MVS Programming: Callable Services for High-Level Languages

Version 2 Release 1
Before using this information and the product it supports, read the information in "Notices" on page 439.
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About this information

Callable services are for use by any program coded in C, COBOL, FORTRAN, Pascal, or PL/I — this information refers to programs written in these languages as high-level language (HLL) programs. Callable services enable HLL programs to use specific MVS services by issuing program CALLs.

Who should use this information

This information is for programmers who code in C, COBOL, FORTRAN, Pascal, or PL/I and want to use the callable services that MVS provides.

How to use this information

This information is one of the set of programming documents for MVS. This set describes how to write programs in assembler language or high-level languages, such as C, FORTRAN, and COBOL. For more information about the content of this set of documents, see z/OS Information Roadmap.

z/OS information

This information explains how z/OS references information in other documents and on the web.

When possible, this information uses cross document links that go directly to the topic in reference using shortened versions of the document title. For complete titles and order numbers of the documents for all products that are part of z/OS, see z/OS Information Roadmap.

To find the complete z/OS library, including the z/OS Information Center, go to the z/OS Internet library (http://www.ibm.com/systems/z/os/zos/bkserv/).
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Summary of changes

This information includes terminology, maintenance, and editorial changes. 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 z/OS Version 2 Release 1 (V2R1) as updated September 2014

The following changes are made for z/OS Version 2 Release 1 (V2R1), as updated September 2014.

Changed

Changes have been made to the descriptions of the FPZ4ABC and FPZ4RMR compression services.

Changes have been made to some parameter field descriptions for the FPZ4PRB, FPZ4RMR and FPZ4RZV compression services.

Summary of changes for z/OS Version 2 Release 1 (V2R1) as updated March 2014

The following changes are made for z/OS Version 2 Release 1 (V2R1), as updated March 2014.

New

New option fields are added in the FPZ4RZV and FPZ4PRB compression services.

Note: For more information on the zEDC compression enhancements, see z/OS DFSMS Using the New Functions.

z/OS Version 2 Release 1 summary of changes

See the following publications for all enhancements to z/OS Version 2 Release 1 (V2R1):

- z/OS Migration
- z/OS Planning for Installation
- z/OS Summary of Message and Interface Changes
- z/OS Introduction and Release Guide
Part 1. Window services
Chapter 1. Introduction to window services

Window services allow HLL programs to:

- Read or update an existing permanent data object
- Create and save a new permanent data object
- Create and use a temporary data object

Window services enable your program to access data objects without your program performing any input or output (I/O) operations. All your program needs to do is issue a CALL to the appropriate service program. The service program performs any I/O operations that are required to make the data object available to your program. When you want to update or save a data object, window services again perform any required I/O operations.

Permanent data objects

A permanent data object is a virtual storage access method (VSAM) linear data set that resides on DASD. (This type of data set is also called a data-in-virtual object.) You can read data from an existing permanent object and also update the content of the object. You can create a new permanent object and when you are finished, save it on DASD. Because you can save this type of object on DASD, window services calls it a permanent object. Window services can handle very large permanent objects that contain as many as 4 gigabytes (four billion bytes).

Note: Installations whose FORTRAN programs used data-in-virtual objects prior to MVS/SP 3.1.0 had to write an assembler language interface program to allow the FORTRAN program to invoke the data-in-virtual program. Window services eliminates the need for this interface program.

Temporary data objects

A temporary data object is an area of expanded storage that window services provides for your program. You can use this storage to hold temporary data, such as intermediate results of a computation, instead of using a DASD workfile. Or you might use the storage area as a temporary buffer for data that your program generates or obtains from some other source. When you finish using the storage area, window services deletes it. Because you cannot save the storage area, window services calls it a temporary object. Window services can handle very large temporary objects that contain as many as 16 terabytes (16 trillion bytes).

Structure of a data object

Think of a data object as a contiguous string of bytes organized into blocks, each 4096 bytes long. The first block contains bytes 0 to 4095 of the object, the second block contains bytes 4096 to 8191, and so forth.

Your program references data in the object by identifying the block or blocks that contain the desired data. Window services makes the blocks available to your program by mapping a window in your program storage to the blocks. A window is a storage area that your program provides and makes known to window services. Mapping the window to the blocks means that window services makes the data from those blocks available in the window when you reference the data.
You can map a window to all or part of a data object depending on the size of the object and the size of the window. You can examine or change data that is in the window by using the same instructions that you use to examine or change any other data in your program storage.

The following figure shows the structure of a data object and shows a window mapped to two of the object’s blocks.

**Figure 1. Structure of a Data Object**

**What does window services provide?**

Window services allows you to view and manipulate data objects in a number of ways. You can have access to one or more data objects at the same time. You can also define multiple windows for a given data object. You can then view a different part of the object through each window. Before you can access any data object, you must request access from window services.

When you request access to a permanent data object, you must indicate whether you want a scroll area. A scroll area is an area of expanded storage that window services obtains and maps to the permanent data object. You can think of the permanent object as being available in the scroll area. When you request a view of the object, window services maps the window to the scroll area. If you do not request a scroll area, window services maps the window directly to the object on DASD.

A scroll area enables you to save interim changes to a permanent object without changing the object on DASD. Also, when your program accesses a permanent object through a scroll area, your program might attain better performance than it would if the object were accessed directly on DASD.

When you request a temporary object, window services provides an area of expanded storage. This area of expanded storage is the temporary data object. When you request a view of the object, window services maps the window to the temporary object. Window services initializes a temporary object to binary zeroes.

**Note:**
1. Window services does not transfer data from the object on DASD, from the scroll area, or from the temporary object until your program references the data. Then window services transfers those blocks.

2. The expanded storage that window services uses for a scroll area or for a temporary object is called a hiperspace. A hiperspace is a range of contiguous virtual storage addresses that a program can indirectly access through a window in the program’s virtual storage. Window services uses as many hiperspaces as needed to contain the data object.

**The ways that window services can map an object**

Window services can map a data object a number of ways. The following examples show how window services can:

- Map a permanent object that has no scroll area
- Map a permanent object that has a scroll area
- Map a temporary object
- Map an object to multiple windows
- Map multiple objects

**Example 1 — Mapping a permanent object that has no scroll area**

If a permanent object has no scroll area, window services maps the object from DASD directly to your window. In this example, your window provides a view of the first and second blocks of an object.

**Example 2 — Mapping a permanent object that has a scroll area**

If the object has a scroll area, window services maps the object from DASD to the scroll area. Window services then maps the blocks that you wish to view from the scroll area to your window. In this example, