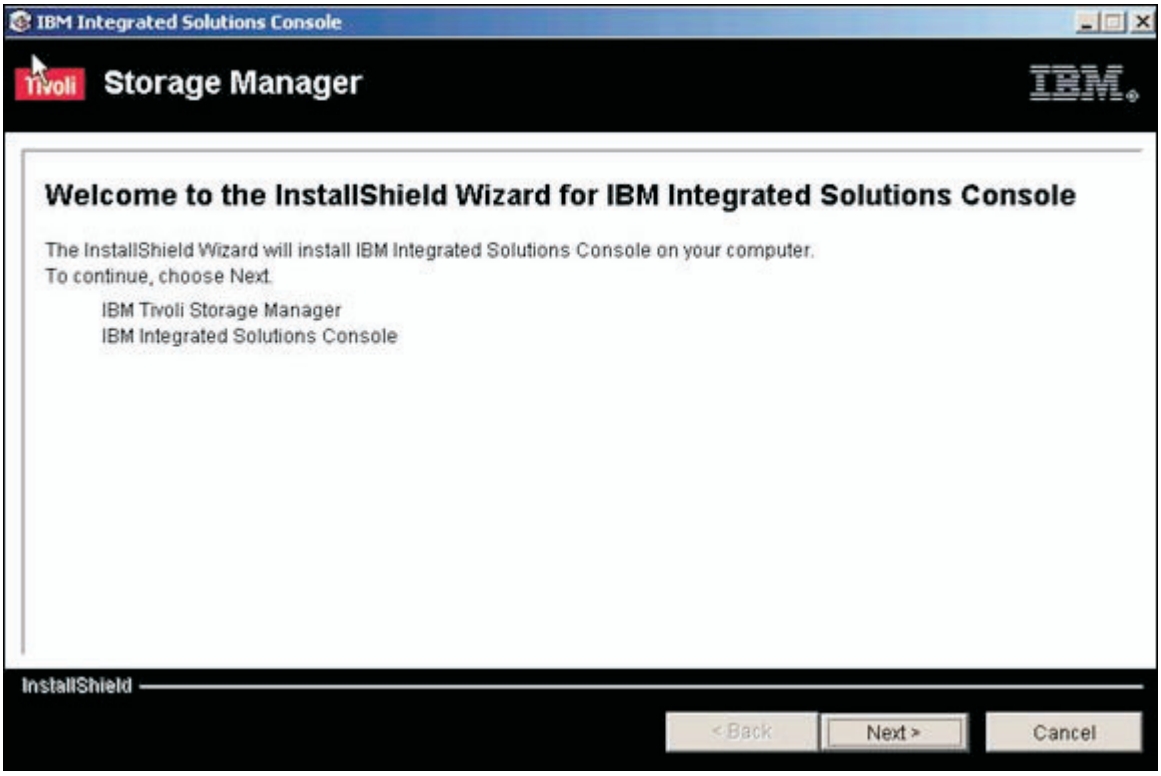
We checked out the Windows system we planned to use for the Administration Center. It was the same machine we used for the Administrators Console on the old version of TSM.

- Gig of RAM
- 800 Mhz Pentium 4 or greater
- 3 Gig of disk space minimum
- Fully qualified host name for the Administration Center (litadmin.ltic.pok.ibm.com)

The directions on how to configure the IP of the Administration Center were included in the Administration Center installation manual.

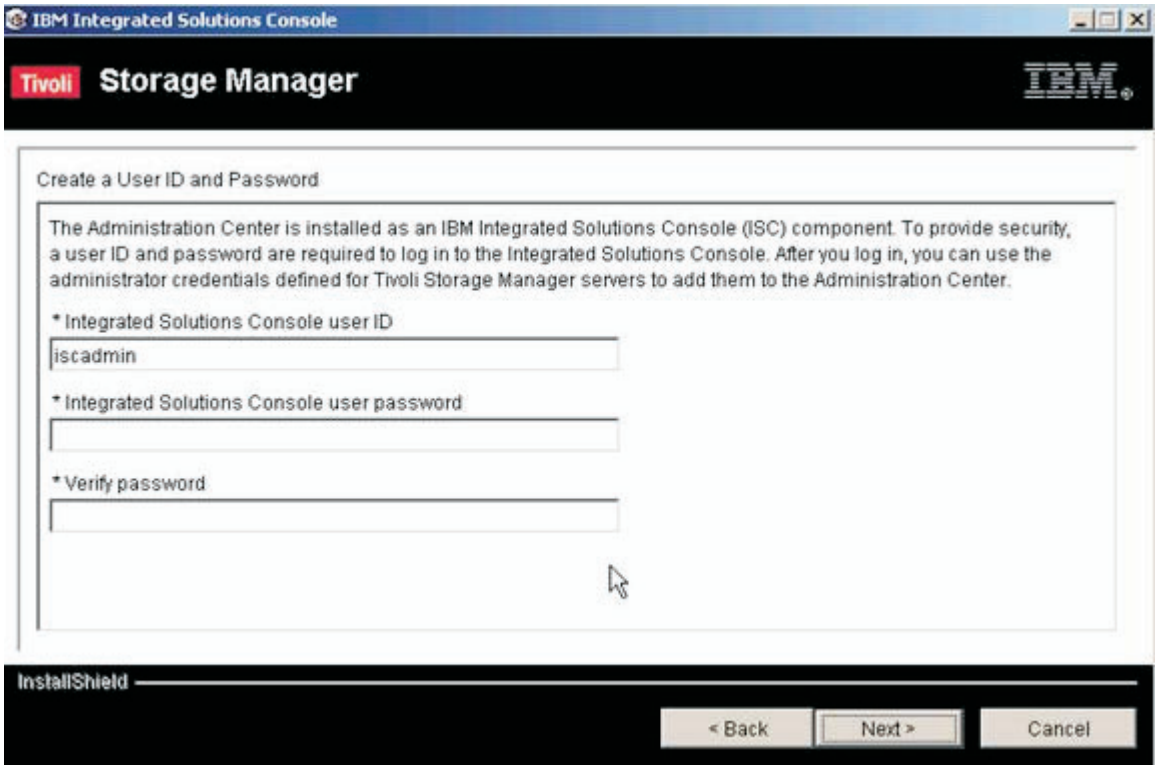
Installed the ISC First:

1. The directions from the TSM InfoCenter said the ISC must be installed first. From the TSM\AdminCtr\ISC\win directory, we executed C8241ML.exe to unzip it, then executed the resulting setup.ISC.exe



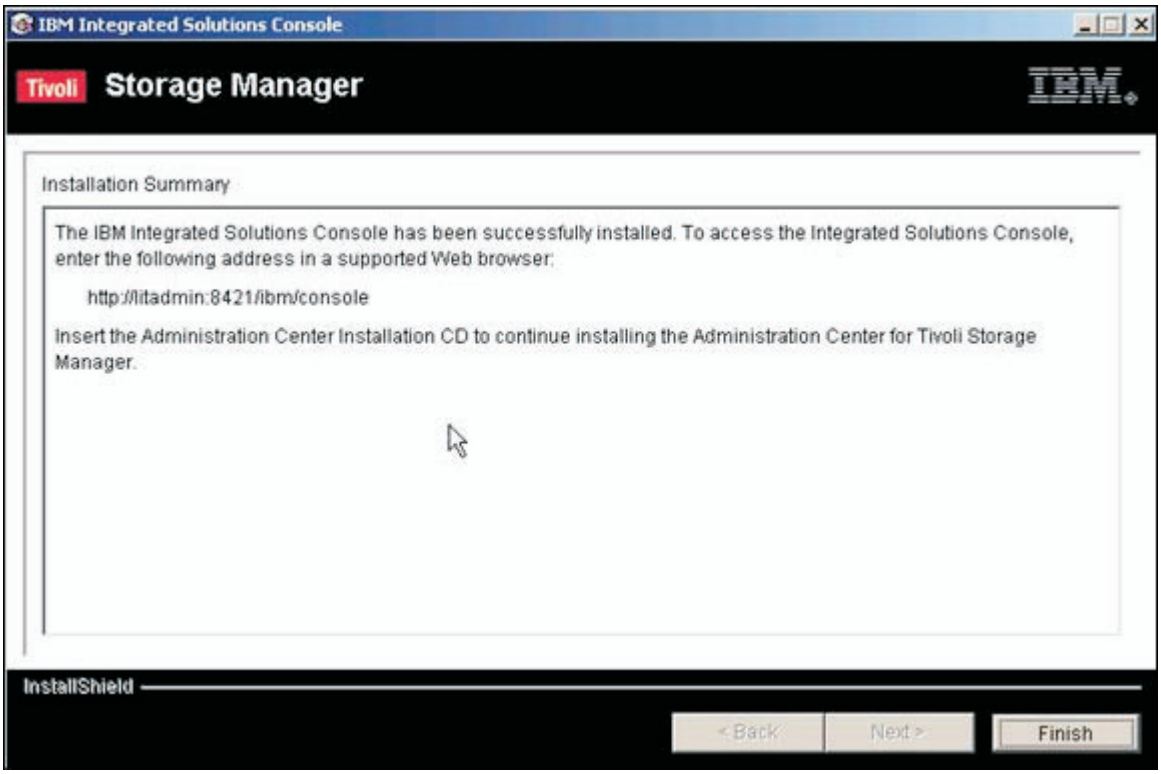
This stepped us through the installation steps with explanations of why each step was being performed.

2. An unexpected step was that it asked for a user ID and password for the Integrated Solutions Console itself (not the TSM Server or the Administration Center).



3. The installation process suggested the name iscadmin for this new user. We provided a password.

   Note: This is not the TSM administrator's user ID that we defined earlier.
4. Eventually we got the Installation Summary display:

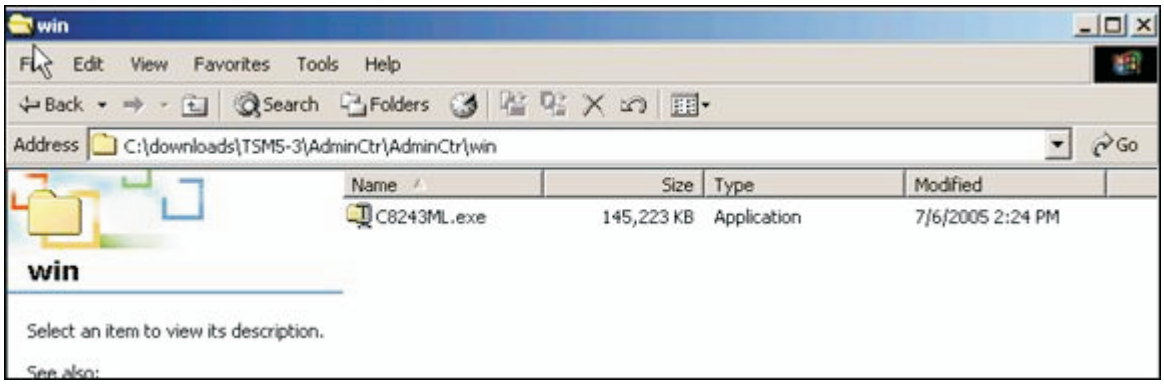


5. This completed the installation of the ISC. We now needed to install the Administration Center.

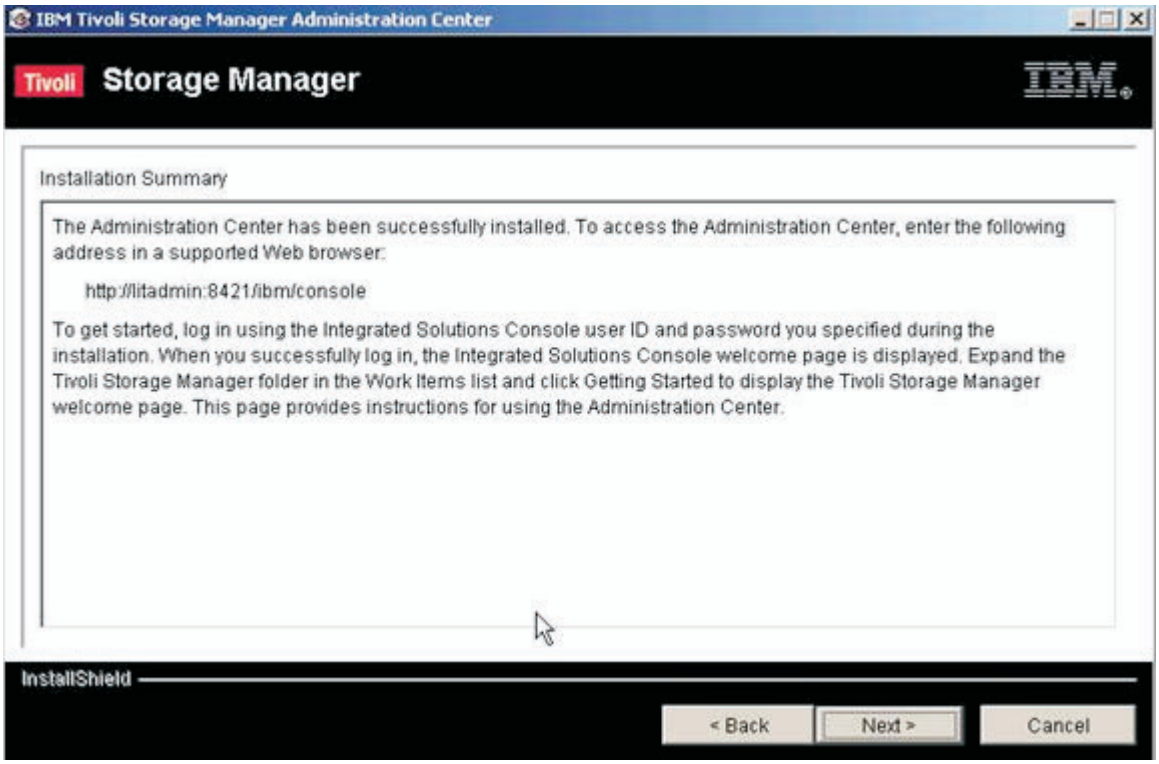
Installed the Administration Center:

1. We went to the directory:

   `C:\downloads\TSM5-3\AdminCtr\Admin\Ctr\win`

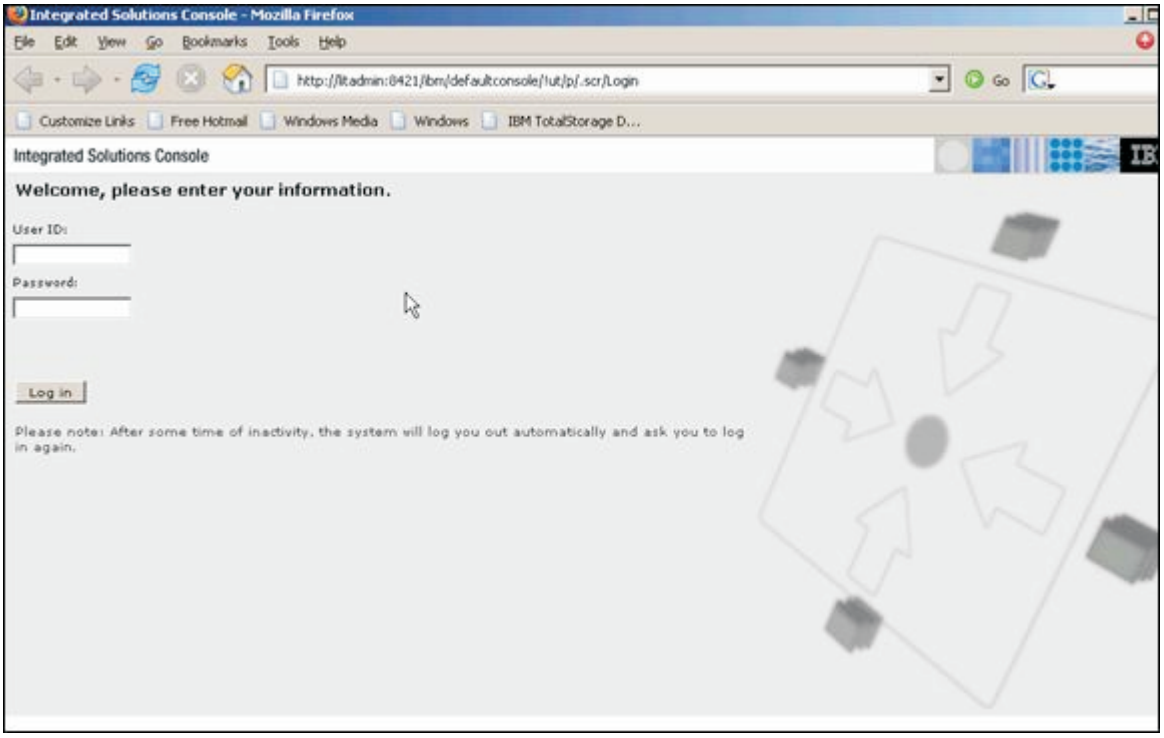


2. We clicked on C8243ML.exe to unzip it, then ran setupAC.exe to perform the install. It completed successfully:

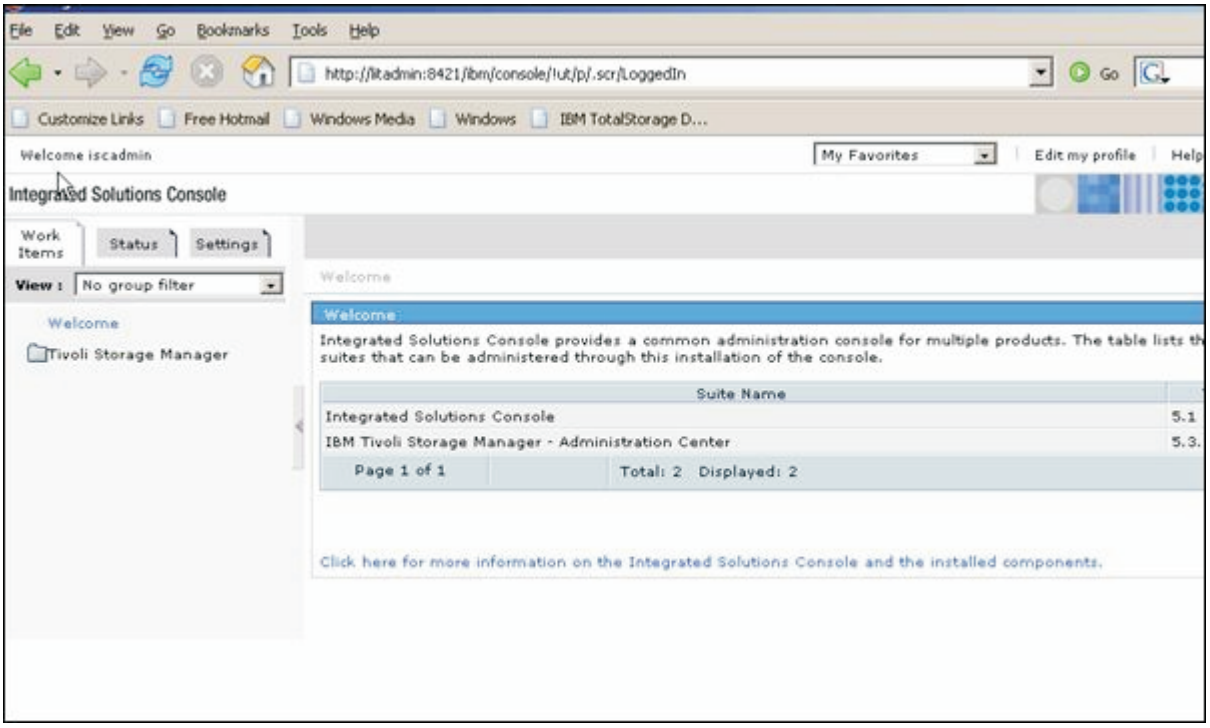


3. Note that the message says that to use the Administration Center you need to go to web address

   `http://litadmin:8421/ibm/console`



4. We entered the user ID and the password defined during the installation of the ISC. (user ID of: iscadmin)



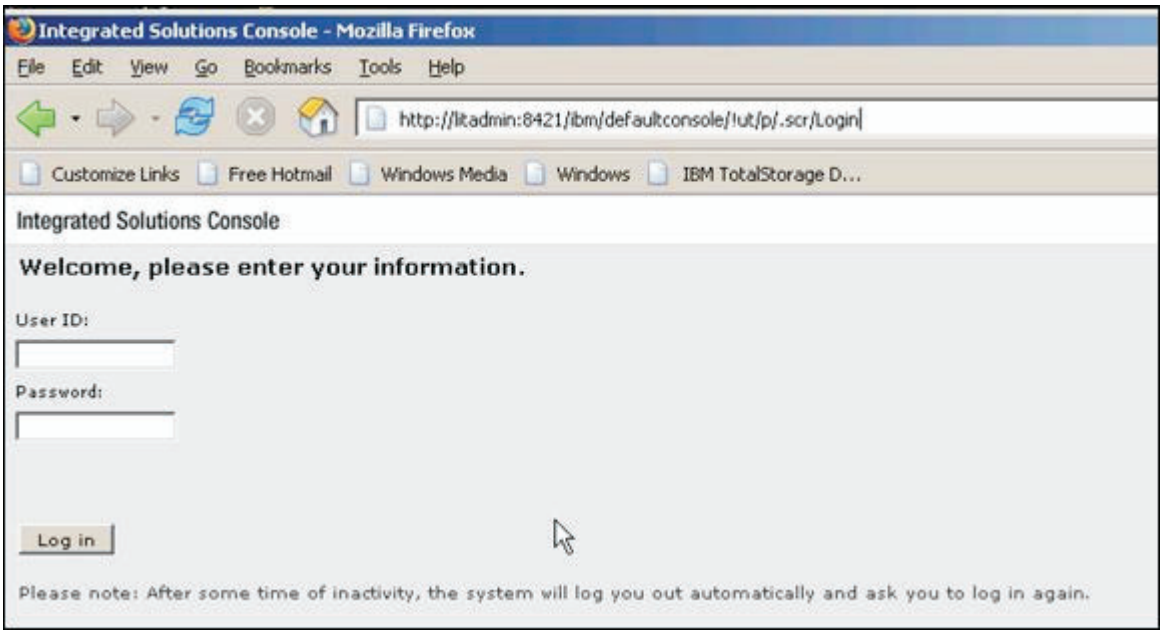
5. We defined a new administrative user to the TSM server thinking we would need it later.
   a. We defined a user to TSM by first registering the user name and giving it a password from the TSM Server console on littsm01:

```
YSM:SERVER2>
register admin  tsmadmin  *******
```

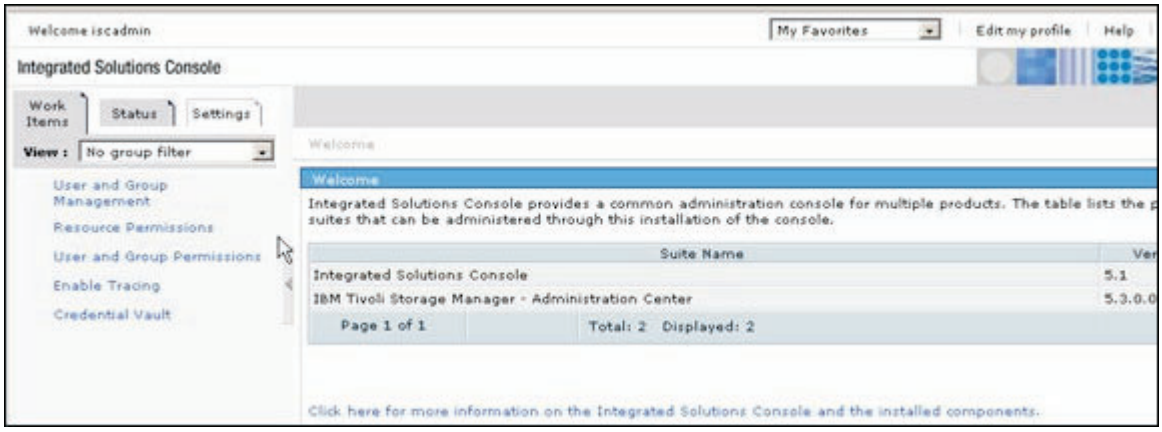
   b. We then gave that user an authorization level by GRANT AUTHORITY

```
 TSM:SERVER2>
grant auth tsmadmin classes=sys
ANR2017I Administrator SERVER_CONSOLE issued command: GRANT
AUTHORITY tsmadmin
classes=sys
ANR2076I System privilege granted to administrator TSMADMIN.
 TSM:SERVER2>
```

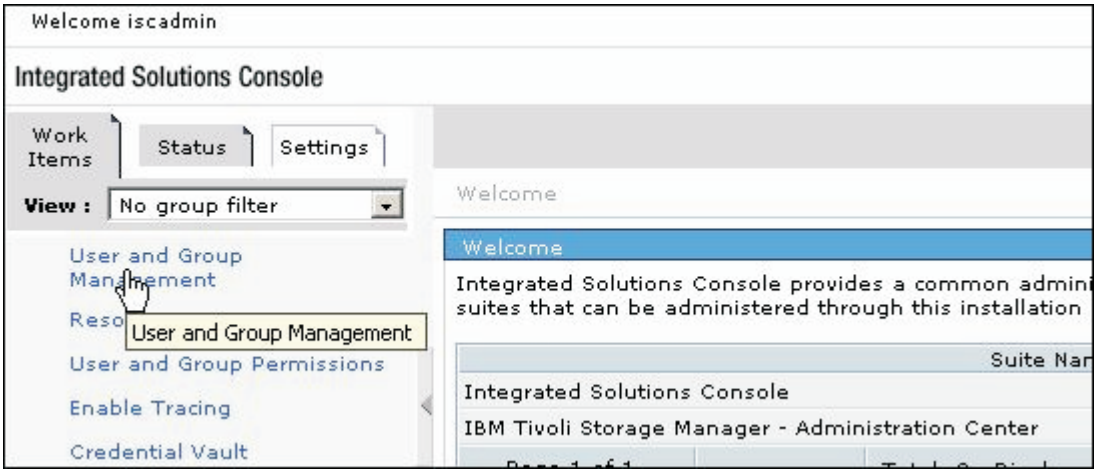
6. We defined that user to the Administration Center.
   a. We logged on the Administration Center as iscadmin.



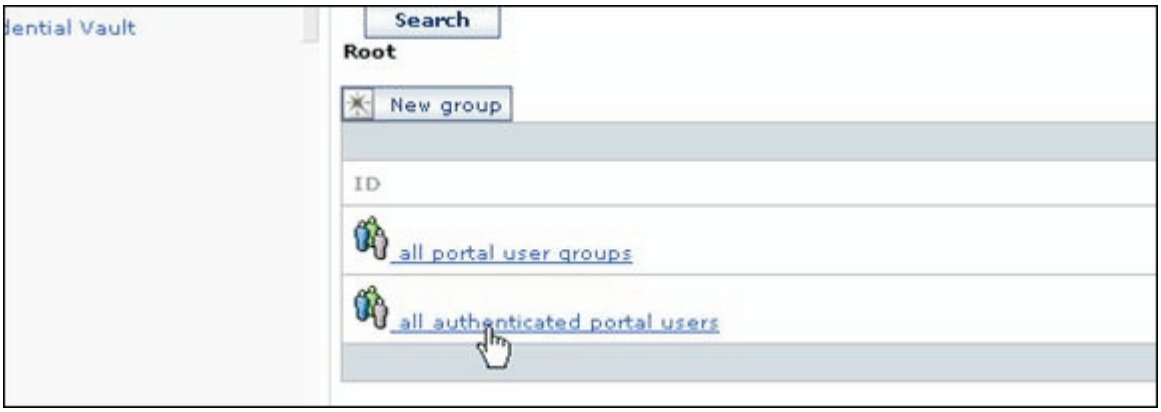
b. Clicked on Settings

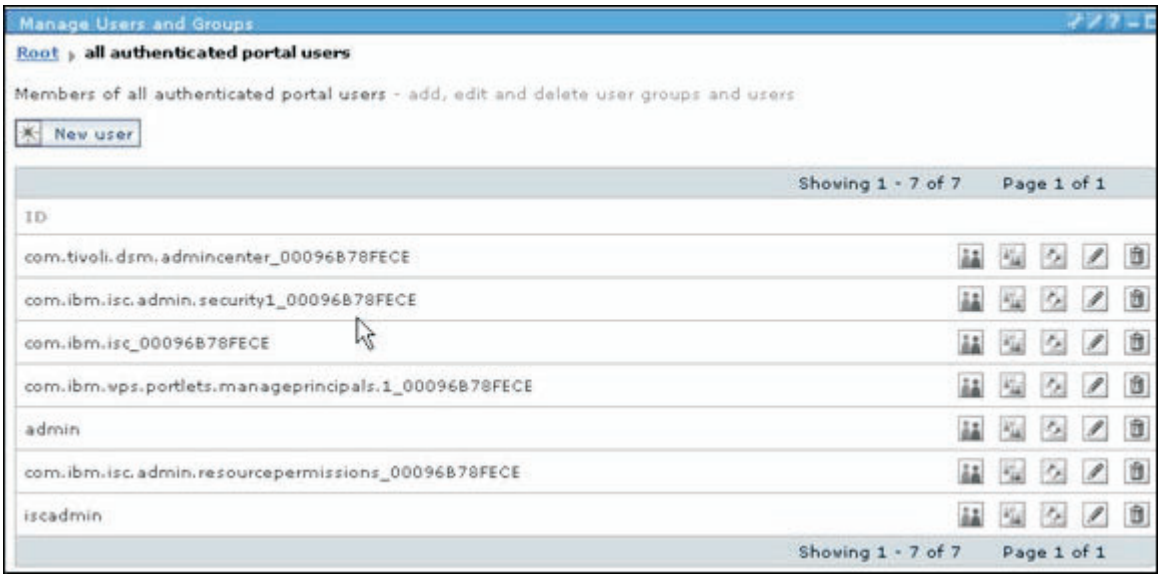


c. Clicked on User and Group Management

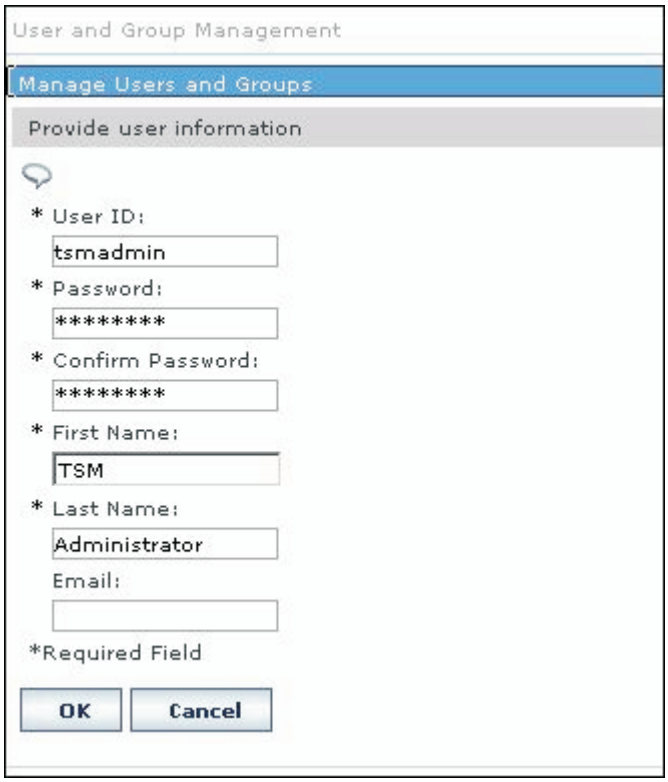


d. Clicked on all authenticated portal users

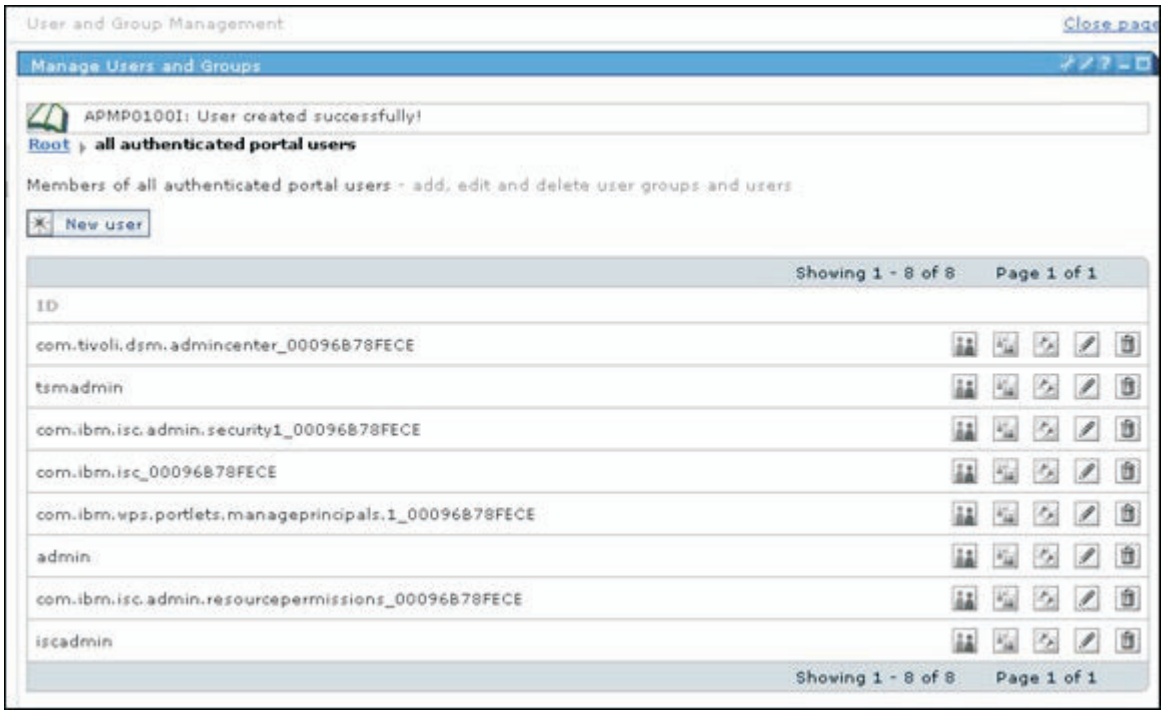




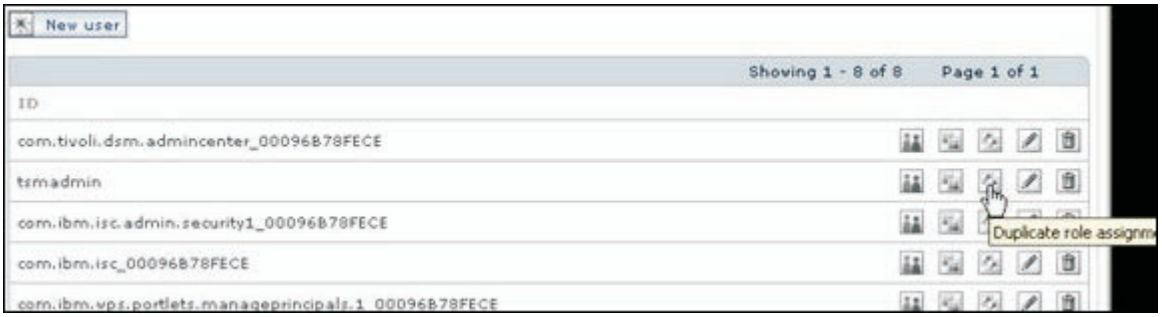
e. Clicked on New user



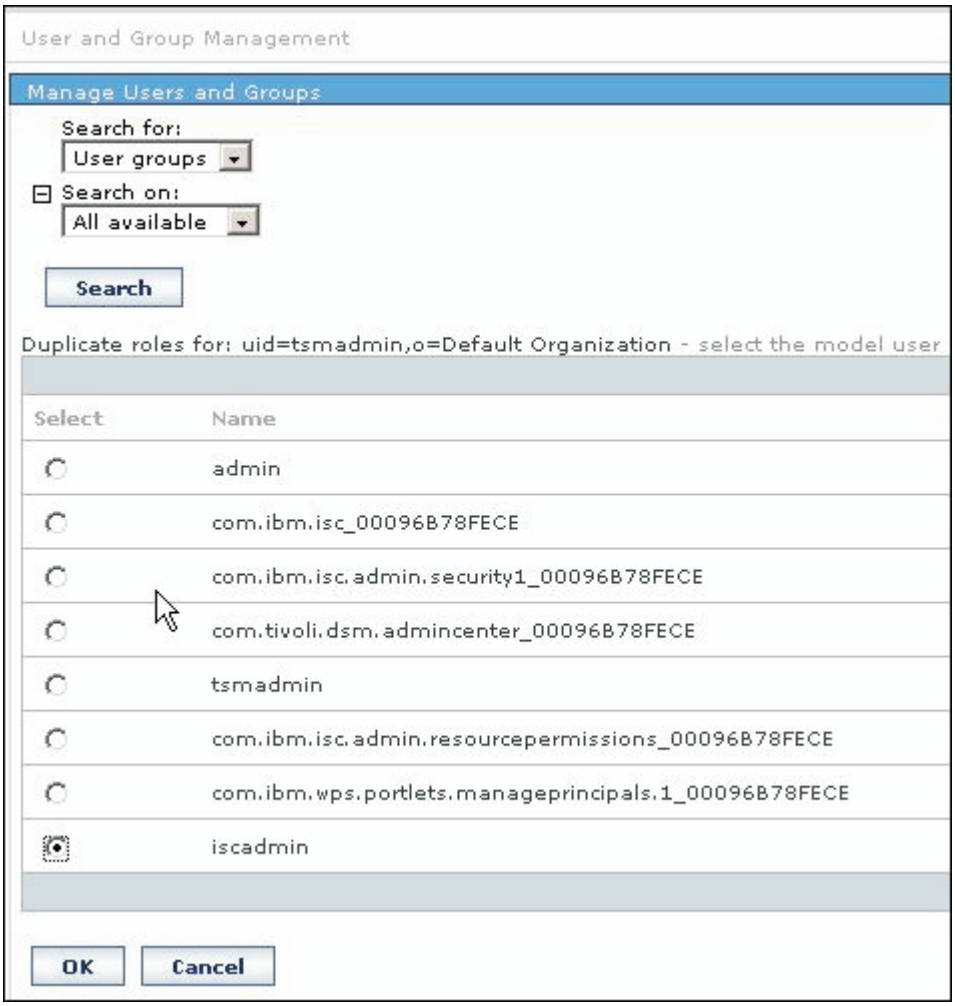
f. Entered the user ID and password: tmsadmin pw: ********
g. Gave the user a name TSM Administrator
h. Pressed OK



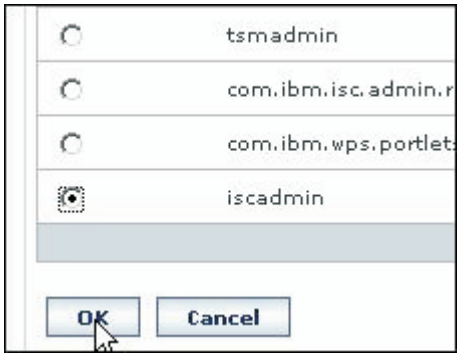
7. We then gave tsmadmin the same type of role that was given to the iscadmin.
   a. Clicked on the third icon --- duplicate role assignment



   b. A list of current user IDs was displayed where we selected the appropriate role model: iscadmin by clicking on its name



c. Note that we picked the existing user that has the role we wanted to duplicate.
d. Pressed OK at the bottom.

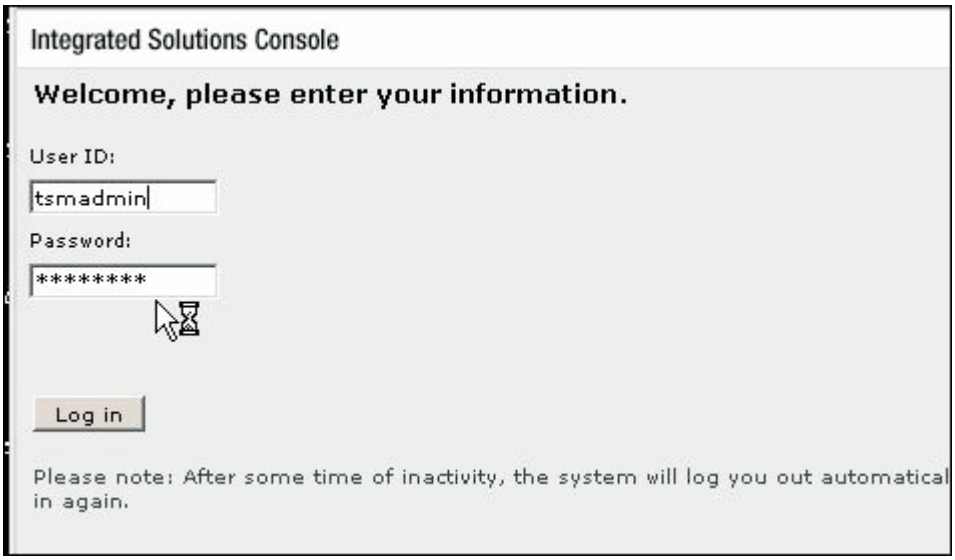


8. We exited the Administration Center by pressing Log out

Defined the TSM Server to the Administration Center: At this point we had the Administration Center up and running but it did not know the TSM server. The Administration Center can actually monitor multiple servers at the same time.

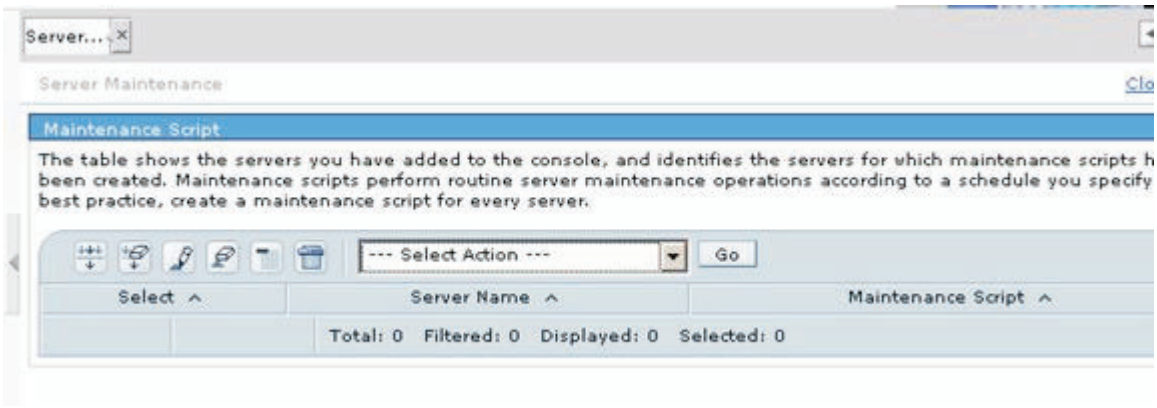
We only needed to define it to work with one server.

1. Logged on the Administration Center as tsmadmin

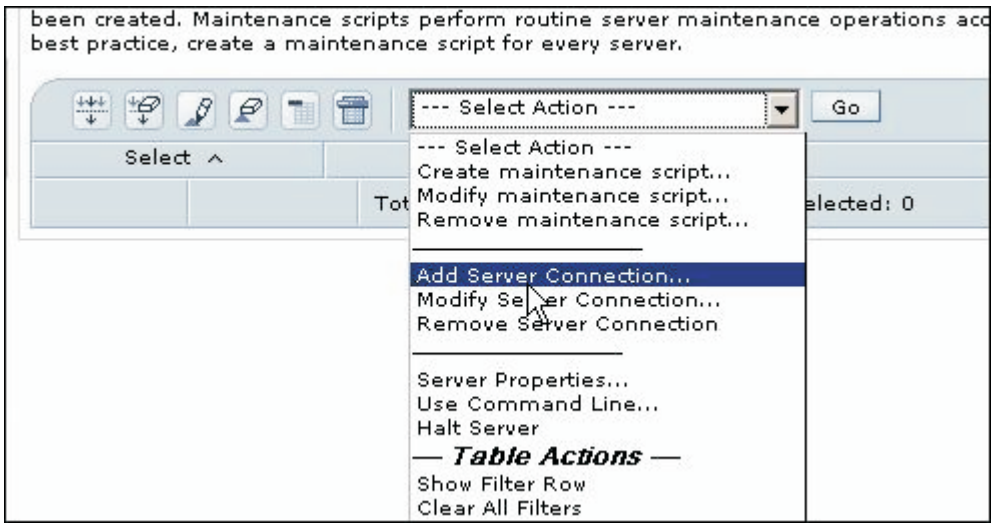


2. Clicked on Tivoli Storage Manager
3. And then clicked on Server Maintenance

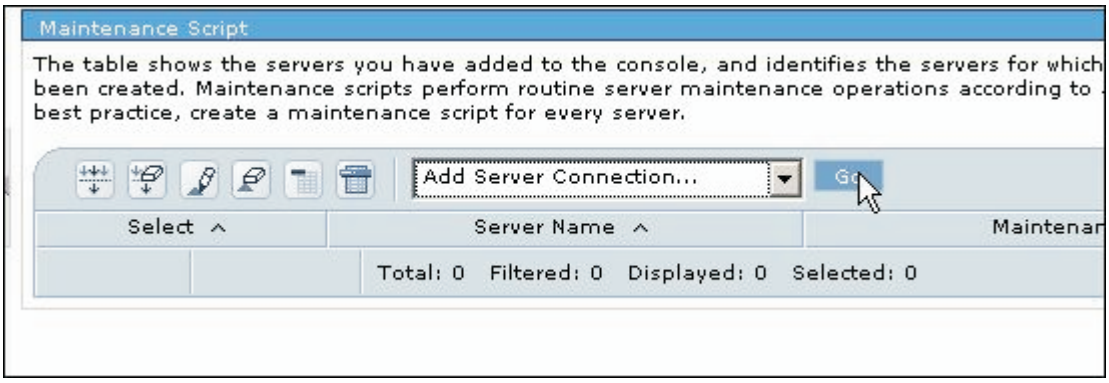
4. We clicked on the menu selection (downward arrow)

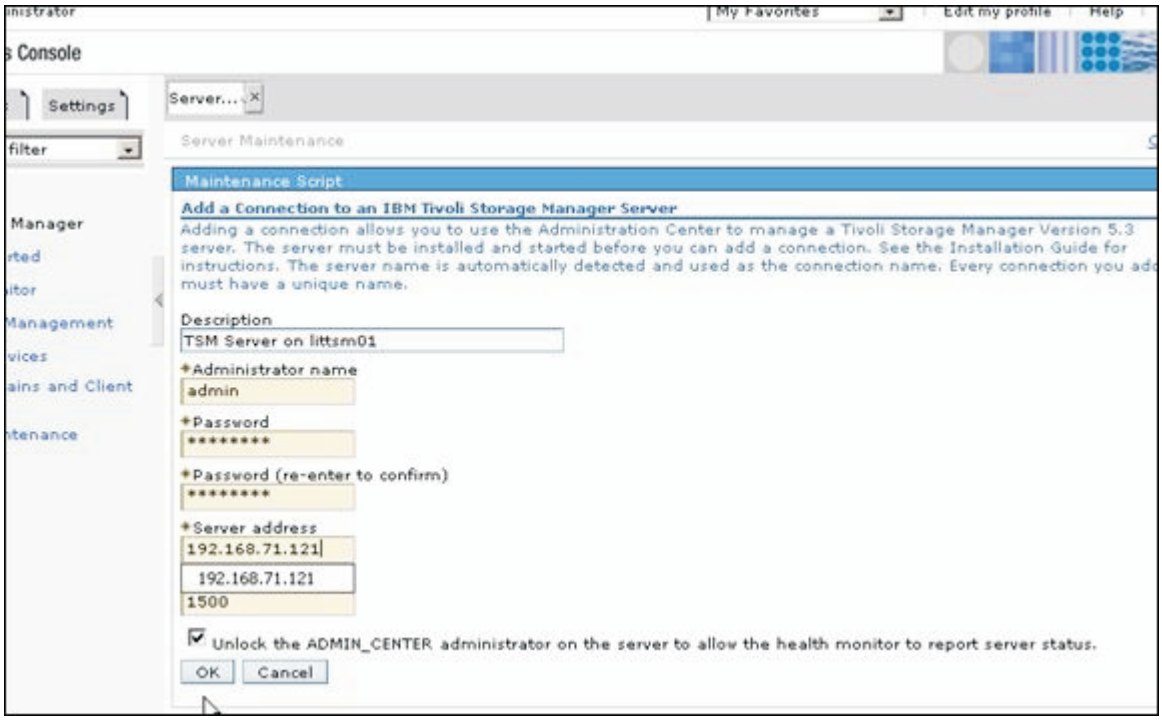


5. Selected “Add Server Connection”

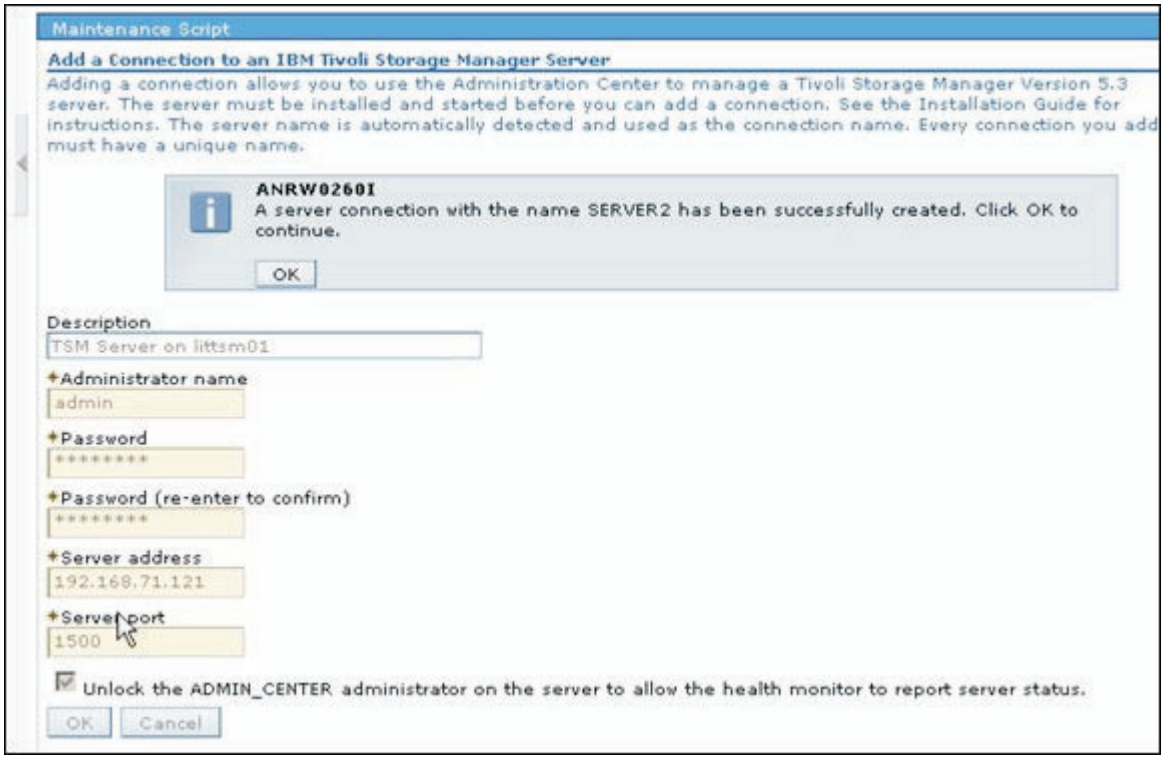

been created. Maintenance scripts perform routine server maintenance operations acc
best practice, create a maintenance script for every server.
--- Select Action ---
Go
Select
--- Select Action ---
Create maintenance script...
Modify maintenance script...
Remove maintenance script...
Add Server Connection...
Modify Server Connection...
Remove Server Connection
Server Properties...
Use Command Line...
Halt Server
— Table Actions —
Show Filter Row
Clear All Filters

6. Pressed Go


Maintenance Script
The table shows the servers you have added to the console, and identifies the servers for which
been created. Maintenance scripts perform routine server maintenance operations according to
best practice, create a maintenance script for every server.
Add Server Connection...
Go
Select
Server Name
Total: 0 Filtered: 0 Displayed: 0 Selected: 0



7. We filled in the information and pressed OK
   a. The administrator name is the user ID you want to manage the server.
   b. We used ADMIN – the user ID from the original TSM system.
   c. The server address is the network name of the Server system or the IP address. We used the IP address.
   d. The server port number is the default port number.
   e. We checked the box at the bottom so we could see the server console messages if we wanted.



8. After pressing OK, we got the following screen which shows we successfully connected to the server:

Added the MANUAL Tape Drive to the Server

A manual tape drive needed to be defined to the system so that we could restore the database. The same naming convention was followed that was used on the original system.

In order to do this we defined a MANUAL library containing the tape drive to be used and defined a new device class (CLTO3) for that library.

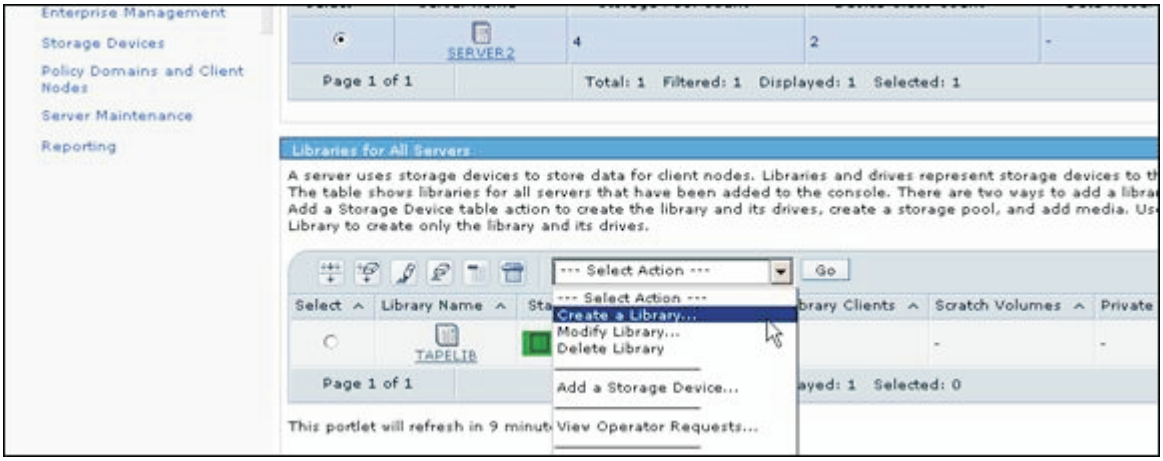
The library was called MANUAL. The library type was MANUAL. The drive was called MDRIVE0 and was mapped to /dev/IBMtape0.

From the devcnfg.out file of the original:

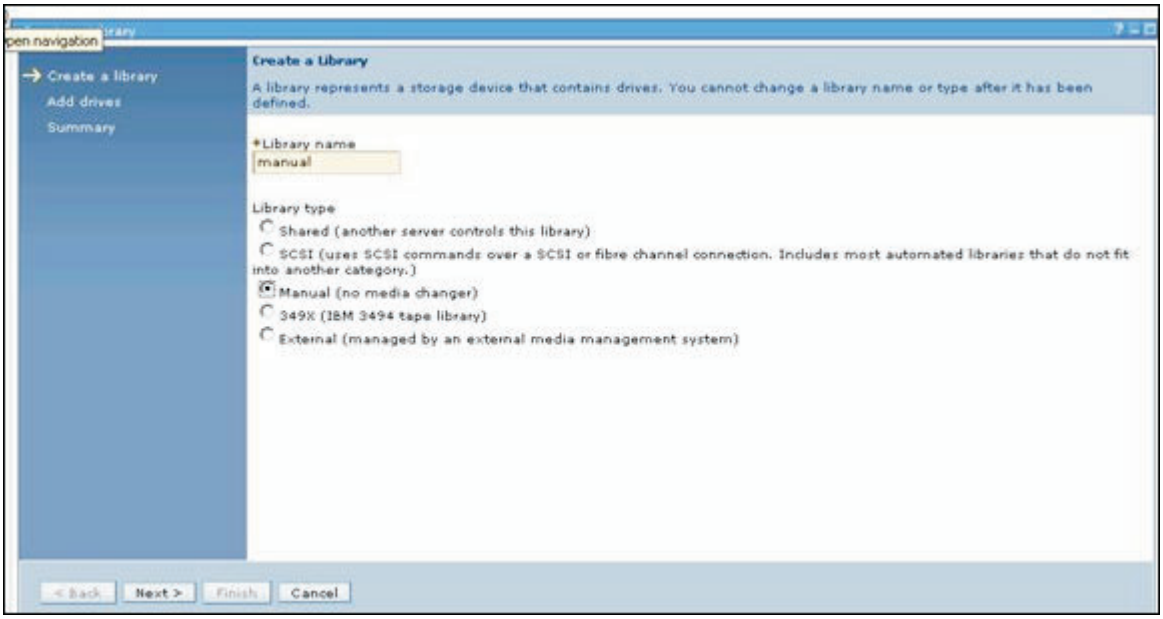
```
DEFINE DEVCLASS CLTO3 DEVTYPE=LTO FORMAT=DRIVE MOUNTLIMIT=DRIVES
MOUNTWAIT=60 MOUNTRETENTION=60 PREFIX=ADSM LIBRARY=MANUAL
SET SERVERNAME SERVER2
DEFINE LIBRARY MANUAL LIBTYPE=MANUAL
DEFINE DRIVE MANUAL MDRIVE0 ONLINE=Yes SERIAL="1110015929"
DEFINE PATH SERVER2 MDRIVE0 SRCTYPE=SERVER DESTTYPE=DRIVE
LIBRARY=MANUAL DEVICE=/dev/IBMtape0 ONLINE=YES
```

We used the above to help make the definitions:

1. We logged on to the Administration Center and clicked on Storage Devices and then clicked on the pull down menu and selected Create a Library :

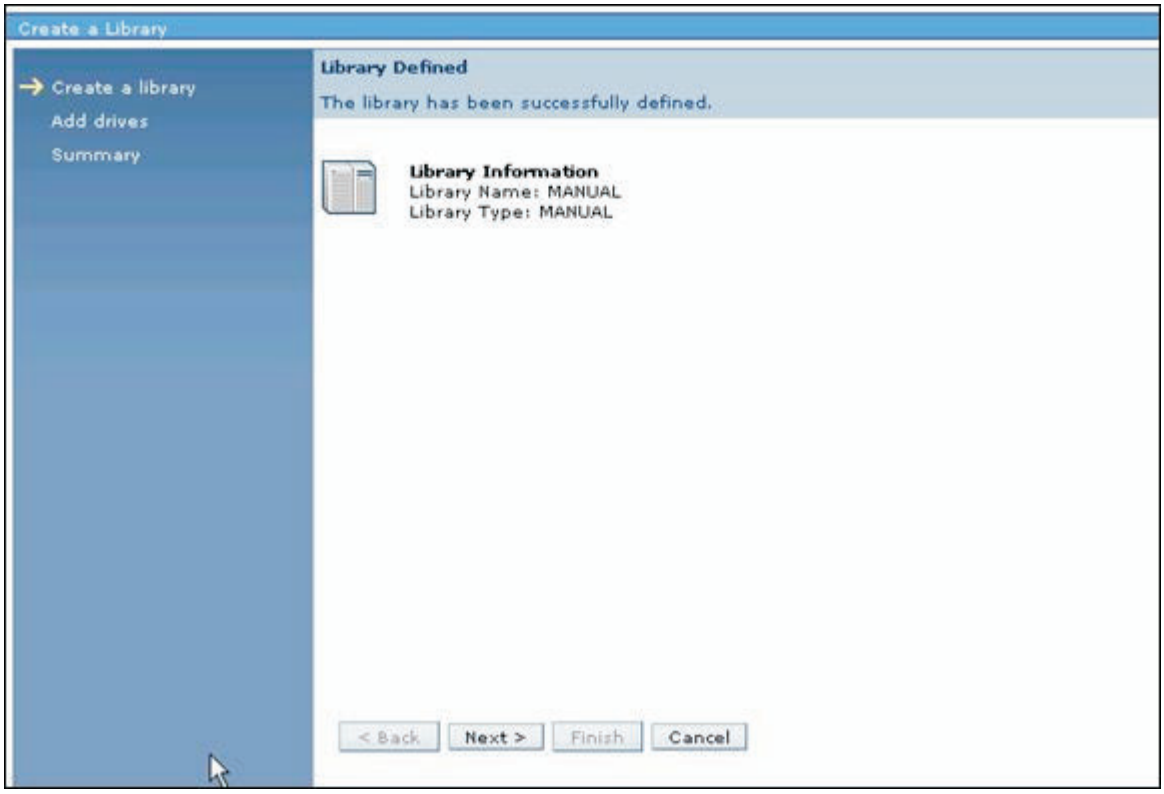


2. Note the server list appeared again. We made sure SERVER2 was selected from the radial button. We clicked on the pull down and selected “Create a Library” again. Then clicked on the “Go” button.

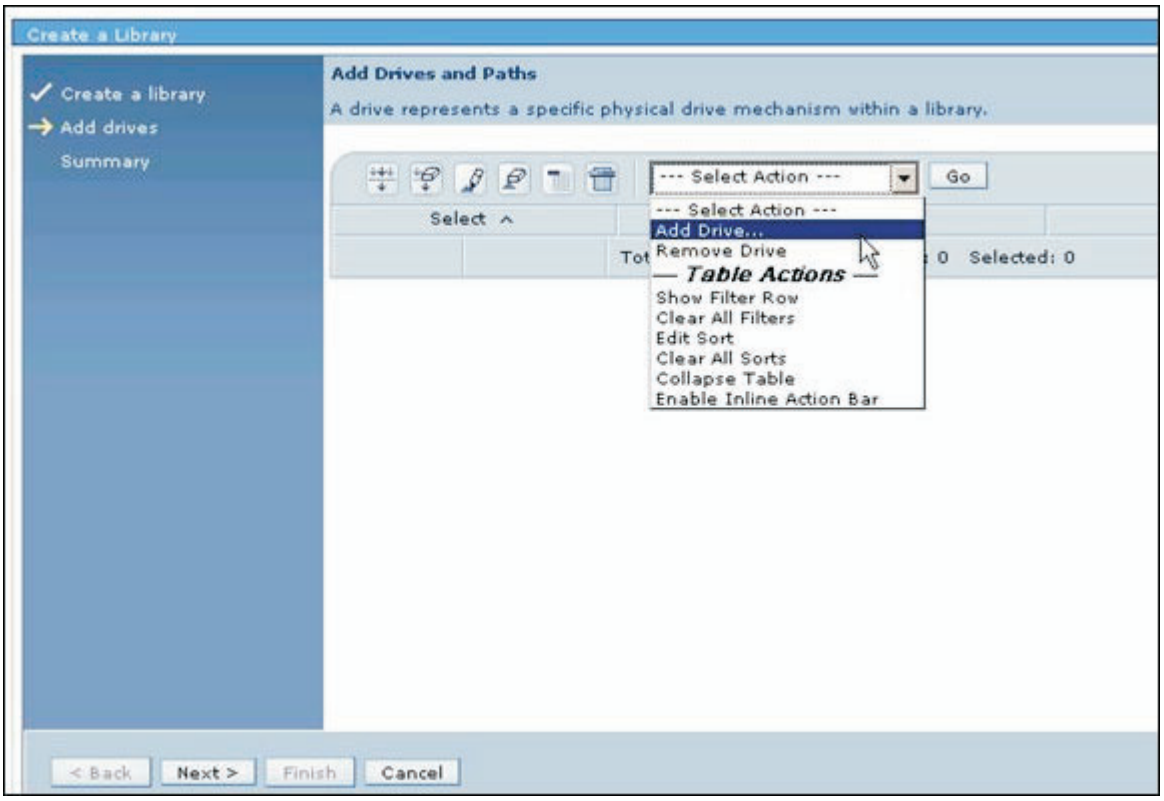


3. We named it MANUAL and selected the “Manual” radial button

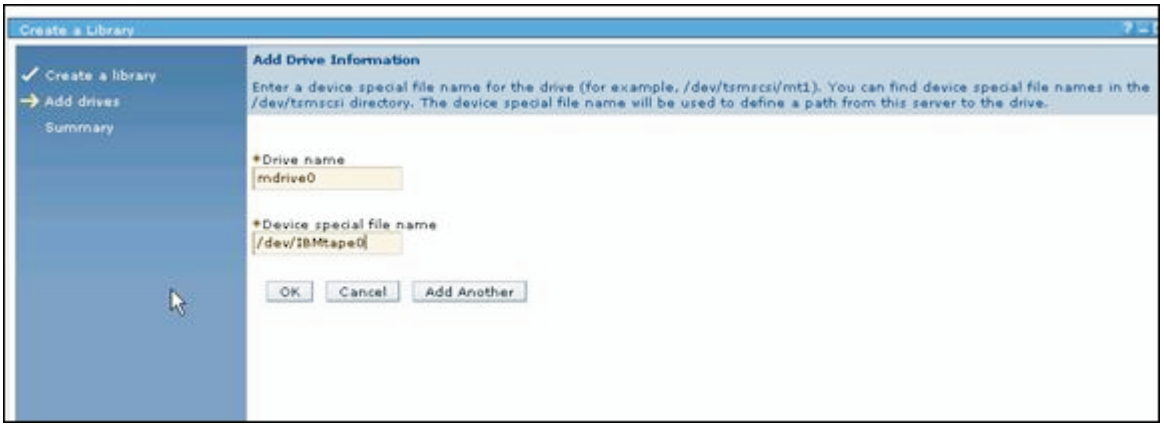
4. We press Next and saw this:



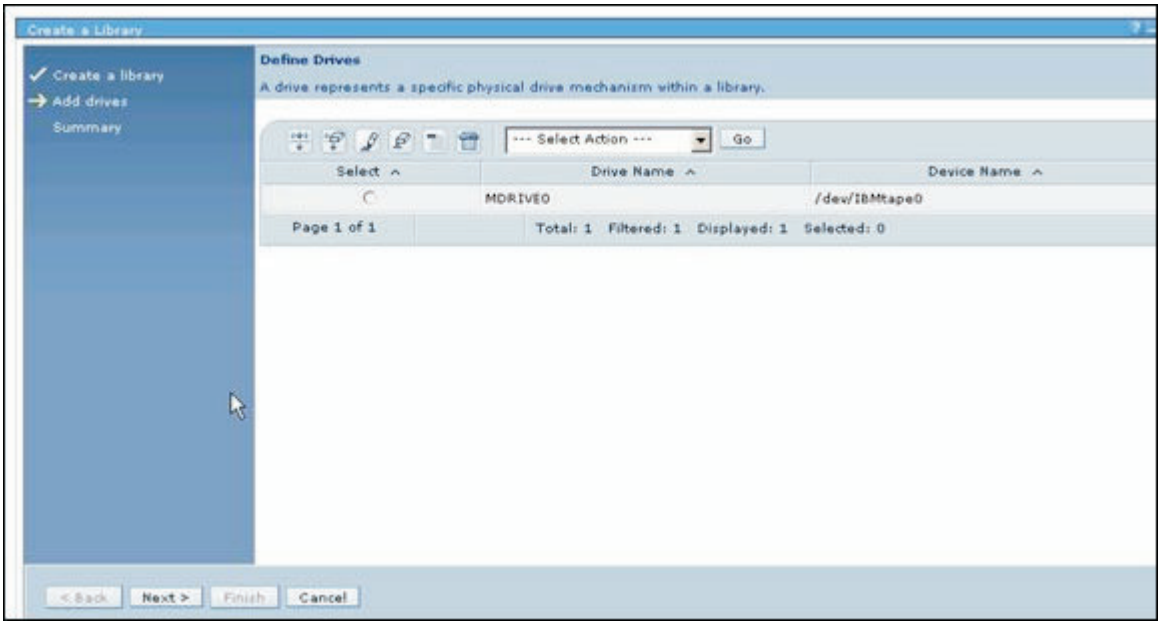
5. We pressed Next to add the drives



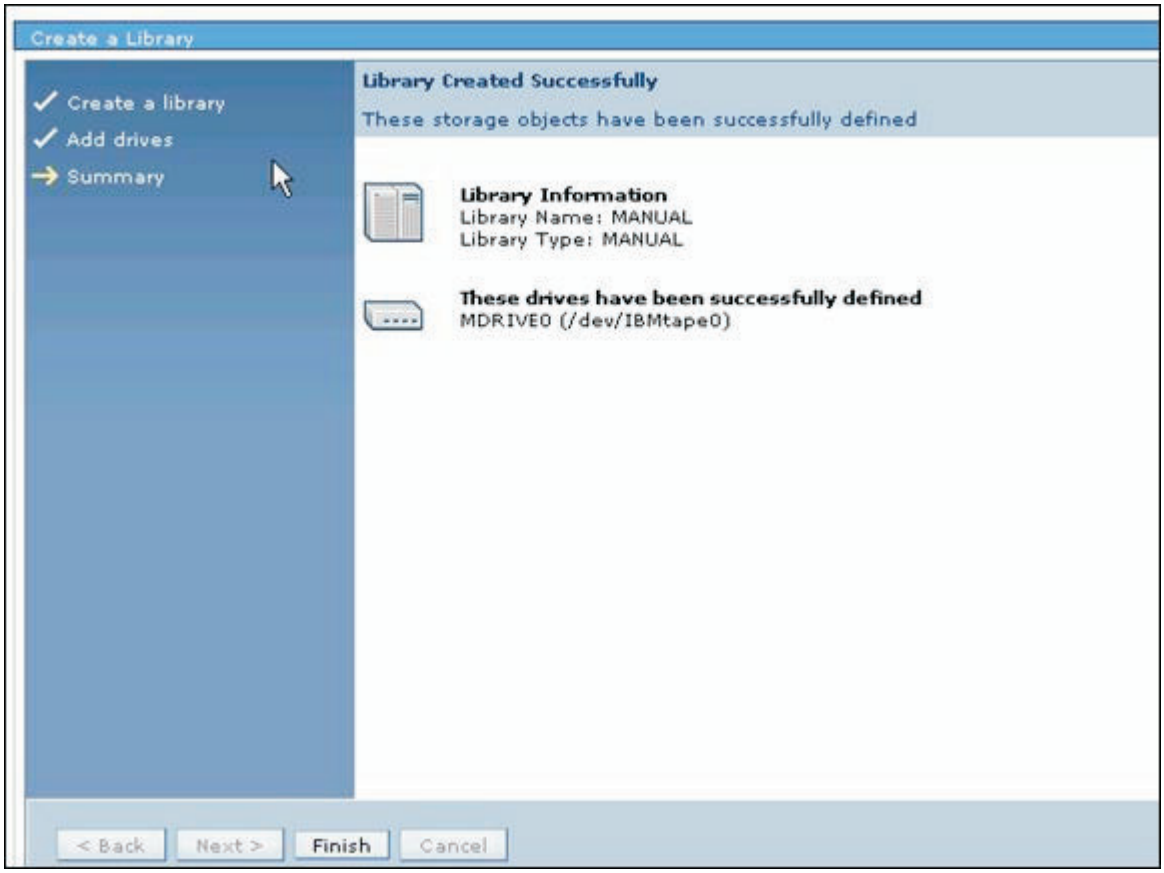
6. We selected “add Drive” from the pull down menu and pressed Go



7. We filled in the drive name and the path to the device special file for the drive and pressed OK.



8. We pressed Next

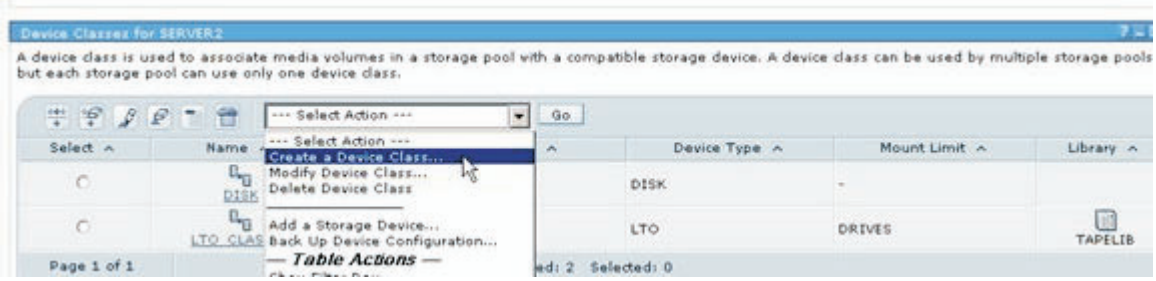


9. We pressed Finish
10. We needed to define a DEVICE CLASS for the tape.

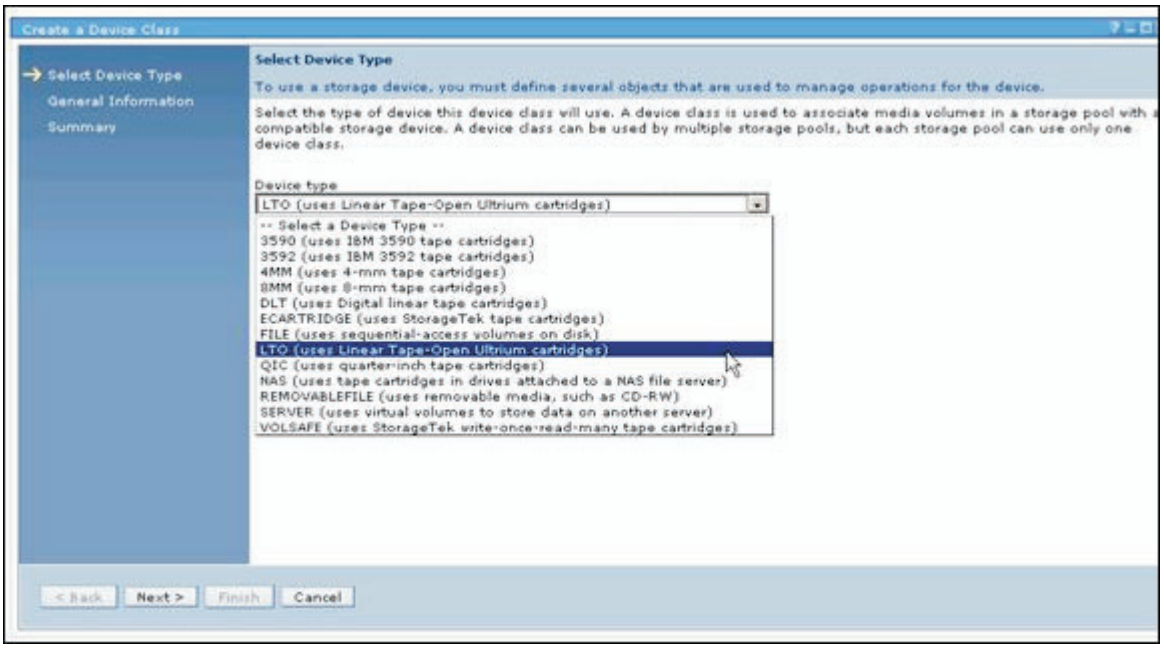
a. We went back to the top of the screen and selected to view device classes:

Note: SERVER2 is selected from the radial buttons

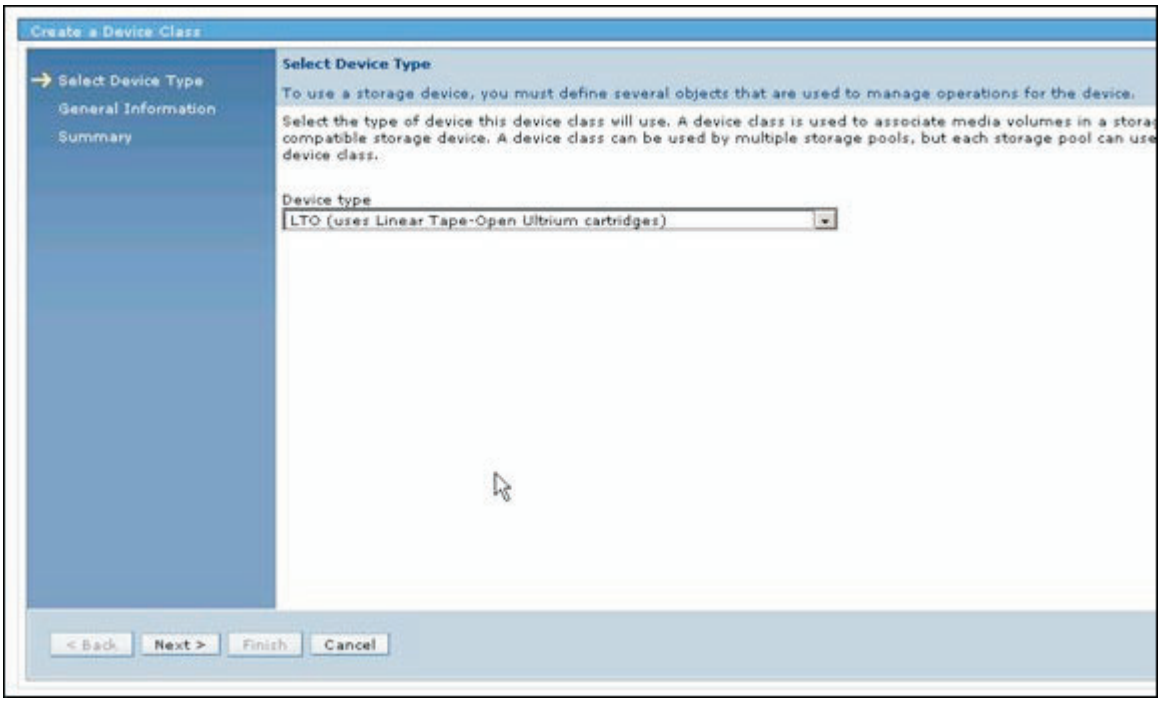
b. The list of device classes for the server is listed at the bottom (new portlet)



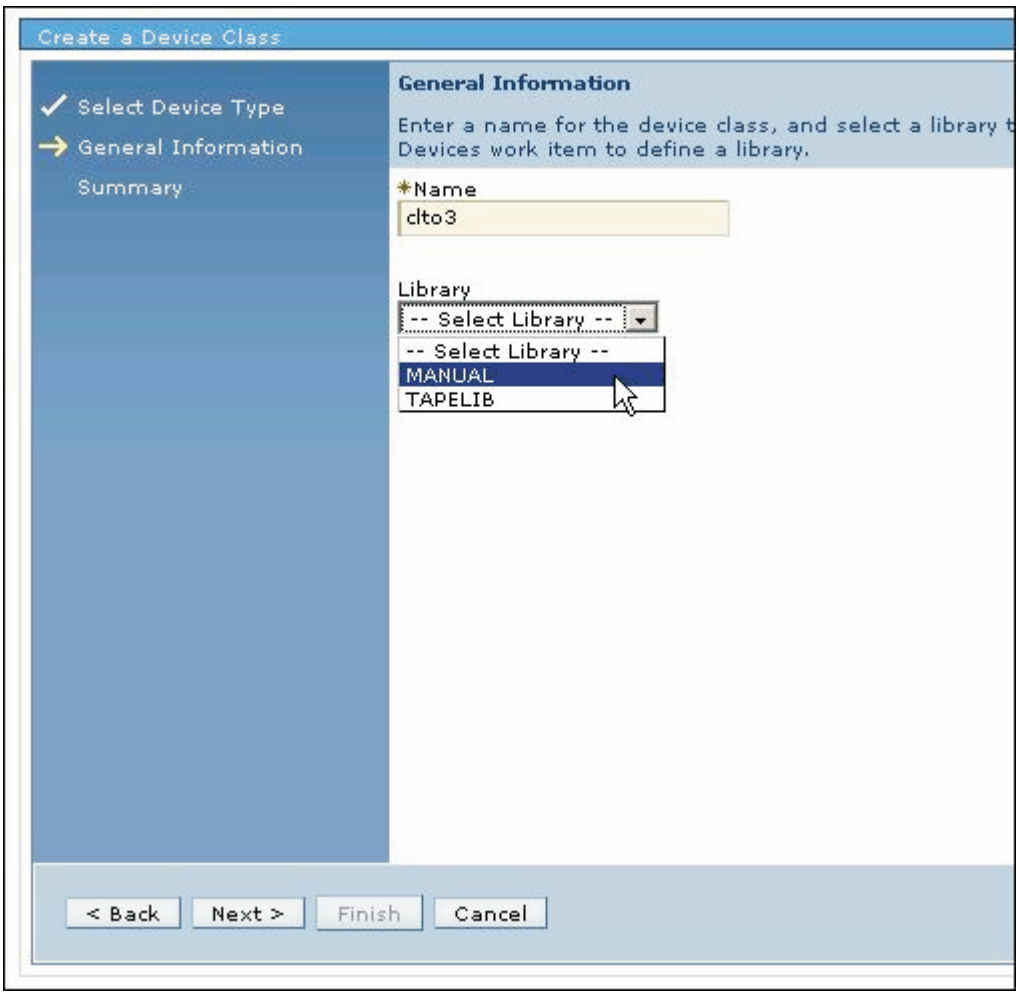
c. We selected “Create a Device Class” from the pull down list and pressed Go.



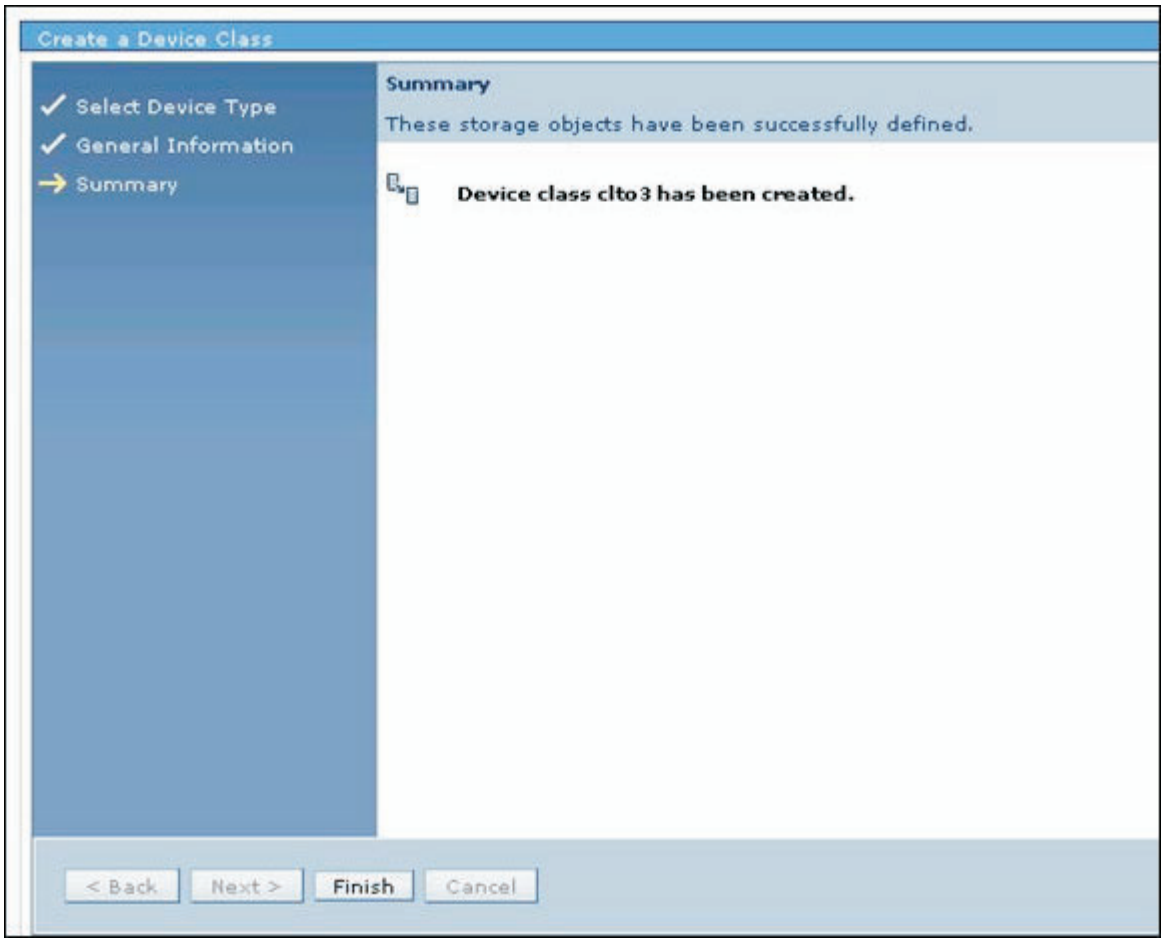
d. We selected the Device type from the pull down menu



e. And pressed Next



f. We named the new Device Class CLTO3 to match the name of the original and linked it to the MANUAL library, and pressed Next.



g. We then pressed Finish to exit the setup

Reloaded the Database

We were now ready to attempt the reloading of the database. To review:

1. Installed the device driver for the tape subsystem.
2. Installed the new server and the Administration Center
3. Signed the licenses for the new system
4. Defined users to the Administration Center and the server
5. Configured the server to define the manual tape drive and the device class for the restore operation
6. Brought down the server in preparation for the reload of the database by issuing a halt from the TSM server console

First Attempt: To reload the database we issued the dsmserv command with the loaddb option:

```
littsm01:/opt/tivoli/tsm/server/bin # dsmserv loaddb d
evclass=clto3 vol=030003lt
ANR0982E The server database must be initialized before the
database can be loaded.
littsm01:/opt/tivoli/tsm/server/bin #
```

The reload failed.

We looked up the error message on the Tivoli InfoCenter web site (see “Migrating the Tivoli Storage Manager Server” for the address) and got the following:

```
The server database must be initialized before the database
can be loaded.

Explanation:

The server database must be initialized before it can be loaded with the LOADDB
parameter, by issuing the DSMSERV LOADFORMAT command. The server
database is not currently in the initialized state.

System Action:

Server LOADDB processing stops.

User Response:

Issue the DSMSERV LOADFORMAT command. For complete details on this
command, refer to the Administrator's Reference.
```

Created and Formatted the Database and Log Files: We looked up the DSMSERV LOADDFORMAT command and found that the files it works with must already exist and you must first use the DSMFMT command to create/format files.

This is where using/remembering what made up the database on the original system came into play. From the first part of this discussion, we found out that the database was made up of 10 files:

```
littsm01:/opt/tivoli/tsm/server/bin # ls -lh db*
-rw-r--r--  1 root root  17M Aug  8 05:41 db.dsm
-rw-r--r--  1 root root 101M Aug  8 05:41 db_v2.dsm
-rw-r--r--  1 root root 101M Aug  8 05:41 db_v3.dsm
-rw-r--r--  1 root root 101M Aug  8 05:41 db_v4.dsm
-rw-r--r--  1 root root 101M Aug  8 05:41 db_v5.dsm
-rw-r--r--  1 root root 101M Aug  8 05:41 db_v6.dsm
-rw-r--r--  1 root root 101M Aug  8 05:41 db_v7.dsm
-rw-r--r--  1 root root 101M Aug  8 05:41 db_v8.dsm
-rw-r--r--  1 root root 101M Aug  8 05:41 db_v9.dsm
```

The first was 17 Megabytes and the rest were each 101 Megabytes in size.

We needed to create files that matched the files on the old system using the command dsmfmt.

We found that the first file, db.dsm, already existed and was the correct size (17 Megabytes).

The others needed to be created.

The command to create the files is

```
dsmfmt -m –db filename filesize  . . .
```

Each file used to build the database must be a multiple of 4 MG in size plus 1 Meg for overhead. (For example: 4 + 1 = 5 Meg; 3*4 + 1 = 13 Meg, 25*4 + 1 = 101 Meg)

From the TSM Server base directory we issued the command and created two files at a time:

```
littsm01:/opt/tivoli/tsm/server/bin # dsmfmt  -m -db db_v2.dsm
101 db_v3.dsm 101

Allocated space for db_v2.dsm: 105906176 bytes
```

```
Allocated space for db_v3.dsm: 105906176 bytes

littsm01:/opt/tivoli/tsm/server/bin # dsmfmt  -m -db db_v4.dsm
101 db_v5.dsm 101

Allocated space for db_v4.dsm: 105906176 bytes

Allocated space for db_v5.dsm: 105906176 bytes

littsm01:/opt/tivoli/tsm/server/bin # dsmfmt  -m -db db_v6.dsm
101 db_v7.dsm 101

Allocated space for db_v6.dsm: 105906176 bytes

Allocated space for db_v7.dsm: 105906176 bytes

littsm01:/opt/tivoli/tsm/server/bin # dsmfmt  -m -db db_v8.dsm
101 db_v9.dsm 101

Allocated space for db_v8.dsm: 105906176 bytes

Allocated space for db_v9.dsm: 105906176 bytes

littsm01:/opt/tivoli/tsm/server/bin #
littsm01:/opt/tivoli/tsm/server/bin # ls -lh db*

-rw-r--r--  1 root root  17M Aug  8 16:53 db.dsm
-rw-r--r--  1 root root 101M Aug  8 18:47 db_v2.dsm
-rw-r--r--  1 root root 101M Aug  8 18:47 db_v3.dsm
-rw-r--r--  1 root root 101M Aug  8 18:48 db_v4.dsm
-rw-r--r--  1 root root 101M Aug  8 18:48 db_v5.dsm
-rw-r--r--  1 root root 101M Aug  8 18:48 db_v6.dsm
-rw-r--r--  1 root root 101M Aug  8 18:48 db_v7.dsm
-rw-r--r--  1 root root 101M Aug  8 18:49 db_v8.dsm
-rw-r--r--  1 root root 101M Aug  8 18:49 db_v9.dsm
```

We also discovered we needed to define and format the log files. The requirements on file size were the same as for the database.

The original log files were:

```
-rw-r--r--  1 root root 9.0M Aug  8 12:33 log.dsm
-rw-r--r--  1 root root  53M Aug  8 11:56 log_v2.dsm
```

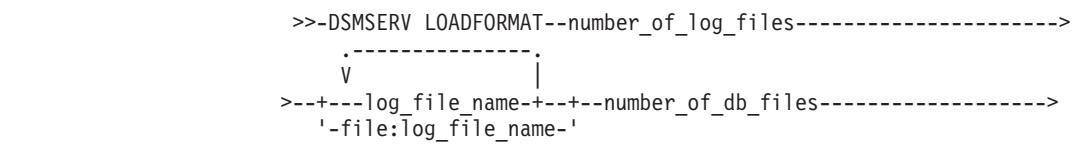
We found that the first file, log.dsm, already existed and was the correct size.

We defined the additional log file:

```
littsm01:/opt/tivoli/tsm/server/bin # dsmfmt -m -log log_v2.dsm 53
Allocated space for log_v2.dsm: 55574528 bytes
littsm01:/opt/tivoli/tsm/server/bin # ls -lh log*
-rw-r--r--  1 root root 9.0M Aug  8 16:53 log.dsm
-rw-r--r--  1 root root  53M Aug  8 19:00 log_v2.dsm
```

We now had the database files and log files to match the original system. We needed to tell the system how to use these files by running the LOADFORMAT TSM command.

1. The format of the dsmserv loadformat command is:



```
     .--------------.
     V              |
>--+---db_file_name-+--+-------------------------------------><
   '-file:db_file_name-'
```

a. We created a file logfile.list which contained the list of log files.
b. And a file dbfile.list which contained the list of database files

   This should make the command a little easier to type.

```
littsm01:/opt/tivoli/tsm/server/bin # ls log* >logfile.list
littsm01:/opt/tivoli/tsm/server/bin # ls db* >dbfile.list
```

2. We issued the dsmserv loadformat command

```
littsm01:/opt/tivoli/tsm/server/bin #
dsmserv loadformat 2 file:logfile.list 9 file:dbfile.list

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Version 5, Release 3, Level 0.0

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ANR7800I DSMSERV generated at 09:05:58 on Dec  7 2004.
ANR7801I Subsystem process ID is 5448.
ANR0900I Processing options file dsmserv.opt.
ANR4726I The ICC support module has been loaded.
ANR0300I Recovery log format started; assigned capacity 60 megabytes.
ANR0301I Recovery log format in progress; 4 megabytes of 60.
ANR0301I Recovery log format in progress; 8 megabytes of 60.
. . . . .
ANR0301I Recovery log format in progress; 60 megabytes of 60.
ANR0302I Recovery log formatting took 6712 milliseconds.
ANR0303I Format rate:  2288.4 pages/second.
ANR0304I Page service time:     0.4 ms.
ANR0305I Recovery log format complete.
ANR0306I Recovery log volume mount in progress.
ANR0353I Recovery log analysis pass in progress.
ANR0354I Recovery log redo pass in progress.
ANR0355I Recovery log undo pass in progress.
ANR0352I Transaction recovery complete.
ANR1004I Server formatting complete, database ready for loading.
littsm01:/opt/tivoli/tsm/server/bin #
```

Second Attempt to Reload the Database: Now that everything was in place we reissued the dsmserv loaddb command:

```
dsmserv loaddb devclass=clto3 vol=030003lt
```

WE MADE A MISTAKE – the tape label was 030003L1 not 030003LT so the system would not accept the tape and would wait one hour for the correct tape to be loaded. Unfortunately, the system would not let us stop the loaddb command (no user interface). After trying a number of things, we finally killed the server process:

1. We went to /opt/tivoli/tsm/server/bin/dsmserv.lock and got the process id
2. Issued kill -9 5483 (the process id of the server)
3. The entire system crashed (a shutdown was issued internally by the server)
4. The system was left in some unstable state – not up not down
5. We needed to log on to the operator console (zVM guest) and logoff the guest
6. We then logged on the guest and rebooted the zLinux system

Third Attempt to Reload the Database: We reissued the dsmserv loaddb command:

```
littsm01:/opt/tivoli/tsm/server/bin # dsmserv loaddb devclass=clto3 vol=03000311

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ANR7800I DSMSERV generated at 09:05:58 on Dec  7 2004.
ANR7801I Subsystem process ID is 3706.
ANR0900I Processing options file dsmserv.opt.
ANR4726I The ICC support module has been loaded.
ANR0990I Server restart-recovery in progress.
ANR0200I Recovery log assigned capacity is 60 megabytes.
ANR0201I Database assigned capacity is 816 megabytes.
ANR0981E The server database must be restored before the server can be started.
```

Found that we needed to go back and redo the dsmserv loadformat command possibly because of the failure of the second attempt.

Fourth Attempt to Reload the Database: We reissued the loadformat and then the loaddb:

```
littsm01:/opt/tivoli/tsm/server/bin # dsmserv loadformat 2
file:logfile.list 9 file:dbfile.list

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ANR7800I DSMSERV generated at 09:05:58 on Dec  7 2004.
ANR7801I Subsystem process ID is 3766.
ANR0900I Processing options file dsmserv.opt.
ANR4726I The ICC support module has been loaded.
ANR0300I Recovery log format started; assigned capacity 60
megabytes.
ANR0301I Recovery log format in progress; 4 megabytes of 60.
. . . .
ANR0301I Recovery log format in progress; 60 megabytes of 60.
ANR0302I Recovery log formatting took 6845 milliseconds.
ANR0303I Format rate:  2244.0 pages/second.
ANR0304I Page service time:     0.4 ms.
ANR0305I Recovery log format complete.
ANR0306I Recovery log volume mount in progress.
ANR0353I Recovery log analysis pass in progress.
ANR0354I Recovery log redo pass in progress.
ANR0355I Recovery log undo pass in progress.
ANR0352I Transaction recovery complete.
ANR1004I Server formatting complete, database ready for
loading.
```

```
littsm01:/opt/tivoli/tsm/server/bin # dsmserv loaddb
devclass=clto3 vol=030003l1
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ANR7800I DSMSERV generated at 09:05:58 on Dec  7 2004.
ANR7801I Subsystem process ID is 3793.
ANR0900I Processing options file dsmserv.opt.
ANR4726I The ICC support module has been loaded.
ANR0990I Server restart-recovery in progress.
ANR0200I Recovery log assigned capacity is 60 megabytes.
ANR0201I Database assigned capacity is 816 megabytes.
ANR0306I Recovery log volume mount in progress.
ANR0353I Recovery log analysis pass in progress.
ANR0354I Recovery log redo pass in progress.
ANR0355I Recovery log undo pass in progress.
ANR0352I Transaction recovery complete.
ANR4003I LOADDB: Database load process started.
ANR1793W TSM SAN discovery is not supported on this platform
or this version of OS.
ANR8200I TCP/IP driver ready for connection with clients on
port 1500.
ANR8326I 001: Mount LTO volume 030003L1 R/O in drive MDRIVE0
(/dev/IBMtape0) of
library MANUAL within 60 minutes.
ANR4039I LOADDB: Loaded 0 database entries (cumulative).
ANR8335I 001: Verifying label of LTO volume 030003L1 in drive
MDRIVE0
(/dev/IBMtape0).
ANR8328I 001: LTO volume 030003L1 mounted in drive MDRIVE0
(/dev/IBMtape0).
ANR1363I Input volume 030003L1 opened (sequence number 1).
ANR4038I LOADDB: Loading database information dumped on
08/05/2005 at 06:44:49
PM.
ANR4039I LOADDB: Loaded 384308 database entries (cumulative).
ANR4039I LOADDB: Loaded 975515 database entries (cumulative).
. . . . .
ANR4039I LOADDB: Loaded 5390468 database entries (cumulative).
ANR1365I Volume 030003L1 closed (end reached).
ANR4039I LOADDB: Loaded 5439418 database entries (cumulative).
ANR8468I LTO volume 030003L1 dismounted from drive MDRIVE0
(/dev/IBMtape0) in
library MANUAL.
ANR0362W Database usage exceeds 98 % of its assigned capacity.
ANR4405I LOADDB: Loaded an inconsistent dump image - a
database audit (AUDITDB)
IS REQUIRED with FIX=YES.
ANR4517E No files have been defined for storing sequential
```

```
volume history information - information cannot be read.
ANR2106I : Quiescing database update activity.
ANR2107I : Database update activity is now quiesced.
littsm01:/opt/tivoli/tsm/server/bin #
```

It took about a half hour for the reload.

From the messages at the end of the reload, it indicated we needed to define history files.

The definition of the history file was done in dsmserv.opt.

We edited /opt/tivoli/tsm/server/bin/dsmserv.opt and added the following line to the file:

```
volumehistory   volhist.out

*** IBM TSM Server options file
*** Refer to dsmserv.opt.smp for other options
COMMMETHOD TCPIP
TCPPORT 1500

DEVCONFIG devcnfg.out
VOLUMEHISTORY volhist.out
```

We also discovered we needed to issue the dsmserv auditdb command with the option fix=yes to resynchronize the database.

```
littsm01:/opt/tivoli/tsm/server/bin # dsmserv auditdb fix=yes

Tivoli Storage Manager for Linux/s390x
Version 5, Release 3, Level 0.0

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ANR7800I DSMSERV generated at 09:05:58 on Dec  7 2004.
ANR7801I Subsystem process ID is 4023.
ANR0900I Processing options file dsmserv.opt.
ANR4726I The ICC support module has been loaded.
. . . .
ANR4306I AUDITDB: Processed 5390779 database entries (cumulative).
ANR6646I AUDITDB: Auditing disaster recovery manager definitions.
ANR4210I AUDITDB: Auditing physical volume repository definitions.
ANR4446I AUDITDB: Auditing address definitions.
ANR4141I AUDITDB: Database audit process completed.
littsm01:/opt/tivoli/tsm/server/bin #
```

Restarted the Server after the Reload Activity

After all the above steps were completed we restarted the server and see if it would work.

```
littsm01:/opt/tivoli/tsm/server/bin # dsmserv

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```

```
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ANR7800I DSMSERV generated at 09:05:58 on Dec  7 2004.
ANR7801I Subsystem process ID is 4229.
. . . . .
ANR0355I Recovery log undo pass in progress.
ANR0352I Transaction recovery complete.
ANR1636W The server machine GUID changed: old value
(00.9f.a7.4c.04.25.11.d8.9c-
.75.00.02.55.9a.17.db), new value
(00.00.00.00.e8.d7.11.d9.be.0f.02.00.00.00.00-
.17).
. . . . . .
ANR2803I License manager started.
ANR0993I Server initialization complete.
ANR0916I TIVOLI STORAGE MANAGER distributed by Tivoli is now
ready for use.
ANR2560I Schedule manager started.
ANR8200I TCP/IP driver ready for connection with clients on port
1500.
. . . . . .
ANR0987I Process 2 for AUDIT LICENSE running in the BACKGROUND
processed 16
items with a completion state of SUCCESS at 08:28:18 PM.
TSM:SERVER2>
```
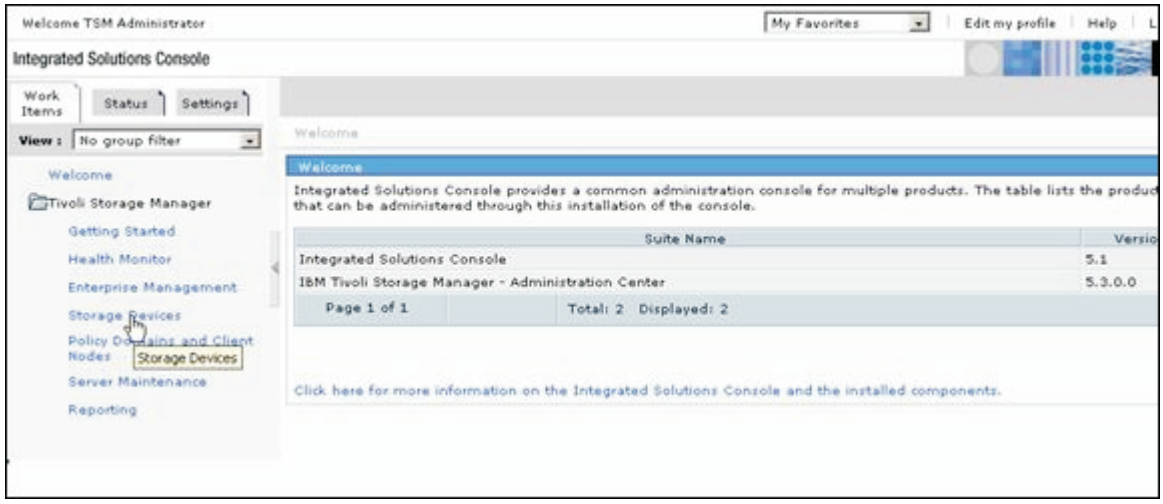

The server has started successfully!

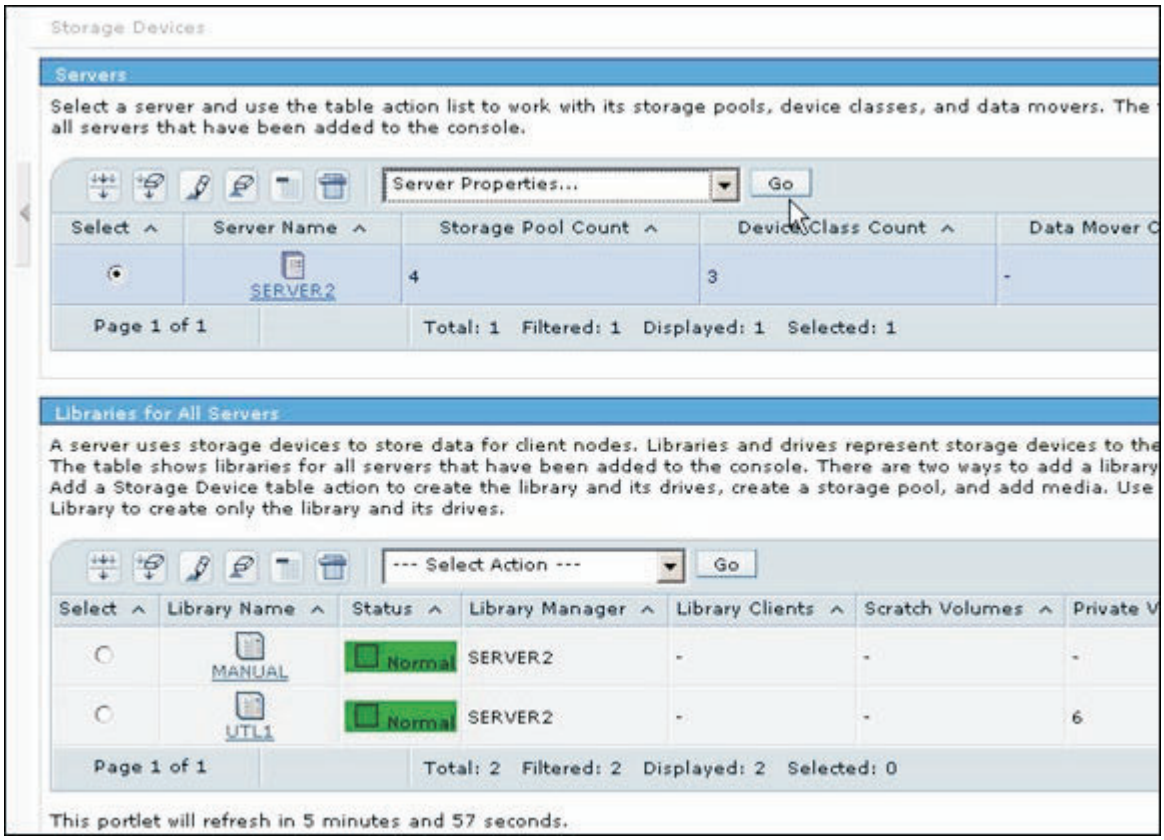
Verified the Resulting System

We logged on the Administration Center to see if we could observe what the resulting system looked like. We logged on as tsmadmin:

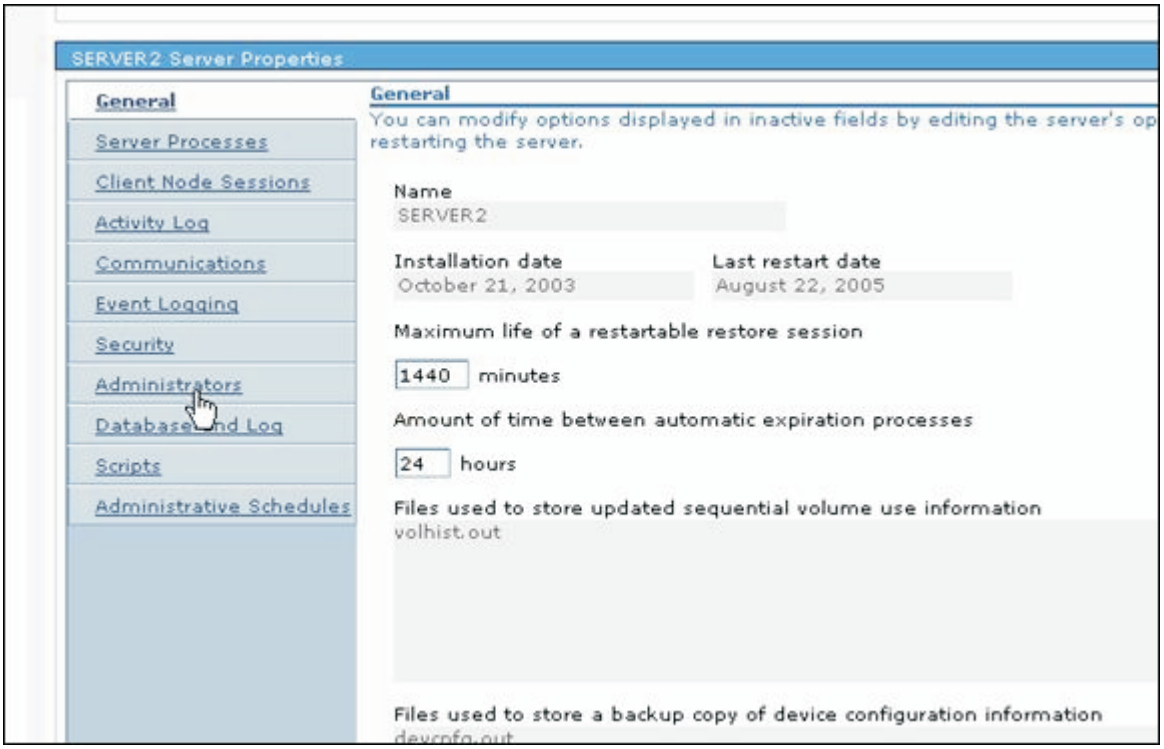
1. We wanted to know if the user definitions carried over.
   a. We clicked on Storage Devices



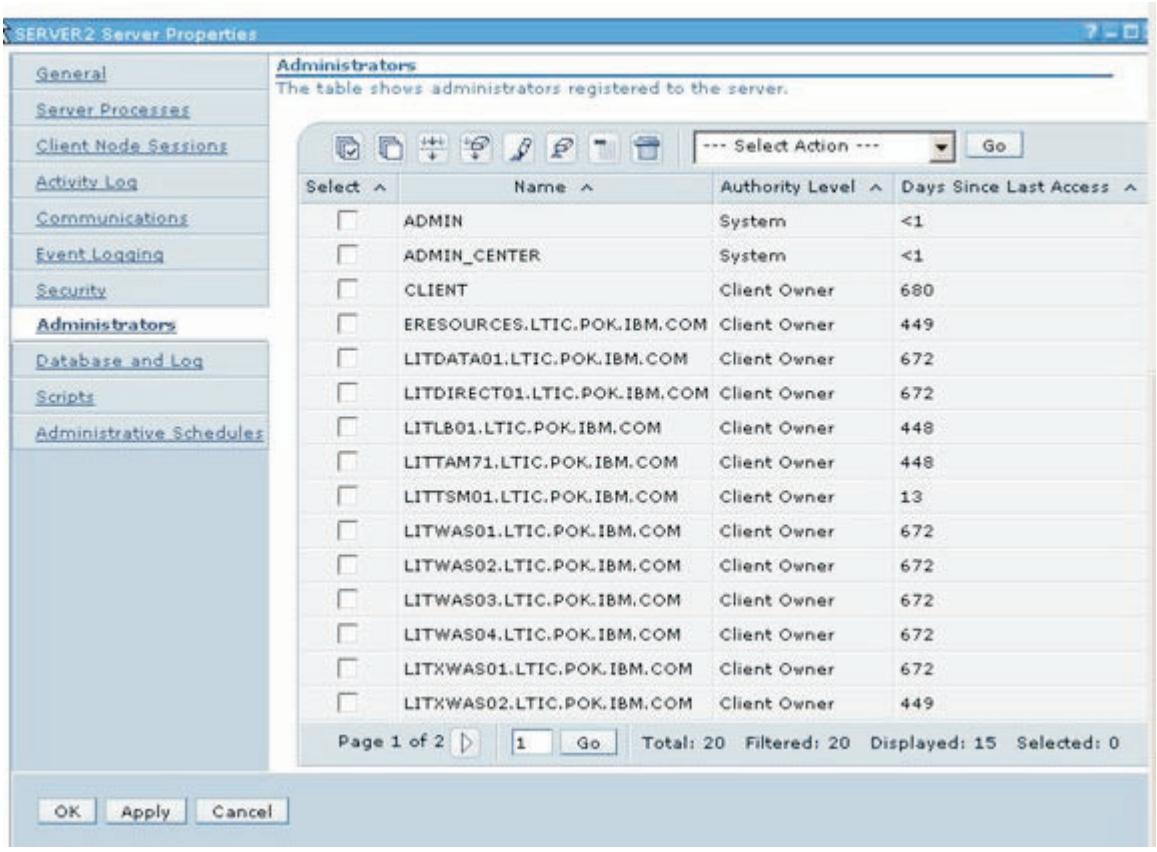
b. And then on Server Properties from the first portlet:



c. We clicked on Administrators from the properties list:

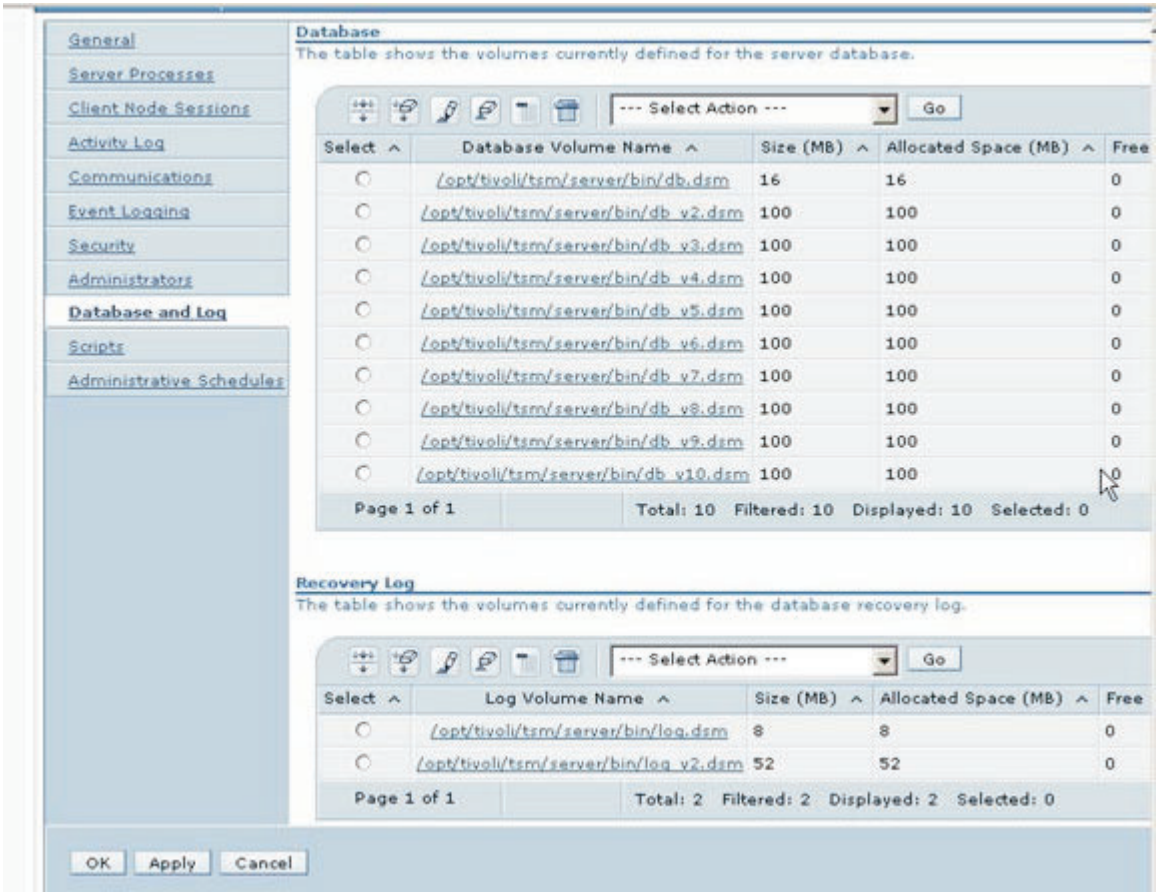


d. And ended up with a list of the administrators of the server system.

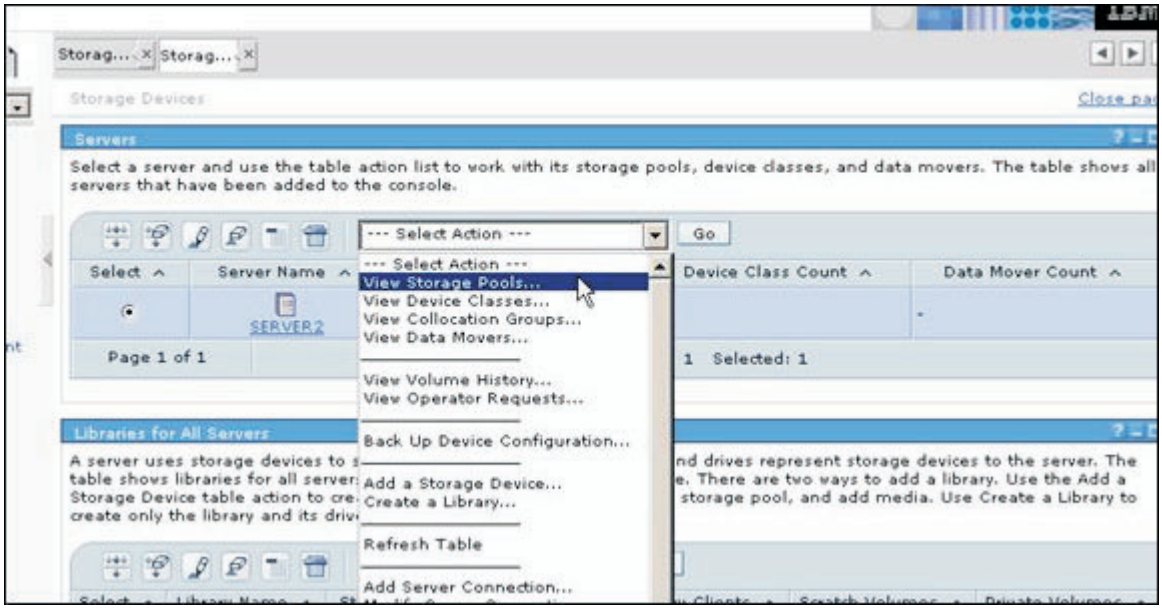


e. This list matched the list of Administrators from the original TSM.

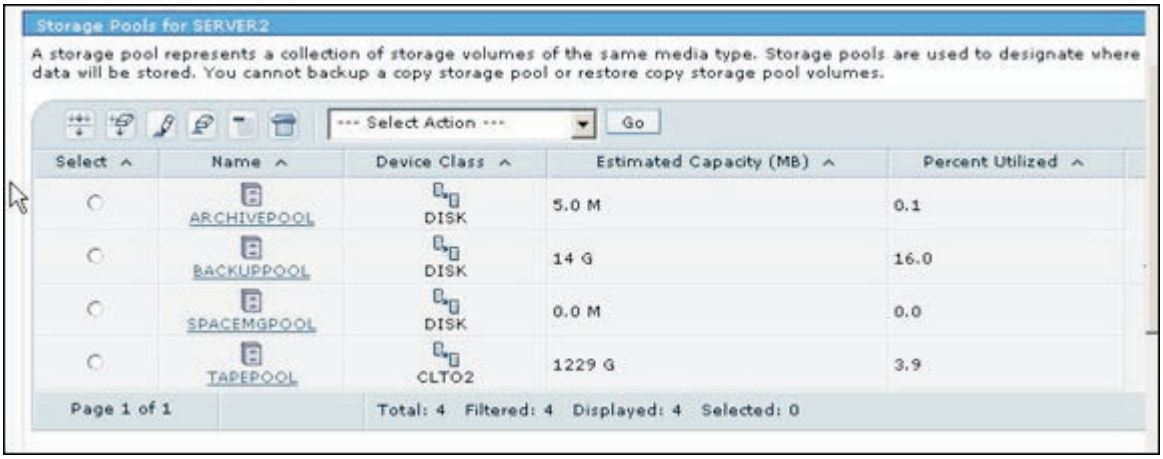
2. We checked the database and logs.
   a. Clicked on the Database and Logs property



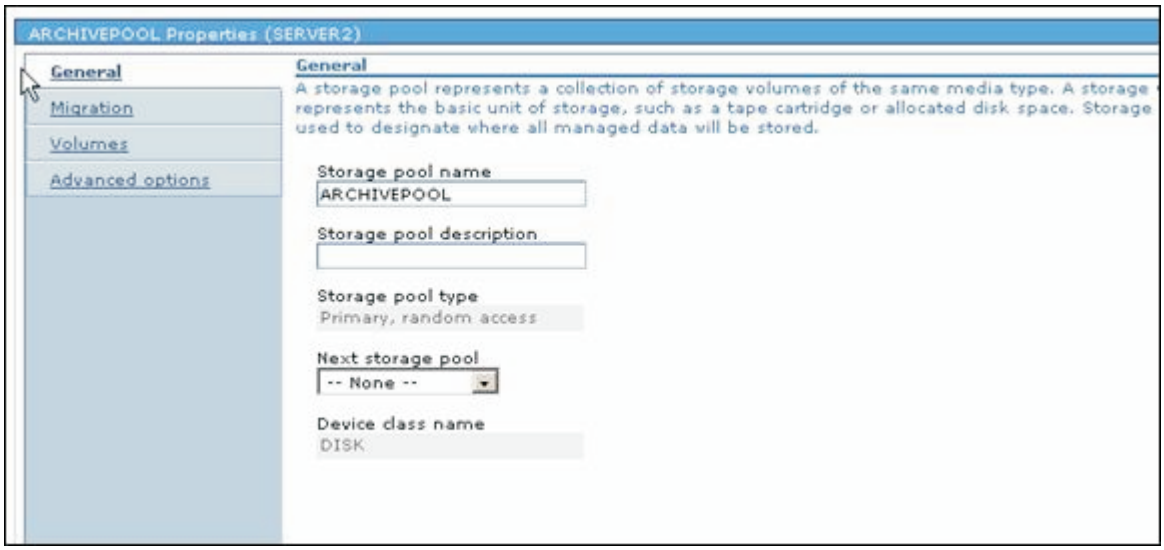
3. There is one more database volume than in the description because we added the additional volume for added space. The database was 99% full from the migration.
4. We displayed the storage pools.
   a. From the Storage Devices option, we selected View Storage Pools from the menu selection



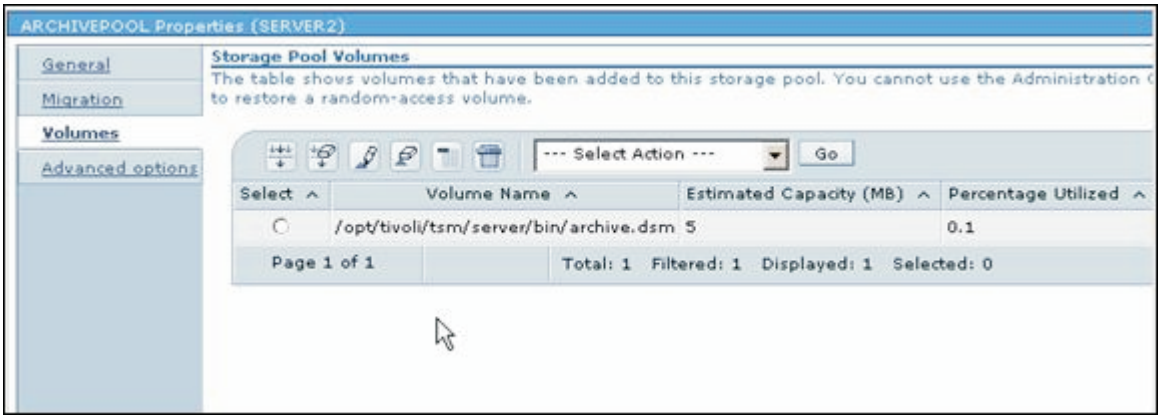
b. We saw the list of storage pools:



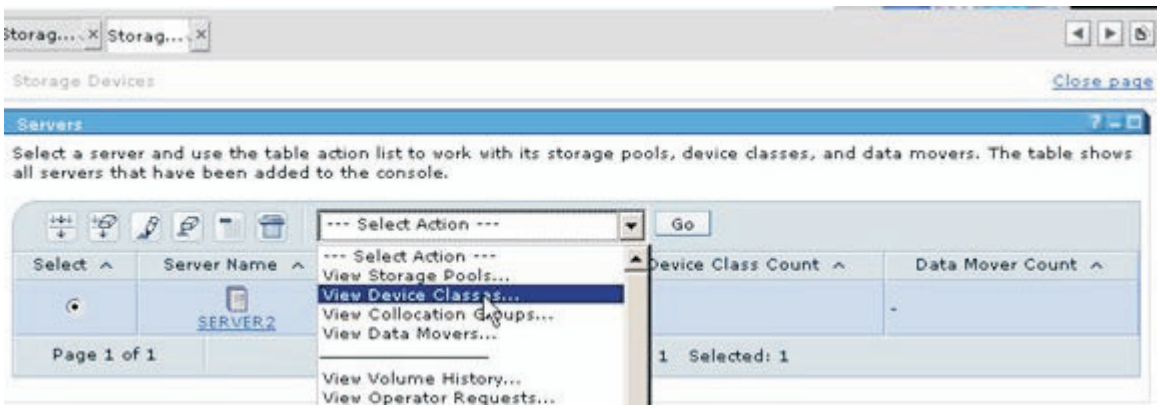
c. By clicking on a storage pool name we see the list of properties for the pool:

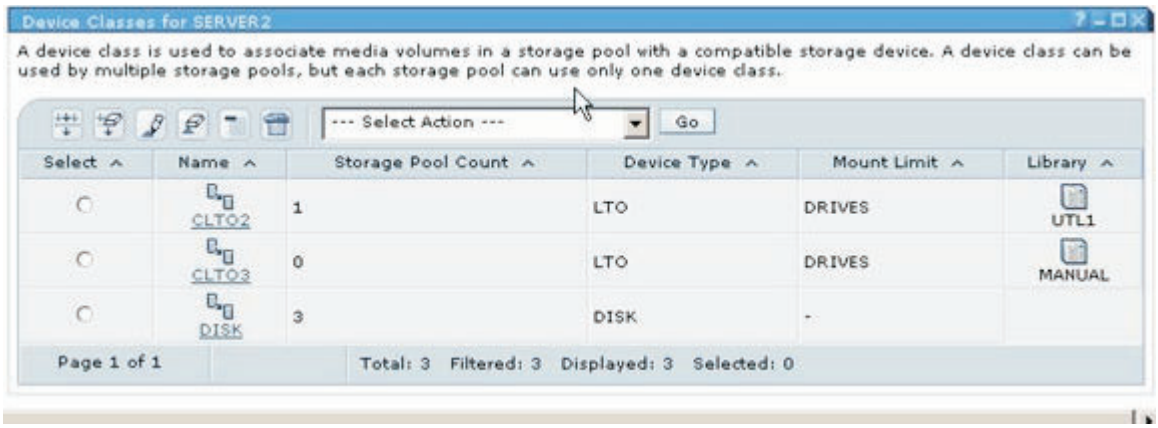


d. By clicking on Volumes we saw the list of volumes for that pool:



5. Device classes
   a. Select View Device Classes from the Storage Devices menu





All the original configuration information was migrated to the new system.

Migrating a TSM Client System

Overview

We installed TSM Client systems on each of the client machines. Because the procedure is basically the same for each client system, we will explain the actions taken for one system. Each of the systems we installed was a new system that had been migrated from a 31 bit 2.4 platform to a 64 bit 2.6 platform (see “Upgrading the OS” for details). We were simply adding in the TSM Client component to a working system.

The procedure was

- Made sure the system was not already installed
- Downloaded the client package to littsm01 system and unbundled it
- Downloaded the needed parts from littsm01 to the Client litwas01
- Installed the TSM Client product
- Configured the Client
- Configured the Web Client function
- Contacted the TSM Server system

We installed the client on a SLES9 64 bit system.

Made Sure the Product was not Already Installed

We logged on the target system (litwas01 – 192.168.71.101) and checked to see if the client package was already installed:

```
litwas01:~/downloads/tsm-client # rpm -qa | grep TIV
litwas01:~/downloads/tsm-client #
```

If the client had been installed we would have gotten the following results:

```
litwas01:~ # rpm -qa |grep TIV
TIVsm-API-5.3.0-0
TIVsm-BA-5.3.0-0
TIVsm-API64-5.3.0-0
litwas01:~ #
```

Downloaded the Distribution Package to the Server for Distribution

The distribution package included all the code for all the supported Linux platforms. In order to avoid distributing unnecessary parts, we downloaded the complete package to the central location (the server) and divided it into mini packages for each platform.

We downloaded the combined package (C80C5ML.tar.gz) to littsm01 and placed it in the

```
/root/downloads/TSM5-3-client
```

directory. We then untarred the package (tar –xvzf C80C5ML.tar.gz) into the same directory and got the following structure:

```
littsm01:~/downloads/TSM5-3-client # ls
.  ..  C80C5ML.tar.gz  LK4T-0349-00
littsm01:~/downloads/TSM5-3-client # cd LK4T-0349-00/
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00 # ls
.  ..  LICENSE.TXT  README.1ST  tsmcli
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00 # cd tsmcli/
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00/tsmcli # ls
.  ..  linux390  linux86  linuxppc
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00/tsmcli # cd linux390
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00/tsmcli/linux390 # ls
.  TIVsm-API64.s390.rpm      TIVsm-msg.hu_HU.s390.rpm  TIVsm-msg.ru_RU.s390.rpm
.. TIVsm-BA.s390.rpm         TIVsm-msg.it_IT.s390.rpm  TIVsm-msg.zh_CN.s390.rpm
LICENSE.TXT                  TIVsm-msg.cs_CZ.s390.rpm  TIVsm-msg.ja_JP.s390.rpm
                             TIVsm-msg.zh_TW.s390.rpm
README                       TIVsm-msg.de_DE.s390.rpm  TIVsm-msg.ko_KR.s390.rpm
README.API                   TIVsm-msg.es_ES.s390.rpm  TIVsm-msg.pl_PL.s390.rpm
TIVsm-API.s390.rpm           TIVsm-msg.fr_FR.s390.rpm  TIVsm-msg.pt_BR.s390.rpm
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00/tsmcli/linux390 #
```

This last directory (linux390) contained all the packages for installation on zSeries Linux platforms. We only needed the

TIVsm-API64.s390.rpm	64 bit API
TIVsm-API.s390.rpm	31 bit API
TIVsm-BA.s390.rpm	common Backup/Archive package
LICENSE.TXT	license to register
README	Directions for installation of BA package
README.API	Directions for installing of the API

packages. From the README, we learned that the BA section was the same for the 31 and 64 bit distributions. From the installation process (see below) we learned we needed both the 31 and 64 bit versions of the API.

Downloaded the Package from the Server

The TSM Client packages we needed were in the following directory on the server system:

```
/root/downloads/TSM5-3-client/LK4T-0349-00/tsmcli/linux390
```

1. From litwas01 root directory we created a directory called downloads.
2. And then created a directory called tsm .
3. We copied the required files from littsm01 using scp:

```
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00/tsmcli/linux390 #
scp README LICENCE.TXT README.API root@192.168.71.101:downloads/tsm-client/
The authenticity of host '192.168.71.101 (192.168.71.101)' can't be established.
RSA key fingerprint is 21:a7:10:d4:c1:fc:2b:28:92:39:58:e0:b8:33:f7:69.
Are you sure you want to continue connecting (yes/no)? yes
```

```
Warning: Permanently added '192.168.71.101' (RSA) to the list of known hosts.
Password:
README                          100%   42KB  42.3KB/s   00:00
LICENSE.TXT                     100%   78KB  78.0KB/s   00:01
README.API                      100%   13KB  12.9KB/s   00:00
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00/tsmcli/linux390 #
scp TIVsm-API64.s390.rpm TIVsm-API.s390.rpm TIVsm-BA.s390.rpm
root@192.168.71.101:downloads/tsm-client/
Password:
TIVsm-API64.s390.rpm            100% 4060KB   4.0MB/s   00:01
TIVsm-API.s390.rpm              100% 4005KB   2.0MB/s   00:02
TIVsm-BA.s390.rpm               100%   10MB   3.3MB/s   00:03
littsm01:~/downloads/TSM5-3-client/LK4T-0349-00/tsmcli/linux390 #
```

4. On the litwas01 system we listed the results:

```
litwas01:~/downloads/tsm-client # ls
.   LICENSE.TXT  README.API          TIVsm-API64.s390.rpm
..  README       TIVsm-API.s390.rpm  TIVsm-BA.s390.rpm
litwas01:~/downloads/tsm-client #
```

We had the packages needed for installation of the client.

Installed the TSM Client

In order to install the client we needed to run the rpm program for each of the downloads. The README directed us to install the API package first and then the BA package.

1. Installed the 64 bit API package

```
litwas01:~/downloads/tsm-client # rpm -i TIVsm-API64.s390.rpm
Postinstall of the API

IBM TSM Linux API installation complete.

Be sure to set up the configuration files!
```

2. Attempted to install the BA package

```
litwas01:~/downloads/tsm-client # rpm -i TIVsm-BA.s390.rpm
error: Failed dependencies:
        TIVsm-API = 5.3.0 is needed by TIVsm-BA-5.3.0-0
        libApiDS.so is needed by TIVsm-BA-5.3.0-0
```

We failed the install of the BA package! The message told us we needed the 31 bit API to install the BA package.

3. So we installed the 31 bit API package

```
litwas01:~/downloads/tsm-client # rpm -i TIVsm-API.s390.rpm
Postinstall of the API
IBM TSM Linux API installation complete.

Be sure to set up the configuration files!
```

4. We then reinstalled the BA package:

```
litwas01:~/downloads/tsm-client # rpm -i TIVsm-BA.s390.rpm
Postinstall of the Backup Archive client

TSM Linux client installation complete.

Be sure to set up the system configuration file
before starting the client!
litwas01:~/downloads/tsm-client #
```

The packages were now installed and we needed to configure the client.

Configured the Client

In order to configure the client we needed to create the dsm.sys file for configuration information for the client, the dsm.opt file for options, and modify the /root/.bashrc file for adding PATH, CLASSPATH, and LC_ALL environment variables.

1. We changed to the /opt/tivoli/tsm/client/ba/bin directory and
   a. Copied the dsm.sys.smp file to dsm.sys
   b. Changed the permissions on the file to allow editing
   c. Edited the dsm.sys file to contain the following info:

```
*  If your client node communicates with multiple TSM servers, be
*  sure to add a stanza,beginning with the SERVERNAME option, for
*  each additional server.

************************************************************

SErvername  SERVER2
   COMMMethod         TCPip
   TCPPort            1500
   TCPServeraddress   192.168.71.121
   compression yes

PASSWORDACCESS GENERATE
NODENAME LITWAS01.LTIC.POK.IBM.COM
```

2. We created the dsm.opt file
   a. Copied the dsm.opt.smp file to the dsm.opt file
   b. Edited the dsm.opt file for the following:

```
************************************************************

  SErvername   SERVER2
   compressalways no
```

3. Edited the /root/.bashrc file for accessing the TSM files

```
# added for running TSM
export PATH=/opt/IBMJava2-s390x-142/jre/bin/:/opt/tivoli/tsm/client/ba/bin:.$PATH
export CLASSPATH=/opt/tivoli/tsm/client/ba/bin/dsm.jar:$CLASSPATH
export LC_ALL=en_US
```

4. We then invoked the .bashrc file to set the variables

```
litwas01:/opt/tivoli/tsm/client/ba/bin # . ~/.bashrc
```

Configured the Web Client function

Configuring the Web Client established a connection to the server, identified the client to the server and the server to the client, and provided the password necessary for future communication.

Because we had already migrated the server and all its control information, the client was already defined to the server. We only had to reestablish communication and provide a password.

To do this we moved back to the TSM client base directory and invoked dsmc using the “query session” option.

```
litwas01:/opt/tivoli/tsm/client/ba/bin # dsmc query session
IBM Tivoli Storage Manager
Command Line Backup/Archive Client Interface
  Client Version 5, Release 3, Level 0.0
  Client date/time: 08/18/05   16:03:34
(c) Copyright by IBM Corporation and other(s) 1990, 2004. All Rights Reserved.

Node Name: LITWAS01.LTIC.POK.IBM.COM
Please enter your user id <LITWAS01.LTIC.POK.IBM.COM>:

Please enter password for user id "LITWAS01.LTIC.POK.IBM.COM":
```

```
Session established with server SERVER2: Linux/s390x
  Server Version 5, Release 3, Level 0.0
  Data compression forced on by the server
  Server date/time: 08/18/05   16:03:34  Last access: 08/15/05   17:06:01

TSM Server Connection Information

Server Name.............: SERVER2
Server Type.............: Linux/s390x
Server Version..........: Ver. 5, Rel. 3, Lev. 0.0
Last Access Date........: 08/15/05   17:06:01
Delete Backup Files.....: "No"
Delete Archive Files....: "Yes"

Node Name...............: LITWAS01.LTIC.POK.IBM.COM
User Name...............: root

litwas01:/opt/tivoli/tsm/client/ba/bin #
```

This request did not continue the session with the TSM server. It provided an opportunity for the client and server to exchange identification information for later operations.

Note: The default userid of the client is the fully qualified host name of the client. In this case, the userid is ″LITWAS01.LTIC.POK.IBM.COM″. Because this was the first time we logged in we established the password for the client.

Started the Web Client: The web client is used to direct the client requests to the server and, generally, control operations from the client perspective.

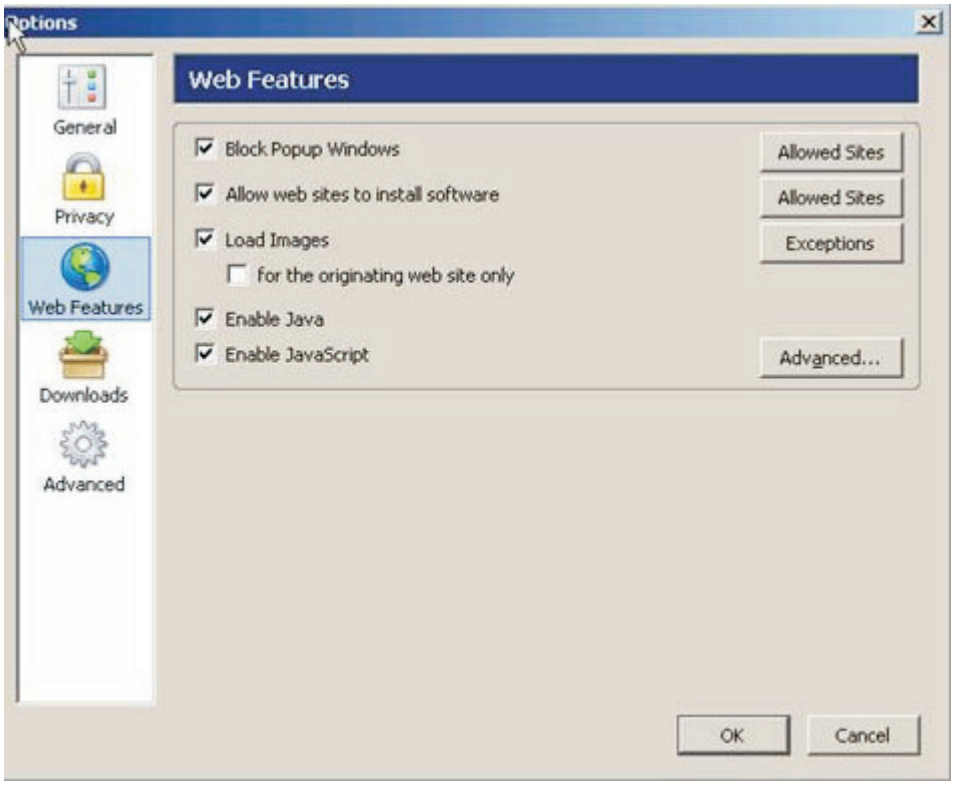
1. We started the Tivoli Client Acceptor Daemon (CAD) so that we could use the web interface for talking between the client and the server.

   ```
   litwas01:/opt/tivoli/tsm/client/ba/bin # dsmcad
   litwas01:/opt/tivoli/tsm/client/ba/bin #
   ```

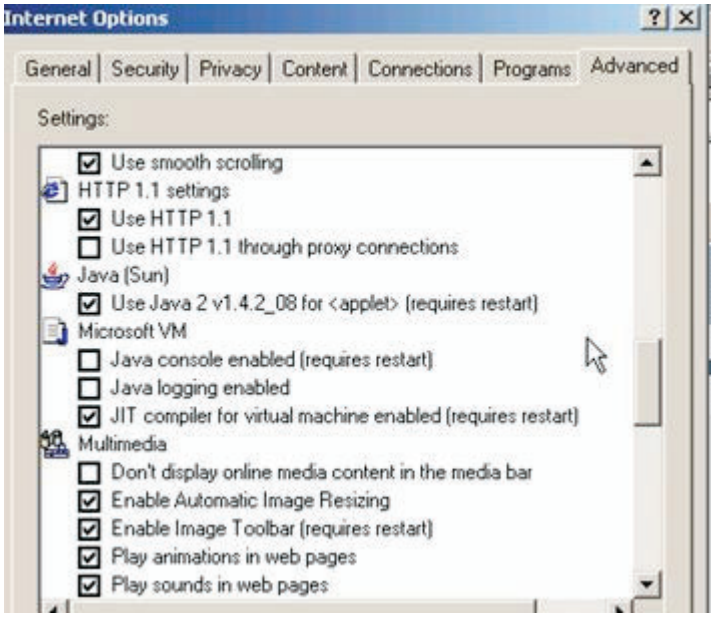
2. And verified that it started I

   ```
   itwas01:/opt/tivoli/tsm/client/ba/bin # ps -ef |grep dsm
   root     21592     1  0 16:06 ?        00:00:00 dsmcad
   root     21596 21364  0 16:08 pts/1    00:00:00 grep dsm
   ```

3. We invoked the web client by starting a web browser from our administrator's Windows2000 system. Because the interface is Java based, we checked to insure that the browser supported JavaScript.
   a. For a Mozilla browser we went to Tools -> Options and verified that the Enable Java and Enable JavaScript boxes were checked



b. For an Internet Explorer Browser we went to Tools -> Internet Options -> Advanced and verified that the Java (Sun) Use Java 2 v1.4.2_08 for checkbox was marked.

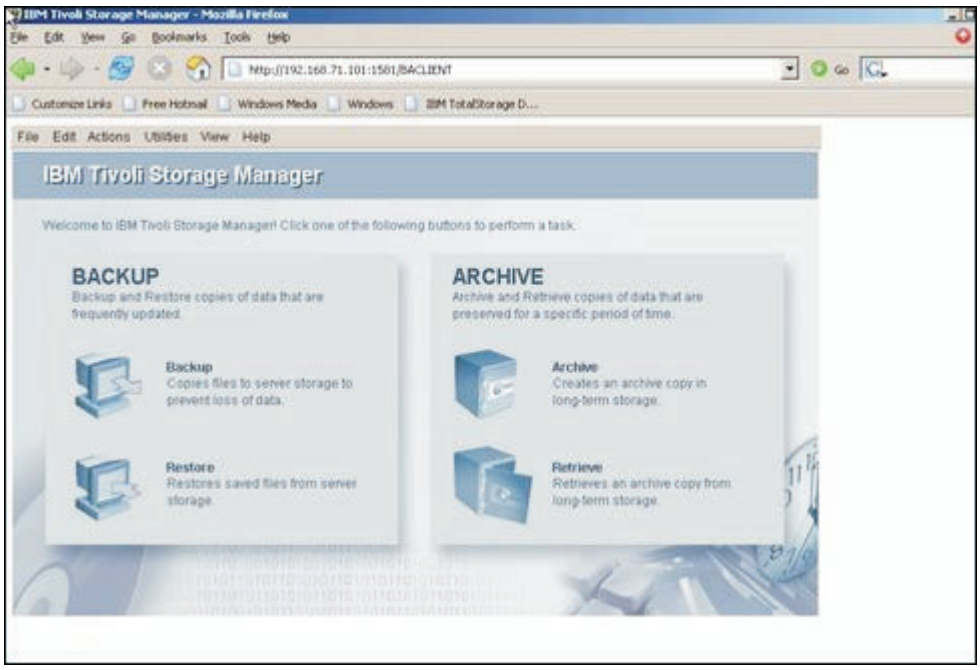


c. If the boxes needed to be checked, we had to reboot the Windows system to pick up the changes.

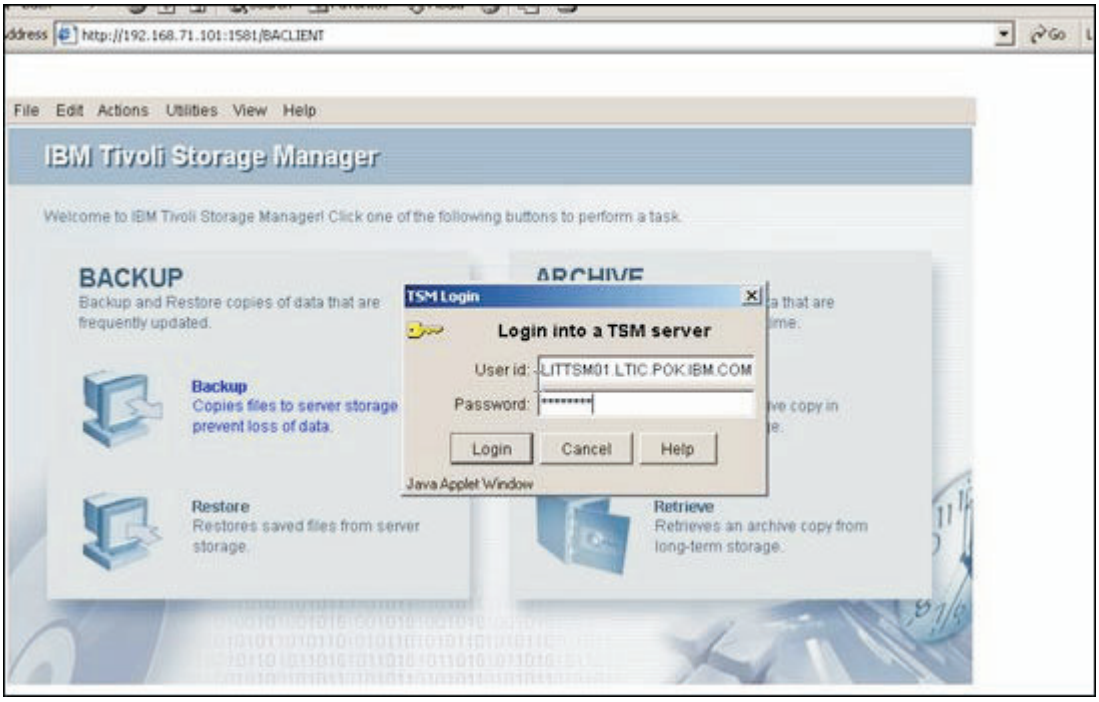
The URL for addressing the web client is

`http://clientIPaddress:1581`

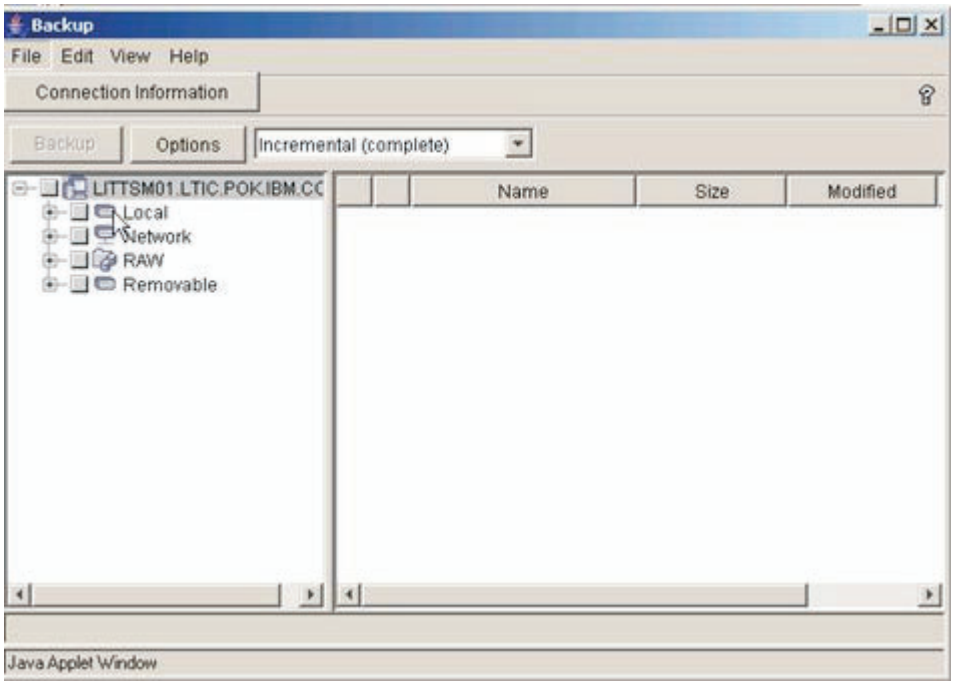
In our case the address was
`http:// 192.168.71.101:1581`



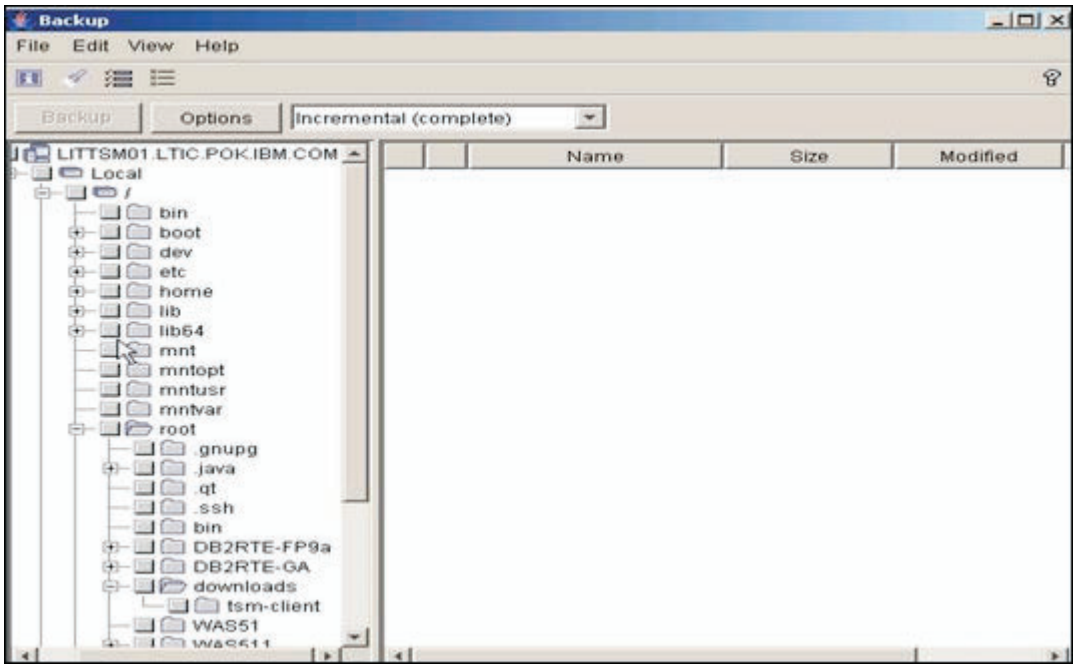
4. We chose the BACKUP icon and needed to log in.



5. The user ID is filled in by the system. We entered the password we used in the previous step.



6. We viewed the available files for backup by clicking on the Local icon.



Tivoli Access Manager for e-business

The level of TAM that ran on both SuSE Linux Enterprise Server 8 and 9 is v5.1 fix pack 13.

So we followed the Transition Guide's recommendation in transitioning this piece of middleware in our environment.

We worked on TAM last because we wanted to make sure WAS, DB2, and WAS ND Edge Components were all stable on SuSE Linux Enterprise Server 9 first.

We used the following guides and README's as references during the TAM migration:

- README file for TAM for e-business base Patch 5.1.0-TIV-TAM-FP0013:

  ```
  ftp://ftp.software.ibm.com/software/tivoli_support/patches/
  patches_5.1.0/5.1.0-TIV-TAM-FP0013/5.1.0-TIV-TAM-FP0013.README
  ```

- README file for TAM for e-business WebSEAL Patch 5.1.0-TIV-AWS-FP0013:

  ```
  ftp://ftp.software.ibm.com/software/tivoli_support/patches/
  patches_5.1.0/5.1.0-TIV-AWS-FP0013/5.1.0-TIV-AWS-FP0013.README
  ```

- IBM TAM v5.1 Upgrade Guide:

  ```
  http://publib.boulder.ibm.com/infocenter/tivihelp/v2r1/topic/
  com.ibm.itame3.doc_5.1/am51upgrade.pdf
  ```

For reference, our original TAM policy server was on littam01.ltic.pok.ibm.com, and our original WebSEAL server was on littam02.ltic.pok.ibm.com

Getting GSKit and FP13

TAM for e-business base Patch 5.1.0-TIV-TAM-FP0013:

```
http://www.ibm.com/support/docview.wss?rs=638&context=SSPREK&q1;
=FP0013&uid=swg24009186&loc=en_US&cs=utf-8&lang=en
```

TAM for e-business WebSEAL Patch 5.1.0-TIV-AWS-FP0013:

```
 http://www-1.ibm.com/support/docview.wss?rs=638&context=SSPREK&q1;
=FP0013&uid=swg24009187&loc=en_US&cs=utf-8&lang=en
```

GSKit version 7.0.3.9: To obtain the updated GSKit installation packages, contact IBM Customer Support for download locations.

Contact information can be obtained at the following Web address:

```
 http://techsupport.services.ibm.com/guides/tivoli_contacts.html
```

Upgrading the Policy Server

Registry considerations: Our TAM policy server used the IBM Tivoli Directory Server version 5.1. We decided not to upgrade our directory server because it was not on a Linux on zSeries system. If you are considering upgrading your registry as well, we recommend you do so in stages. Migrate either the registry first or the policy server first. Always backup your registry data and policy server data before doing any type of migration. The TAM Upgrade Guide referenced above contains more details on upgrading a TAM registry.

Backup TAM data*:* We used the pdbackup command to backup TAM data (for more details on the pdbackup command, see the TAM Command Reference or the Upgrade Guide).

```
littam01:~ # pdbackup -a backup -l
/opt/PolicyDirector/etc/pdbackup.lst

The output was written to /tmp/msg__pdbackup.log
```

We checked the log file for error messages, it returned with code 0.

The process backed up TAM data to an archive file in the format of

list_date.time.tar such as the following:
/var/PolicyDirector/pdbackup/pdbackup.lst_20Jul2005.17_45.tar

Apply FP13 to original system, verify functionality: We upgraded our existing GSKIT:

```
littam01:~/eTAM/FP13 # rpm -Uvh gsk7bas-7.0-3.9.s390.rpm
gsk7bas
###############################################
```

Stopped all TAM processes:

```
littam01:~/eTAM/FP13 # pd_start stop
Stopping the: Access Manager Policy Server
```

Applied FP13:

```
littam01:~/eTAM/FP13 # rpm -Uvh PDRTE-PD-5.1.0-13.s390.rpm
PDRTE-PD
###############################################
littam01:~/eTAM/FP13 # rpm -Uvh PDMgr-PD-5.1.0-13.s390.rpm
PDMgr-PD
 ###############################################
```

Restarted TAM and checked status:

```
littam01:~/eTAM/FP13 # pd_start start
Starting the Access Manager Policy Server
littam01:~/eTAM/FP13 # pd_start status

Access Manager Servers

Server                    Enabled   Running

------------------------------------------

pdmgrd                    yes       yes
pdacld                    no        no
pdmgrproxyd               no        no
```

Verified level:

```
littam01:~/eTAM/FP13 # rpm -qa | grep PD
PDMgr-PD-5.1.0-13
PDRTE-PD-5.1.0-13

littam01:~/eTAM/FP13 # pdversion
IBM Tivoli Access Manager Runtime                       5.1.0.13
IBM Tivoli Access Manager Policy Server                 5.1.0.13
IBM Tivoli Access Manager Web Portal Manager            Not Installed
IBM Tivoli Access Manager Application Developer Kit     Not Installed
IBM Tivoli Access Manager Authorization Server          Not Installed
IBM Tivoli Access Manager Java Runtime Environment      Not Installed
IBM Tivoli Access Manager Policy Proxy Server           Not Installed
```

Install TAM 5.1.13 policy server on new system: We created a brand new SuSE Linux Enterprise Server 9 system, littam10, and followed the TAM Upgrade Guide's instructions on "Upgrading the policy server using two systems" to perform the rest of the migration.

First, we installed GSKit (We just installed the version required by TAM 5.1.13):

```
littam10:~/TAM # rpm -Uvh gsk7bas-7.0-3.9.s390.rpm
Preparing...                ########################################### [100%]
   1:gsk7bas                ########################################### [100%]
```

Then, installed LDAP client:

```
littam10:/mnt/zSeries # rpm -Uvh ldap-clientd-5.2-1.s390.rpm
Preparing...                ########################################### [100%]
   1:ldap-clientd           ########################################### [100%]
```

Installed PDRTE and PDMGRD v5.1:

```
littam10:/mnt/zSeries # rpm -Uvh PDRTE-PD-5.1.0-0.s390.rpm
Preparing...                ########################################### [100%]
   1:PDRTE-PD               ########################################### [100%]
littam10:/mnt/zSeries # rpm -Uvh PDMgr-PD-5.1.0-0.s390.rpm
Preparing...                ########################################### [100%]
   1:PDMgr-PD               ########################################### [100%]
```

Installed FP13:

```
littam10:~/TAM # rpm -Uvh PDRTE-PD-5.1.0-13.s390.rpm
Preparing...                ########################################### [100%]
   1:PDRTE-PD               ########################################### [100%]
littam10:~/TAM # rpm -Uvh PDMgr-PD-5.1.0-13.s390.rpm
Preparing...                ########################################### [100%]
   1:PDMgr-PD               ########################################### [100%]
```

Copied over the LDAP key database from our original policy server to new one. This was needed because we were using SSL communication between the policy server and our registry:

```
littam01:/usr/ldap/etc # scp key_ldap.kdb littam10:/usr/ldap/etc/
Password:
key_ldap.kdb         100% |*****************************************|
55080       00:00
```

Copied the archive file produced from running pdbackup over to the new policy server, LITTAM10:

```
littam01:/var/PolicyDirector/pdbackup #
scp pdbackup.lst_20Jul2005.17_22.tar
192.168.71.122:/var/PolicyDirector/pdbackup

Password:
pdbackup.lst_20Jul20 100% |*****************************|
1440 KB    00:
```

Migrate to the new policy server, verify functionality: In order to configure the new TAM Policy Server on SLES 9, we restored the Policy Server settings from the

archive file produced on the Policy Server on SLES 8. This way the new server and the old server were both using the same LDAP registry. This was OK as later on we retired the server on SLES 8.

On the new Policy Server system, we ran the pdbackup command with the restore option, instead of the extract option:

```
littam10:/opt/PolicyDirector/bin # ./pdbackup -a restore -file
/var/PolicyDirector/pdbackup/pdbackup.lst_20Jul2005.17_45.ta

The output was written to /tmp/msg__pdbackup.log
```

We checked the log file for no errors. Then at this point the policy server was actually configured, even though we never ran the pdconfig utility.

```
littam10:/opt/PolicyDirector/bin # pd_start status

Access Manager Servers

Server                    Enabled   Running

------------------------------------------

pdmgrd                    yes       no
pdacld                    no        no
pdmgrproxyd               no        no
```

On the new Policy Server system, we updated /opt/PolicyDirector/etc/pd.conf with the hostname of the new system:

```
master-host = littam10
```

Now, we ran pdconfig to view the status, the Policy Server and runtime showed up as configured on the new system (littam10):

```
Tivoli Access Manager Configuration Status

  Package Name Configured?

  _____________________________________________________________

  Access Manager Runtime                          Yes
  Access Manager Policy Server                    Yes
```

Now we started the policy server and verified that it was registered with our registry:

```
littam10:/opt/PolicyDirector/etc # pd_start start
Starting the Access Manager Policy Server
littam10:/opt/PolicyDirector/etc # pdadmin -a sec_master -p password
pdadmin sec_master> acl list
default-webseal
default-management-proxy
default-management
default-root
default-gso
default-policy
default-config
default-domain
default-replica
pdadmin sec_master> user list s* 10
sec_master
pdadmin sec_master> exit
```

Now the policy server was successfully migrated, but we still needed to point other TAM servers (WebSEAL in our case) to the new Policy Server on littam10:

- On littam02, stopped WebSEAL:

```
littam02:~ # pd_start stop
Stopping the: webseald-WebSeal1
```

- On littam02, we updated /opt/PolicyDirector/etc/pd.conf:

```
master-host = littam10
```

- We updated our WebSEAL configuration file. Ours was /opt/pdweb/etc/webseald-WebSeal1.conf:

```
[manager]
master-host = littam10
```

We didn't have DNS, so we needed to add hostname/IP information in /etc/hosts on littam02 (WebSEAL) and littam10 (new policy server) so they knew how to resolve one another. We restarted WebSEAL and verified that it worked with the new policy server:

```
littam02:~ # pd_start start
Starting the: webseald-WebSeal1
littam02:~ # pd_start status

Access Manager Servers

Server                    Enabled   Running

------------------------------------------

pdmgrd                    no        no
pdacld                    no        no
pdmgrproxyd               no        no
webseald-WebSeal1         yes       yes

littam02:~ # pdadmin -a sec_master -p password
pdadmin sec_master> s list
    WebSeal1-webseald-littam02
pdadmin sec_master> s t WebSeal1-webseald-littam02 list
/
/was
pdadmin sec_master> s t WebSeal1-webseald-littam02 show /was
    Junction point: /was
    Type: SSL Proxy
    Junction hard limit: 0 - using global value
    Junction soft limit: 0 - using global value
    Active worker threads: 0
    Basic authentication mode: filter
    Forms based SSO: disabled
    Authentication HTTP header: insert - iv_user
    Remote Address HTTP header: do not insert
    Stateful junction: no
    Boolean Rule Header: no
    Scripting support: yes
    Preserve cookie names: no
    Delegation support: no
    Mutually authenticated using Basic Authentication: yes
        WebSEAL Username: wasadmin
        Password: lnx4ltic
    Insert WebSphere LTPA cookies: no
    Insert WebSEAL session cookies: no
    Request Encoding: UTF-8, URI Encoded
    Server 1:
        ID: 49283098-ed7f-11d9-b9cb-02000000001a
        Server State: running
        Proxy Hostname: litcp01.ltic.pok.ibm.com
        Proxy Port: 80
        Hostname: litwasclx.ltic.pok.ibm.com
        Port: 443
        Virtual hostname: litwasclx.ltic.pok.ibm.com
```

```
        Server DN:
        Query_contents URL: /cgi-bin/query_contents
        Query-contents: unknown
        Case insensitive URLs: no
        Allow Windows-style URLs: yes
        Total requests : 1
pdadmin sec_master>
```

Retire original policy server: Now we had the new policy server on littam10, the original policy server on littam01. We used the steps outlined in the Upgrade Guide, Chapter 2 -> Linux on zSeries: Upgrading the policy server -> Upgrading using two systems -> Retiring the original policy server. Then we took a short outage and shutdown the littam01 guest on VM and renamed littam10 to littam01 and performed the following steps to put it into production.

We had to edit /opt/PolicyDirector/etc/pd.conf to update:

```
master-host = littam01
```

After restarting the policy server, we verified that everything was still working:

```
littam01:/opt/PolicyDirector # pdadmin -a sec_master -p password
pdadmin sec_master> s list
    WebSeal1-webseald-littam20
pdadmin sec_master> acl list
default-webseal
default-management-proxy
default-management
default-root
default-gso
default-policy
default-config
default-domain
default-replica
pdadmin sec_master> user list s* 10
sec_master
pdadmin sec_master> s t WebSeal1-webseald-littam20 list
/
/was
```

Now we had our TAM v5.1.13 policy server running in 31-bit compatibility mode on a 64bit 2.6 SuSE LINUX Enterprise Server 9 guest, the hostname was still littam01.ltic.pok.ibm.com. We then updated our WebSEAL configuration file, /opt/pdweb/etc/webseald-WebSeal1.conf, to change the master-host parameter to littam01. Next we migrated the WebSEAL server.

Upgrading the WebSEAL Server*:*

Backup WebSEAL data*:* We backed up WebSeal data:

```
littam02:/opt/PolicyDirector # pdbackup -a backup -list
/opt/pdweb/etc/amwebbackup.lst

The output was written to /tmp/msg__pdbackup.log
```

We checked the log file for return code 0.

The process backed up WebSEAL data to an archive file in the format of list_date.time.tar such as the following:

```
/var/PolicyDirector/pdbackup/amwebbackup.lst_25Jul2005.10_44.tar
```

Apply FP13 to original system, verify functionality*:* Upgraded GSKit, needed by FP13:

```
littam02:~/eTAM/FP13 # rpm -qa | grep gsk
gsk7bas-7.0-1.13
littam02:~/eTAM/FP13 # rpm -Uvh gsk7bas-7.0-3.9.s390.rpm
gsk7bas                     ##########################
```

Stopped PDWEB:

```
littam02:~/eTAM/FP13 # pdweb stop
```

Applied FP13:

```
littam02:~/eTAM/FP13 # rpm -Uvh PDRTE-PD-5.1.0-13.s390.rpm
PDRTE-PD                    ##############################
littam02:~/eTAM/FP13 # rpm -Uvh PDWebRTE-PD-5.1.0-13.s390.rpm
PDWebRTE-PD                 ##############################
littam02:~/eTAM/FP13 # rpm -Uvh PDWeb-PD-5.1.0-13.s390.rpm
PDWeb-PD                    ##############################
```

Restarted PDWEB:

```
littam02:~/eTAM/FP13 # pdweb start
Starting the: webseald-WebSeal1
littam02:~/eTAM/FP13 # pdweb status
webseald-WebSeal1         yes       yes
```

Verified version:

```
littam02:~/eTAM/FP13 # rpm -qa | grep PD
PDRTE-PD-5.1.0-13
PDWebRTE-PD-5.1.0-13
PDWeb-PD-5.1.0-13
littam02:~/eTAM/FP13 # pdversion
IBM Tivoli Access Manager Runtime                       5.1.0.13
IBM Tivoli Access Manager Policy Server                 Not Installed
IBM Tivoli Access Manager Web Portal Manager            Not Installed
IBM Tivoli Access Manager Application Developer Kit     Not Installed
IBM Tivoli Access Manager Authorization Server          Not Installed
IBM Tivoli Access Manager Java Runtime Environment      Not Installed
IBM Tivoli Access Manager Policy Proxy Server           Not Installed
IBM Tivoli Access Manager WebSEAL Server                5.1.0.13
```

Verified functionality:

```
pdadmin sec_master> s t WebSeal1-webseald-littam02 show /was
    Junction point: /was
    Type: SSL Proxy
    Junction hard limit: 0 - using global value
    Junction soft limit: 0 - using global value
    Active worker threads: 0
    Basic authentication mode: filter
    Forms based SSO: disabled
    Authentication HTTP header: insert - iv_user
    Remote Address HTTP header: do not insert
    Stateful junction: no
    Boolean Rule Header: no
    Scripting support: yes
    Preserve cookie names: no
    Delegation support: no
    Mutually authenticated using Basic Authentication: yes
        WebSEAL Username: wasadmin
        Password: lnx4ltic
    Insert WebSphere LTPA cookies: no
    Insert WebSEAL session cookies: no
    Request Encoding: UTF-8, URI Encoded
    Server 1:
        ID: 49283098-ed7f-11d9-b9cb-02000000001a
        Server State: running
```

```
        Proxy Hostname: litcp01.ltic.pok.ibm.com
        Proxy Port: 80
        Hostname: litwasclx.ltic.pok.ibm.com
        Port: 443
        Virtual hostname: litwasclx.ltic.pok.ibm.com
        Server DN:
        Query_contents URL: /cgi-bin/query_contents
        Query-contents: unknown
        Case insensitive URLs: no
        Allow Windows-style URLs: yes
        Total requests : 1
pdadmin sec_master> exit
```

Install TAM WebSEAL 5.1.13 on the new system*:* A new 64bit 2.6 SUSE LINUX Enterprise Linux 9 system, littam20, was built to perform a fresh install on.

Installed GSKit:

```
littam20:~/TAM # rpm -Uvh gsk7bas-7.0-3.9.s390.rpm
Preparing...                ########################### [100%]
   1:gsk7bas                ########################### [100%]
```

Installed the LDAP client:

```
littam20:~/TAM # rpm -Uvh gsk7bas-7.0-3.9.s390.rpm
Preparing...                ########################### [100%]
   1:gsk7bas                ########################### [100%]
```

Installed PDRTE, PDWebRTE, and PDWeb, v5.1:

```
littam20:/mnt/zSeries # rpm -Uvh PDRTE-PD-5.1.0-0.s390.rpm
Preparing...                ############################ [100%]
adding ivmgr user
   1:PDRTE-PD               ############################ [100%]
littam20:/mnt/zSeries # rpm -Uvh PDWebRTE-PD-5.1.0-0.s390.rpm
Preparing...                ############################ [100%]
   1:PDWebRTE-PD            ############################ [100%]
littam20:/mnt/zSeries # rpm -Uvh PDWeb-PD-5.1.0-0.s390.rpm
Preparing...                ############################ [100%]
   1:PDWeb-PD               ############################ [100%]
```

Installed FP13:

```
littam20:~/TAM # rpm -Uvh PDRTE-PD-5.1.0-13.s390.rpm
Preparing...                ############################ [100%]
   1:PDRTE-PD               ############################ [100%]
littam20:~/TAM # rpm -Uvh PDWebRTE-PD-5.1.0-13.s390.rpm
Preparing...                ############################ [100%]
   1:PDWebRTE-PD            ############################ [100%]
littam20:~/TAM # rpm -Uvh PDWeb-PD-5.1.0-13.s390.rpm
Preparing...                ############################ [100%]
   1:PDWeb-PD               ############################ [100%]
```

Verified the version:

```
littam20:~/TAM # pdversion
IBM Tivoli Access Manager Runtime                    5.1.0.13
IBM Tivoli Access Manager Policy Server              Not Installed
IBM Tivoli Access Manager Web Portal Manager         Not Installed
IBM Tivoli Access Manager Application Developer Kit  Not Installed
IBM Tivoli Access Manager Authorization Server       Not Installed
IBM Tivoli Access Manager Java Runtime Environment   Not Installed
IBM Tivoli Access Manager Policy Proxy Server        Not Installed
IBM Tivoli Access Manager WebSEAL Server             5.1.0.13
```

Transferred the LDAP key database to the new WebSEAL system:

```
littam02:/usr/ldap/etc # scp key_ldap.kdb littam20:/usr/ldap/etc/
Password:
key_ldap.kdb         100% |********************| 55080       00:00
```

Perform WebSEAL migration, verify functionality*:* WebSEAL is much more hostname dependent than the base policy server, and the Upgrade Guide didn't have instructions on performing the migration using two systems. We tried the pdbackup –action restore method used to migrate our policy server but that did not work. So we used our own method to migrate WebSEAL. Since you can configure more than one WebSEAL server to the same policy server, we simply configured the WebSEAL server on littam20 to our new policy server while the WebSEAL server on littam02 was in production. We then verified that the new WebSEAL worked by creating a junction off of it, and testing that it worked. On littam20, we ran the pdconfig utility to configure the runtime:

```
 Tivoli Access Manager Configuration Menu


        1. Access Manager Runtime Configuration
        2. Access Manager WebSEAL Configuration
        x. Return to the Tivoli Access Manager Setup Menu


Select the menu item [x]: 1

Will the policy server be installed on this machine (y/n) [No]:

Tivoli Common Directory logging is not configured.
This scheme provides a common location for log files for Tivoli products instead of
separate locations determined by each application.



Do you want to use Tivoli Common Directory logging (y/n) [No]:

Log files for this application will be created in directory: /var/PolicyDirector/log


        1. LDAP
        2. Active Directory

Registry [1]: 1

LDAP server host name: eresources.ltic.pok.ibm.com

LDAP server port [389]:

Policy server host name: littam01.ltic.pok.ibm.com

Policy server SSL port [7135]:
Domain [Default]:
Automatically download the pdcacert.b64 file from the policy server? (y/n) [Yes]:
The SSL configuration of Access Control Runtime has completed successfully.
  Tivoli Access Manager policy server domain name:     Default
  Tivoli Access Manager policy server host name:       littam01.ltic.pok.ibm.com
  Tivoli Access Manager policy server listening port:  7135

The package has been configured successfully.


Press Enter to continue.
```

Ran the pdconfig utility again to configure WebSEAL:

```
  Tivoli Access Manager Configuration Menu
```

```
        1. Access Manager WebSEAL Configuration
        x. Return to the Tivoli Access Manager Setup Menu


Select the menu item [x]: 1


        Access Manager WebSEAL Setup Menu

        1. Configure
        2. Unconfigure
        3. Display Configuration Status
        x. Return to Access Manager Setup Menu


Please select the menu item [x]: 1

Enter WebSEAL instance name [default]: WebSeal1

Use logical network interface (y/n) [n]?

Enter WebSEAL hostname [littam20]:

Enter WebSEAL listening port [7234]:

Enter administrator ID [sec_master]:

Enter administrator password:

Enable SSL communication with the LDAP server (y/n) [y]?

Enter key file name (full path): /usr/ldap/etc/key_ldap.kdb

Enter key file password:

Enter certificate label (optional):

Enter LDAP SSL server port number [636]:

Allow HTTP access (y/n) [y]? n

Allow secure HTTPS access (y/n) [y]?

Enter HTTPS port [443]:

Enter Web document root directory [/opt/pdweb/www-WebSeal1/docs]:
Configuring WebSEAL instance 'WebSeal1'...
Starting the: webseald-WebSeal1
The WebSEAL instance 'WebSeal1' has been successfully configured.
Press ENTER to continue...
```

Checked that it was started:

```
littam20:/var/PolicyDirector/pdbackup # pdweb status
webseald-WebSeal1         yes       yes
```

Adding web server's SSL certificate to WebSEAL's key database*:* Now we were going to add our web server's SSL certificate to WebSEAL's key database so that we could create the SSL proxy junction. In order to do so, we first had to install 31bit Java in order to run the ikeyman tool, which we used to add the certificate. We installed IBMJava2-142 31bit from the rpm, and ran ikeyman.

From ikeyman, we opened WebSEAL's key database /var/pdweb/www/certs/pdsrv.kdb and added the web server's certificate lit.crt which we'd transferred from our web server to /var/pdweb/www/certs/ (you can put it in any temporary directory).

Creating a SSL proxy junction on the new WebSEAL*:* For more information about our WebSEAL configuration, please refer to Part 3 of the June 2005 zSeries Platform Test Report at http://www-1.ibm.com/servers/eserver/zseries/zos/integtst/

We started the WebSEAL server:

```
littam20:/mnt/zSeries # pdweb start
Starting the: webseald-WebSeal1
```

We added appropriate hostnames to /etc/hosts file (we didn't have DNS). We added litcp01 (Our caching proxy server) to littam20's /etc/hosts file.

We also added littam20 to litcp01's /etc/hosts file. We then logged into pdadmin, checked that the user ID wasadmin had been created, and created the junction:

```
littam20:/var/PolicyDirector/pdbackup # pdadmin -a sec_master -p password
pdadmin sec_master> user list was* 10
wasadmin
pdadmin sec_master> s t WebSeal1-webseald-littam20 create
-t sslproxy -B -U wasadmin -W lnx4ltic -c iv-user -H
litcp01.ltic.pok.ibm.com -P 80 -h 192.168.71.98 -p 443 -j /was
Created junction at /was
```

Finally, we verified that the junction was working by opening a browser and going to that URL: https://littam20.ltic.pok.ibm.com/was and we saw our application's front page.

Retire original WebSEAL server*:* Now we had littam02 (the original WebSEAL) and littam20 (the new WebSEAL), both running WebSEAL v5.1.13, both defined to the same policy server, and both having junctions to our backend WAS cluster. The only difference was that littam02 was on SUSE LINUX Enterprise Server 8 and littam20 was on SUSE LINUX Enterprise Server 9. In order to retire littam02, we had to shut down the WebSEAL server on it and unconfigured it. At this point we had to take a temporary outage to our production traffic.

In order to maintain the original IP and hostname, we had to install SUSE Linux Enterprise Server 9 over the old distribution on littam02 and reinstall WebSEAL v5.1.13 like we did on littam20. Then we performed the same steps as documented in the above section to configure it and create a junction on it. Finally, we had WebSEAL v.5.1.13 on littam02, which was on 64-bit 2.6 kernel level. After verifying that it worked by running workloads against the server, we retired littam20 for good.

Chapter 23. Future Linux on zSeries projects

Following are some areas of future testing for the Linux on zSeries team.

High availability

The team is also planning on creating a highly available Linux server environment, with interoperability with z/OS and taking advantage of high availability features offered in middleware products as well as on each OS.

Where to find more information

During our testing, we used documentation from several sources, listed below. They contain all of the documents that we have cited throughout the course of this chapter.

- IBM CICS Transaction Gateway documentation, available at http://www.ibm.com/software/ts/cics/library/
- IBM HTTP Server for OS/390 documentation, available at http://www.ibm.com/software/webservers/httpservers/library/
- IBM TechDocs (flashes, white papers, etc.), available at www.ibm.com/support/techdocs/
- IBM WebSphere Application Server for z/OS and OS/390 documentation, available at http://www.ibm.com/software/webservers/appserv/zos_os390/library/
- IBM WebSphere Studio documentation, available at http://www.ibm.com/developerworks/websphere/library/techarticles/0108_studio/studio_beta.html
- IBM WebSphere Studio Workload Simulator documentation, available at www.ibm.com/software/awdtools/studioworkloadsimulator/library/
- *Java Servlet Specification, v2.2*, available at http://java.sun.com/products/servlet/
- *Java 2 Platform Enterprise Edition Specification, v1.2*, available at http://java.sun.com/products/j2ee/
- *JavaServer Pages Specification, Version 1.1*, available at http://java.sun.com/products/jsp/
- *J2EE Connector Architecture*, available at http://java.sun.com/j2ee/connector/
- Tivoli Risk Manager product manuals, available at http://publib.boulder.ibm.com/tividd/td/RiskManager4.2.html
- Tivoli Access Manager Info Center, available at: http://publib.boulder.ibm.com/infocenter/tiv2help/index.jsp?toc=/com.ibm.itame.doc_5.1/toc.xml
- Exploring Open Source Security for a Linux Server Environment available at ftp://ftp.software.ibm.com/eserver/zseries/misc/literature/pdf/whitepapers/gm130636.pdf
- DB2 Info Center located at http://publib.boulder.ibm.com/infocenter/db2help/index.jsp?topic=/com.ibm.db2.udb.doc/ad/c0006975.htm
- IBM WebSphere Application Server Network Deployment Edge Components Info Center located at http://www-306.ibm.com/software/webservers/appserv/doc/v51/ec/infocenter/index.html
- IBM WebSphere Application Server Version 5.1.x Info Center located at: http://publib.boulder.ibm.com/infocenter/wasinfo/v5r1/index.jsp

Appendix A. Some of our parmlib members

This section describes how we have set up some of our parmlib members for z/OS. Table 18 summarizes our new and changed parmlib members for z/OS V1R5 and z/OS.e V1R5. Samples of some of our parmlib members are available on the Samples page of our Web site.

Table 18. Summary of our parmlib changes for z/OS V1R5 and z/OS.e V1R5

Member name	z/OS release	Change summary	Related to
IFAPRD*xx*	z/OS.e V1R5	No changes from z/OS.e V1R3. (See our December 2002 edition.)	z/OS.e, dynamic enablement
IEASYMPT	z/OS.e V1R5	No changes from z/OS.e V1R3. (See our December 2002 edition.)	z/OS.e, dynamic enablement
IEASYS*xx*	z/OS.e V1R5	No changes from z/OS.e V1R3. (See our December 2002 edition.)	z/OS.e
LOAD*xx* (Actually in SYS0.IPLPARM. See note below.)	z/OS V1R5	Changed the PARMLIB statement to use SYS1.PETR15.PARMLIB	concatenated parmlib
	z/OS.e V1R5	No changes from z/OS.e V1R3. (See our December 2002 edition.)	z/OS.e
LPALST*xx*	z/OS V1R5	Added: SYS1.SIATLPA	JES3
PROG*xx* (APF additions)	z/OS V1R5	Added: SYS1.SHASLINK SYS1.SHASMIG	JES2
PROG*yy* (LNKLST)	z/OS V1R5	Added to LNKLST*xx*: SYS1.SHASLINK SYS1.SHASMIG	JES2
		Added to LNKLST*xx*: SYS1.SIATLIB SYS1.SIATLINK SYS1.SIATMIG	JES3

Note: As of our OS/390 R6 testing, we changed LOAD*xx* to use a generic name, IEASYMPT, for our IEASYM*xx* member. We have successfully used the name IEASYMPT for our migrations through all subsequent releases of OS/390 and z/OS. Only the entries in SYS0.IPLPARM changed.

Appendix B. Some of our RMF reports

In this appendix we include some of our RMF reports, as indicated in “z/OS performance” on page 40.

RMF Monitor I post processor summary report

The following contains information from our *RMF Monitor I Post Processor Summary Report*. Some of the information we focus on in this report includes CP (CPU) busy percentages and I/O (DASD) rates.

```
1                                       R M F   S U M M A R Y   R E P O R T
                                                                                PAGE  001
            z/OS  V1R7              SYSTEM ID JA0            START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                    RPT VERSION V1R7 RMF     END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  32.3   1.2  2215   0.0     7     3    21    21   380   376     1     0    43    35 0.00   0.00
1                                       R M F   S U M M A R Y   R E P O R T
                                                                                PAGE  001
            z/OS  V1R7              SYSTEM ID JB0            START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                    RPT VERSION V1R7 RMF     END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  16.9   0.6  5243 549.0    13    10    74    72   646   643     1     0    27    23 0.00   0.00
1                                       R M F   S U M M A R Y   R E P O R T
                                                                                PAGE  001
            z/OS  V1R7              SYSTEM ID JC0            START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                    RPT VERSION V1R7 RMF     END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  12.3   1.5 194.5   0.0    12     9    27    27   385   379     1     0    38    29 0.00   0.00
1                                       R M F   S U M M A R Y   R E P O R T
                                                                                PAGE  001
            z/OS  V1R7              SYSTEM ID JE0            START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                    RPT VERSION V1R7 RMF     END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00   8.4   1.1  1246   0.0     1     0     0     0   363   362     1     0    24    18 0.00   0.00
1                                       R M F   S U M M A R Y   R E P O R T
                                                                                PAGE  001
            z/OS  V1R7              SYSTEM ID JF0            START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                    RPT VERSION V1R7 RMF     END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00   6.0   5.9 202.5   0.0     0     0     0     0   382   381     1     0    25    20 0.00   0.00
1                                       R M F   S U M M A R Y   R E P O R T
                                                                                PAGE  001
            z/OS  V1R7              SYSTEM ID JH0            START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                    RPT VERSION V1R7 RMF     END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  11.7   1.1 159.1   0.0     3     1     0     0   370   368     1     0    30    24 0.00   0.00
1                                       R M F   S U M M A R Y   R E P O R T
                                                                                PAGE  001
            z/OS  V1R7              SYSTEM ID J80            START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                    RPT VERSION V1R7 RMF     END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  86.1   3.9  4977   0.0   464   464   394   394   504   423     3     0   339   261 0.00   0.00
1                                       R M F   S U M M A R Y   R E P O R T
                                                                                PAGE  001
            z/OS  V1R7              SYSTEM ID J90            START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                    RPT VERSION V1R7 RMF     END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
```

```
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  13.9   1.3 446.2   0.0     3     2    12    12   377   370     1     0    29    21 0.00   0.00
1                                        R M F   S U M M A R Y   R E P O R T                                    PAGE  001
             z/OS  V1R7              SYSTEM ID Z0              START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                     RPT VERSION V1R7 RMF      END   09/15/2005-12.00.01  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  14.1   3.5  84.6   0.0     1     0     1     1   380   377     0     0    36    32 0.00   0.00
1                                        R M F   S U M M A R Y   R E P O R T                                    PAGE  001
             z/OS  V1R7              SYSTEM ID Z1              START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                     RPT VERSION V1R7 RMF      END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  23.3   3.4  1417   0.0     0     0     4     4   373   370     1     0    17    12 0.00   0.02
1                                        R M F   S U M M A R Y   R E P O R T                                    PAGE  001
             z/OS  V1R7              SYSTEM ID Z2              START 09/15/2005-11.45.00  INTERVAL 00.14.59
                                     RPT VERSION V1R7 RMF      END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 14.59   3.0   1.6  62.9   0.0    61    60     1     1   365   364     0     0     8     8 0.00   0.00
1                                        R M F   S U M M A R Y   R E P O R T                                    PAGE  001
             z/OS  V1R7              SYSTEM ID Z3              START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                     RPT VERSION V1R7 RMF      END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  23.5   2.0 301.2   0.0   122   121     2     2   396   391     1     0    17     9 0.00   0.00
1                                        R M F   S U M M A R Y   R E P O R T                                    PAGE  001
             z/OS  V1R7              SYSTEM ID TPN             START 09/15/2005-11.45.00  INTERVAL 00.15.00
                                     RPT VERSION V1R7 RMF      END   09/15/2005-12.00.00  CYCLE 0.100 SECONDS
0
 NUMBER OF INTERVALS 1
-DATE   TIME     INT   CPU   DASD  DASD  TAPE   JOB   JOB   TSO   TSO   STC   STC  ASCH  ASCH  OMVS  OMVS SWAP DEMAND
 MM/DD HH.MM.SS MM.SS  BUSY  RESP  RATE  RATE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE   MAX   AVE RATE PAGING
009/15 11.45.00 15.00  43.4   2.7 154.2   0.0     5     4     5     5   355   354     0     0     4     4 0.00   0.09
```

RMF Monitor III online sysplex summary report

The following contains information from the RMF *Monitor III Online Sysplex Summary Report*. This is a real-time report available if you are running WLM in goal mode. We highlighted some of our goals and actuals for various service classes and workloads. At the time this report was captured we were running 2784 CICS transactions/second.

```
WLM Samples: 240     Systems: 13 Date: mm/dd/yy Time: xx.xx.xx Range: 60    Sec

                      >>>>>>>>XXXXXXXXXXXXXXXXXX<<<<<<<<

Service Definition: WLMDEF01              Installed at: 08/23/05, 11.27.42
     Active Policy: WLMPOL01              Activated at: 08/23/05, 11.30.40

               ------- Goals versus Actuals --------  Trans --Avg. Resp. Time-
               Exec Vel  --- Response Time ---  Perf  Ended  WAIT EXECUT ACTUAL
Name     T  I  Goal Act  ---Goal--- --Actual--  Indx  Rate   Time   Time   Time

BATCH    W           64                                0.400 0.745  12.29  12.99
BATCHLOW S  4    10  90                          0.11  0.000 0.000  0.000  0.000
DISCR    S  D        54                                0.400 0.745  12.29  12.99
CICS     W          N/A                                 2784  0.000  0.033  0.031
CICS     S  2       N/A  0.600 80%        100%  0.50   1863 0.000  0.027  0.020
```

```
CICSCONV S  3       N/A  10.00 50%        100%  0.70  5.217 0.000  4.758  4.758
CICSDEFA S  3       N/A  1.000 90%        100%  0.50  513.5 0.000  0.046  0.045
CICSLONG S  3       N/A  10.00 50%        100%  0.50  0.017 0.000  0.147  0.147
CICSMISC S  3       N/A  1.000 90%        100%  0.50  402.2 0.000  0.002  0.002
CICSRGN  S  2    60  75                         0.80  0.000
ICSS     W          69                               50.55 0.000  0.113  0.113
FAST     S  2    50  83                         0.60  40.48 0.001  0.132  0.132
SLOW     S  4    50  50                         1.00  10.07 0.000  0.037  0.037
VEL30    S  2    30  68                         0.44  0.000
STC      W          66                               25.83 0.001  3.161  3.162
DB2HIGH  S  2    50  57                         0.87  0.000 0.000  0.000  0.000
DDF      S  5     5 0.0                          N/A  0.033 0.000  2.66M  2.66M
```

RMF workload activity report in WLM goal mode

The following illustrates a couple of sections from our RMF *Workload Activity Report* in goal mode. This report is based on a 15 minutes interval. Highlighted on the report you see 78.4% of our CICS transactions are completing in 0.5 seconds, and our CICS workload is processing 1139.54 transactions per second.

```
1                                    W O R K L O A D   A C T I V I T Y

1                                    W O R K L O A D   A C T I V I T Y                                        PAGE   6
        z/OS V1R7              SYSPLEX UTCPLXJ8          START 09/15/2005-11.45.00 INTERVAL 000.15.00   MODE = GOAL
                               RPT VERSION V1R7 RMF      END   09/15/2005-12.00.00

                                        POLICY ACTIVATION DATE/TIME 08/23/2005 11.30.40

   REPORT BY: POLICY=WLMPOL01   WORKLOAD=CICS       SERVICE CLASS=CICS       RESOURCE GROUP=*NONE      PERIOD=1 IMPORTANCE=2
                                                    CRITICAL     =NONE

   TRANSACTIONS    TRANS.-TIME  HHH.MM.SS.TTT
   AVG      0.00   ACTUAL                 30
   MPL      0.00   EXECUTION              39
   ENDED  770497   QUEUED                  0
   END/S  856.07   R/S AFFINITY            0
   #SWAPS      0   INELIGIBLE              0
   EXCTD  527308   CONVERSION              0
   AVG ENC  0.00   STD DEV               195
   REM ENC  0.00
   MS ENC   0.00

              RESP  ------------------------------- STATE SAMPLES BREAKDOWN (%) ------------------------------  ------STATE------
   SUB    P   TIME  --ACTIVE-- READY IDLE  ----------------------------WAITING FOR----------------------------  SWITCHED SAMPL(%)
   TYPE        (%)   SUB  APPL              I/O CONV LOCK MISC PROD LTCH                                        LOCAL SYSPL REMOT
   CICS  BTE    78.4 |  2.7   0.0   0.1  0.0   0.4 96.7  0.0  0.0  0.2  0.0                                      17.7  79.1   0.0
   CICS  EXE  21.9  52.4   0.0  11.5  0.1  29.4  0.0  0.0  1.3  5.2  0.0                                       0.4  51.6   0.0
   DB2   BTE   0.0   0.0   0.0   0.0  0.0   0.0  0.0  0.0  0.0  0.0  0.0                                       0.0   0.0   0.0
   DB2   EXE  18.8  31.2   0.0   0.0  0.0  32.7  0.0  8.9 25.8  0.1  1.2                                       0.0   0.0   0.0
   IMS   BTE   0.3   100   0.0   0.0  0.0   0.0  0.0  0.0  0.0  0.0  0.0                                       0.0   0.0   0.0
   IMS   EXE   3.0  96.8   0.0   0.0  0.0   0.0  0.0  3.2  0.0  0.0  0.0                                       0.0   0.0   0.0
   SMS   BTE   0.0   0.0   0.0   0.0  0.0   0.0  0.0  0.0  0.0  0.0  0.0                                       0.0   0.0   0.0
   SMS   EXE  21.2  46.8   0.0   0.0  0.0  37.8  0.0 15.4  0.0  0.0  0.0                                       0.0   0.0   0.0

   GOAL: RESPONSE TIME 000.00.00.600 FOR  80%

           RESPONSE TIME EX   PERF
   SYSTEM      ACTUAL%    VEL% INDX

   *ALL           100      N/A  0.5
   JA0            100      N/A  0.5
   JB0            100      N/A  0.5
   JC0            100      N/A  0.5
   JE0            100      N/A  0.5
   JF0            100      N/A  0.5
   J80            100      N/A  0.5
   J90            100      N/A  0.5
   Z1            99.4      N/A  0.5
   Z3            99.3      N/A  0.5
1                                    W O R K L O A D   A C T I V I T Y                                        PAGE   7
        z/OS V1R7              SYSPLEX UTCPLXJ8          START 09/15/2005-11.45.00 INTERVAL 000.15.00   MODE = GOAL
                               RPT VERSION V1R7 RMF      END   09/15/2005-12.00.00

                                        POLICY ACTIVATION DATE/TIME 08/23/2005 11.30.40

                                       ----------RESPONSE TIME DISTRIBUTION----------
```

```
      ----TIME----    --NUMBER OF TRANSACTIONS--    -------PERCENT-------  0    10   20   30   40   50   60   70   80   90   100
      HH.MM.SS.TTT    CUM TOTAL        IN BUCKET    CUM TOTAL   IN BUCKET  |....|....|....|....|....|....|....|....|....|....|....|
   <  00.00.00.300          762K             762K         98.8        98.8  >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
   <= 00.00.00.360          764K            2495          99.2         0.3  >
   <= 00.00.00.420          766K            1640          99.4         0.2  >
   <= 00.00.00.480          767K            1008          99.5         0.1  >
   <= 00.00.00.540          767K             632           100         0.1  >
   <= 00.00.00.600          768K             465           100         0.1  >
   <= 00.00.00.660          768K             304           100         0.0  >
   <= 00.00.00.720          768K             280           100         0.0  >
   <= 00.00.00.780          769K             193           100         0.0  >
   <= 00.00.00.840          769K             183           100         0.0  >
   <= 00.00.00.900          769K             158           100         0.0  >
   <= 00.00.01.200          769K             557           100         0.1  >
   <= 00.00.02.400          770K             685           100         0.1  >
   >  00.00.02.400          770K             397           100         0.1  >
1                                        W O R K L O A D   A C T I V I T Y                                                    PAGE   8
        z/OS V1R7              SYSPLEX UTCPLXJ8           START 09/15/2005-11.45.00 INTERVAL 000.15.00   MODE = GOAL
                               RPT VERSION V1R7 RMF       END   09/15/2005-12.00.00

                                       POLICY ACTIVATION DATE/TIME 08/23/2005 11.30.40


   REPORT BY: POLICY=WLMPOL01   WORKLOAD=CICS
                                      cics workload

   TRANSACTIONS    TRANS.-TIME  HHH.MM.SS.TTT   --DASD I/O--   ---SERVICE----   --SERVICE TIMES--   PAGE-IN RATES    ----STORAGE----
   AVG     86.95   ACTUAL                124   SSCHRT  8878   IOC     62703K   TCB        4174.0   SINGLE     0.0   AVG     49200.5
   MPL     86.95   EXECUTION              95   RESP     1.4   CPU    775053K   SRB        3200.4   BLOCK      0.0   TOTAL   4277751
   ENDED 1025752   QUEUED                  0   CONN     0.6   MSO      9117M   RCT           0.0   SHARED     0.0   CENTRAL 4277751
   END/S  1139.67  ▌ R/S AFFINITY           0   DISC     0.3   SRB    577547K   IIT          46.6   HSP        0.0   EXPAND     0.00
   #SWAPS      2   INELIGIBLE              0   Q+PEND   0.4   TOT     10532M   HST           0.0   HSP MISS   0.0
   EXCTD  610047   CONVERSION              0   IOSQ     0.0   /SEC    11702K   IFA           7.9   EXP SNGL   0.0   SHARED   573.63
   AVG ENC  0.00   STD DEV            11.665                                  APPL% CP    823.1   EXP BLK    0.0
   REM ENC  0.00                                             ABSRPTN   135K   APPL% IFACP   0.1   EXP SHR    0.0
   MS ENC   0.00                                             TRX SERV  135K   APPL% IFA     0.9
```

Appendix C. Some of our Linux for zSeries samples, scripts and EXECs

This section lists some of the scripts and EXECs we did with in Chapter 19, “About our Linux virtual server environment,” on page 299.

Files on our FTP server

Following are some sample files for our FTP server.

lticIPsetup

```
#!/bin/bash
#
# simple script to change the ifcfg-eth0 ip address and hostname regardless on Linux  #
iplist=/etc/ip.list

if [ -e /etc/run_lticIPsetup ]; then

  # assuming first column in the iplist is the ip-address
  uniqueid=$(cat /proc/sysinfo | grep "VM00 Name:" | awk '{print $3}')

  oldhostname=ltic0000.pdl.pok.ibm.com
  oldip=192.168.70.170

  myhostname=${uniqueid}.pdl.pok.ibm.com
  myip=$(grep -i $uniqueid $iplist | awk '{print $1}')

  if [ $(grep -i -c "SUSE" /etc/issue) -gt 0 ]; then
    # we have suse system
    targetfile=$(grep -l $oldip /etc/sysconfig/network/*)
    hostfile=/etc/HOSTNAME
  elif [ $(grep -i -c "RED HAT" /etc/issue) -gt 0 ]; then
    # we have redhat system
    targetfile=$(grep -l $oldip /etc/sysconfig/network-scripts/*)
    hostfile=/etc/sysconfig/network
  else
    echo "system not recognized"
    exit
  fi

  # change network file permanently for future boot up
  cat $targetfile | sed "s/$oldip/$myip/" > /tmp/target-eth0
  cat $hostfile | sed "s/$oldhostname/$myhostname/" > /tmp/target-host
  mv /tmp/target-eth0 $targetfile
  mv /tmp/target-host $hostfile
  chmod 644 $targetfile
  chmod 644 $hostfile

  # change running ip now
  ifconfig eth0 $myip netmask 255.255.255.0 broadcast 192.168.70.255

route add default gw 192.168.70.1
  hostname $myhostname

  # remove so that this script doesn't get run more than once
  rm /etc/run_lticIPsetup
fi
```

ip.list

```
192.168.70.170  LTIC0000
192.168.70.171  LTIC0001
192.168.70.172  LTIC0002
192.168.70.173  LTIC0003
192.168.70.174  LTIC0004
```

```
192.168.70.175  LTIC0005
192.168.70.176  LTIC0006
192.168.70.177  LTIC0007
192.168.70.178  LTIC0008
192.168.70.179  LTIC0009
192.168.70.180  LTIC0010
```

Files on our USER 194 disk

Following are our samples for our USER 194 disk.

PROFILE EXEC

```
/* LINUX PROFILE EXEC */
USR = USERID()
CP SET PF12 RETRIEVE
CP SET MSG ON
CP SET EMSG ON
CP SET RUN ON
CP SET RETRIEVE MAX
CP TERM CHARDEL OFF
ACC 592 K

/* Check if there is a 200 swap disk, if not, create one from V-DISK */
'PIPE CMS Q V 200'
if RC <> 0 THEN 'SWAPGEN 200 2048000 diag'

/* Ipl the Linux system if Disconnected  */
'PIPE CP Q ' USR ' | STACK LIFO '
PARSE PULL USER DASH STATE
IF STATE = 'DSC' THEN 'IPL 201 CLEAR'
ELSE call 'WELCOME'
EXIT
```

WELCOME EXEC

```
/*****************************************************************/
/*    WELCOME EXEC                                               */
/*        Display a Menu for the user                            */
/*****************************************************************/
/* Ipl the Linux system if Disconnected  */
'PIPE CMS ID | STACK LIFO '
PARSE PULL USER AT SYS .

TOP:
CLRSCRN  /* CLEAR THE SCREEN  */
say ' Welcome to ' USER ' on ' sys
say ' You have the following options: '
say;
say ' 1) IPL Linux on the 201 disk '
say ' 2) IPL Linux on the a disk other then 201 '
say ' 3) Install a new linux system '
say ' 4) Copy a pre-built Linux system '
say ' 5) Display my Networking Information'
say ' 6) What can I do with a LTICxxxx system '
say ' 7) EXIT '
 say;
 Pull opt
 SELECT
    when opt = 1 then do
         'IPL 201 CLEAR'
    end

    when opt = 2 then do
         say 'What disk do you want to IPL'
         pull disk
```

```
         if strip(disk)='CMS' then 'IPL CMS'
         ELSE 'IPL ' disk ' CLEAR'
    end

    when opt = 3 then do
         call DISTRO
    end

   when opt = 4 then do
        call DISTCOPY
      SIGNAL TOP
   end

   when opt = 5 then do
       'IPDATA'
       say ; say 'Hit enter to continue'
       pull .
       SIGNAL TOP
   end

   when opt = 5 then do
       'IPDATA'
       say ; say 'Hit enter to continue'
       pull .
       SIGNAL TOP
   end

   when opt = 6 then do
       'HELP LTIC'
      SIGNAL TOP
   end
   otherwise nop;
end /* Select */
```

Files on our USER 195 disk

Following are our samples for our USER 195 disk.

DISKCOPY EXEC

```
/*****************************************************************/
/*  DISTCOPY - Copy the DISTRO from the Master pack to 201 disk  */
/*                                                               */
/*                                                               */
/*                                                               */
/*****************************************************************/
'CLRSCRN'  /* Clear the screen */
'PIPE < DISTCOPY LIST * |spec 1-3 1 14-80 5 |  CONSOLE'
say;say;
say 'Enter the ID of the system you would like to copy'
say '       or Blank to exit'
pull id
if id = '' then exit
'PIPE < DISTCOPY LIST * | LOCATE 1-3 /'id'/ | STACK LIFO '
PARSE PULL new_id VOL DESC

'CLRSCRN'  /* Clear the screen */

"FLASHCOPY " VOL" 0 END 201 0 END"
IF RC = 0 then do
     say" The copy has completed"
    say ' Hit enter to return to the Main Menu'
    pull .
    EXIT 0
END
```

```
/* If we got here the flash copy failed so we will do a DDR copy */
'CLRSCRN'  /* Clear the screen */
SAY;say; SAY '                          HIT ENTER WHEN COPY COMPLETES '

    'makebuf'
    push '   '
    push 'YES'
    push 'YES'
    push 'COPY ALL'
    push 'OUTPUT 201 DASD'
    push 'INPUT 'VOL 'DASD'
    push 'SYSPRINT CONS'
    'DDR'
    'dropbuf'
    Say ' Copy has completed with Return Code: 'rc
    say ' Hit enter to return to the Main Menu'
    pull .
```

DISKCOPY LIST

```
ID           DISTRO

1   572A     SUSE   SLES 9 RC5           64 BIT  2.6.5-7.97-s390x
2   5720     SUSE   SLES 9 RC5           31 BIT  2.6.5-7.97-s390

3   572B     RHEL4 UPDATE 1 BETA         64 BIT  2.6.9-6.37.EL
4   5721     REDHAT RHEL 4  BETA 1       31 BIT  2.6.8-1.528.2.5

5   572C     REDHAT RHEL4 BETA1 REFRESH  64 BIT  2.6.8-1.528.2.5
6   5722     REDHAT RHEL4 BETA1 REFRESH  31 BIT  2.6.8-1.528.2.5

7   572D     REDHAT RHEL4 BETA 2         64 BIT  2.6.9-1.648_EL
8   5723     REDHAT RHEL4 BETA 2         31 BIT  2.6.9-1.648_EL

9   5724     REDHAT RHEL3 UPDATE 3       31 BIT  2.4.21-4.EL
```

DISTRO EXEC

```
/*****************************************************************/
/* DISTRO EXEC                                                   */
/*                                                               */
/* This exec will display the linux RamDisk systems that can be  */
/*  be loaded and then prompt the user for the system to install.*/
/*                                                               */
/*                                                               */
/*****************************************************************/

'CLRSCRN'  /* Clear the screen */
'PIPE < DISTRO LIST * |spec 1-3 1 14-80 5 |  CONSOLE'
say;say;
say 'Enter the ID of the system you would like to install'
say '       or Blank to exit'
pull id
if id = '' then exit
'PIPE < DISTRO LIST * | LOCATE 1-3 /'id'/ | STACK LIFO '
PARSE PULL new_id TAG DESC
'LOADRDR ' tag
```

DISKCOPY LIST

```
ID           DISTRO
1   26579731  SUSE   SLES 9 RC5          31 BIT  2.6.5-7.97-s390
2   26579764  SUSE   SLES 9 RC5          64 BIT  2.6.5-7.97-s390x

3   24211764  REDHAT RHEL3  update 3     64 BIT- 2.4.21-17.EL
4   24211731  REDHAT RHEL3  update 3     31 BIT  2.4.21-17.EL
```

```
5   241931    SUSE   SLES 8              31 BIT  2.4.19-3suse-SMP
6   SLES864   SUSE   SLES 8              64 BIT  2.4.19

7   RHEL4U1B  REDHAT RHEL4 UPDATE1 Beta  64 BIT 2.6.9-6.37.EL
8   RH4U131   REDHAT RHEL4 UPDATE1 Beta  31 BIT 2.6.9-1.37.EL

9   26571264  SUSE   SLES 9 RC1-update   64 BIT  2.6.5-7.127-s390x

A   RH4RC231  REDHAT RHEL4 RC2           31 BIT 2.6.9-1.906_EL
B   RH4RC264  REDHAT RHEL4 RC2           64 BIT 2.6.9-1.906_EL

C   RH4RC_31  REDHAT RHEL4 GA            31 BIT 2.6.?
D   RH4RC_64  REDHAT RHEL4 GA            64 BIT 2.6.?

E   S8SP3_31  SuSE SLES 8 SP 3           31 BIT 2.6.?
F   S8SP3_64  SuSE SLES 8 SP 3           64 BIT 2.6.?
```

IPDATA EXEC

```
/*****************************************************************/
/*  IPDATA EXEC - Display the users IP Information.              */
/*                                                               */
/*****************************************************************/
'PIPE CMS ID | STACK LIFO '
PARSE PULL USER AT SYS .
CLRSCRN  /* CLEAR THE SCREEN  */

'PIPE < IPDATA LIST * | LOCATE 1-8 /'USER'/| VAR OUTPUT '
 PARSE VAR OUTPUT USERID IP


say ' The IP Address for user: ' USER ' on ' sys 'is: 'IP

/* GET A LIST OF ALL THE VSWITCHES */
'PIPE CP Q VSWITCH | LOCATE /VSWITCH SYSTEM/ | STEM VSWITCH. '

x=1

DO VSWITCH.0
   switch_str=vswitch.x
   parse var switch_str . . switch .
   'PIPE CP Q VSWITCH DETAIL 'switch'| LOCATE /RDEV/ | var port'
   PARSE VAR PORT . name .
  'PIPE CP Q VSWITCH DETAIL 'switch' | LOCATE /'USER'/ | var detail '
  PARSE VAR detail . . . . dev .
  if dev <> '' then do
    say; say ' VSWITCH 'switch' DEVICE:'dev ' Portname:'name
  end
x=x+1
END /* do */
```

IPDATA LIST

```
LTIC0000     192.167.70.170
LTIC0001     192.167.70.171
LTIC0002     192.167.70.172
LTIC0003     192.167.70.173
LTIC0004     192.167.70.174
LTIC0005     192.167.70.175
LTIC0006     192.167.70.176
LTIC0007     192.167.70.177
LTIC0008     192.167.70.178
LTIC0009     192.167.70.179
LTIC0010     192.167.70.180
```

LOADRDR EXEC

```
/*****************************************************************/
/* LOADRDR EXEC                                                  */
/* This EXEC will load the required files into the reader        */
/* so that you can IPL the LINUX RAM DISK to build the DISTRO    */
/*                                                               */
/* Usage:  DISKLOAD linux_distro_id                              */
/*                                                               */
/*****************************************************************/
arg tag
if tag  = '' then do
    say 'USEAGE:   linux_distro_id '
    say;
say 'RUN the xxxx EXEC to get the linux_distro_id'
    EXIT
end

'close rdr'
'purge rdr all'
'spool punch * rdr'

/*  Need to add some code to make sure the files exist */

'PUNCH 'tag ' IMAGE D (NOH'
'PUNCH 'tag ' PARM D (NOH'
'PUNCH 'tag ' INITRD D (NOH'
'change rdr all keep nohold'
'ipl 00c clear'
```

Appendix D. Availability of our test reports

The following information describes the variety of ways in which you can obtain our test reports.

Our publication schedule is changing

Starting in 2003, our publication schedule changed somewhat from our traditional quarterly cycle as a result of the planned change in the development cycle for annual z/OS releases. Keep an eye on our Web site for announcements about the availability of new editions of our test report.

Availability on the Internet: You can view, download, and print the most current edition of our test report from our z/OS Integration Test Web site at:

www.ibm.com/servers/eserver/zseries/zos/integtst/

Our Web site also provides all of our previous year-end editions, each of which contains all of the information from that year's interim editions.

You can also find our test reports on the z/OS Internet Library Web site at:

www.ibm.com/servers/eserver/zseries/zos/bkserv/

Each edition is available in the following formats:

- IBM BookManager BOOK format

  On the Web, BookManager documents are served as HTML via IBM BookServer. You can use your Web browser (no plug-in or other applications are needed) to view, search, and print selected topics. You can also download individual BOOK files and access them locally using the IBM Softcopy Reader or IBM Library Reader™. You can get the Softcopy Reader or Library reader free of charge from the IBM Softcopy Web site at www.ibm.com/servers/eserver/zseries/softcopy/.
- Adobe Portable Document Format (PDF)

  PDF documents require the Adobe Acrobat Reader to view and print. Your Web browser can invoke the Acrobat Reader to work with PDF files online. You can also download PDF files and access them locally using the Acrobat Reader. You can get the Acrobat Reader free of charge from www.adobe.com/products/acrobat/readstep.html.

Softcopy availability: BookMaster BOOK and Adobe PDF versions of our test reports are included in the OS/390 and z/OS softcopy collections on CD-ROM and DVD. For more information about softcopy deliverables and tools, visit the IBM Softcopy Web site (see above for the Web site address).

A note about the currency of our softcopy editions

Because we produce our test reports toward the end of the product development cycle, just before each new software release becomes generally available (GA), we cannot meet the production deadline for the softcopy collections that coincide with the product's GA release. Therefore, there is normally a one-edition lag between the release of our latest test report edition and the softcopy collection in which it is included. That is, the test report that appears in any given softcopy collection is normally one edition behind the most current edition available on the Web.

Hardcopy availability: Our December 2001 edition was the last edition to be published in hardcopy. As of 2002, we no longer produce a hardcopy edition of our year-end test reports. You can still order a printed copy of a previous year-end edition (using the order numbers shown in Table 19 below) through your normal ordering process for IBM publications.

Available year-end editions: The following year-end editions of our test report are available:

Table 19. Available year-end editions of our test report

		Covers our test experiences for...		
Title	**Order number**	**This year...**	**And these releases...**	**Softcopy collection kits**
zSeries Platform Test Report	SA22-7997-00	2004	z/OS V1R6	SK3T-4269-14
z/OS Parallel Sysplex Test Report	SA22-7663-09	2003	z/OS V1R4	SK3T-4269-11 SK3T-4271-11
z/OS Parallel Sysplex Test Report	SA22-7663-07	2002	z/OS V1R3 and V1R4	SK3T-4269-07 SK3T-4271-07
z/OS Parallel Sysplex Test Report	SA22-7663-03	2001	z/OS V1R1 and V1R2	SK3T-4269-03 SK3T-4270-04 SK3T-4271-03
OS/390 Parallel Sysplex Test Report	GC28-1963-19	2000	OS/390 V2R9 and V2R10	SK2T-6700-24 SK2T-6718-14
OS/390 Parallel Sysplex Test Report	GC28-1963-15	1999	OS/390 V2R7 and V2R8	SK2T-6700-17
OS/390 Parallel Sysplex Test Report	GC28-1963-11	1998	OS/390 V2R5 and V2R6	SK2T-6700-15 and -17
OS/390 Parallel Sysplex Test Report	GC28-1963-07	1997	OS/390 V1R3 and V2R4	SK2T-6700-11 and -13
OS/390 Parallel Sysplex Test Report	GC28-1963-03	1996	OS/390 V1R1 and V1R2	SK2T-6700-07
S/390 MVS Parallel Sysplex Test Report	GC28-1236-02	1995	MVS/ESA SP V5	none

Other related publications: From our Web site, you can also access other related publications, including our companion publication, *OS/390 Parallel Sysplex Recovery*, GA22-7286, as well as previous editions of *OS/390 e-Business Integration Test (eBIT) Report*.

Appendix E. Useful Web sites

We have cited the IBM books we used to do our testing as we refer to them in each topic in this test report. This chapter contains listings of some of the Web sites that we reference in this edition or previous editions of our test report.

IBM Web sites

Table 20 lists some of the IBM Web sites that we reference in this edition or previous editions of our test report:

Table 20. Some IBM Web sites that we reference

Web site name or topic	Web site address
IBM Terminology (includes the *Glossary of Computing Terms*)	www.ibm.com/ibm/terminology/
IBM CICS Transaction Gateway	www.ibm.com/software/ts/cics/library/
IBM HTTP Server library	http://www.ibm.com/software/webservers/httpservers/library/
IBMLink™	www.ibm.com/ibmlink/
IBM mainframe servers Internet library	www.ibm.com/servers/eserver/zseries/library/literature/
IBM Redbooks	www.ibm.com/redbooks/
IBM Systems Center Publications (IBM TechDocs — flashes, white papers, etc.)	www.ibm.com/support/techdocs/
Linux at IBM	www.ibm.com/linux/
Net.Data Library	http://www.ibm.com/servers/eserver/iseries/software/netdata/docs/index.html
OS/390 Internet library	www.ibm.com/servers/s390/os390/bkserv/
Parallel Sysplex	www.ibm.com/servers/eserver/zseries/pso/
Parallel Sysplex Customization Wizard	http://www.ibm.com/servers/eserver/zseries/pso/tools.html
System Automation for OS/390	www.ibm.com/servers/eserver/zseries/software/sa/
WebSphere Application Server	www.ibm.com/software/webservers/appserv/
WebSphere Application Server library	www.ibm.com/software/webservers/appserv/zos_os390/library/
WebSphere Studio library	http://www.ibm.com/developerworks/views/websphere/libraryview.jsp
WebSphere Studio Workload Simulator	www.ibm.com/software/awdtools/studioworkloadsimulator/library/
z/OS Consolidated Service Test	www.ibm.com/servers/eserver/zseries/zos/servicetst
z/OS downloads	www.ibm.com/servers/eserver/zseries/zos/downloads/
z/OS Integration Test (includes information from OS/390 Integration Test and e-business Integration Test (ebIT))	www.ibm.com/servers/eserver/zseries/zos/integtst/
z/OS Internet library	www.ibm.com/servers/eserver/zseries/zos/bkserv/
z/OS UNIX System Services	www.ibm.com/servers/eserver/zseries/zos/unix/
z/OS.e home page	www.ibm.com/servers/eserver/zseries/zose/

Table 20. Some IBM Web sites that we reference (continued)

Web site name or topic	Web site address
z/OS.e Internet library	www.ibm.com/servers/eserver/zseries/zose/bkserv/

Other Web sites

Table 21 lists some other non-IBM Web sites that we reference in this edition or previous editions of our test report:

Table 21. Other Web sites that we reference

Web site name or topic	Web site address
Cisco Systems	www.cisco.com/
Java Servlet Technology	java.sun.com/products/servlet/
Java 2 Platform, Enterprise Edition (J2EE)	java.sun.com/products/j2ee/
JavaServer Pages (JSP)	java.sun.com/products/jsp/
J2EE Connector Architecture	java.sun.com/j2ee/connector/
SUSE Linux	www.suse.com/

Appendix F. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to *z/OS TSO/E Primer*, *z/OS TSO/E User's Guide*, and *z/OS ISPF User's Guide Vol I* for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

z/OS information

z/OS information is accessible using screen readers with the BookServer/Library Server versions of z/OS books in the Internet library at:

`www.ibm.com/servers/eserver/zseries/zos/bkserv/`

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MQSeries
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MVS/ESA
Net.Data
NetView
Notes
OS/2
OS/390
Parallel Sysplex
PR/SM
Processor Resource/Systems Manager
QMF
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Readers' Comments — We'd Like to Hear from You

z/OS
zSeries Platform Test Report for z/OS and Linux Virtual Servers
Version 1 Release 7

Publication No. SA22-7997-02

Overall, how satisfied are you with the information in this book?

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Overall satisfaction	☐	☐	☐	☐	☐

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Complete	☐	☐	☐	☐	☐
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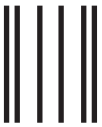

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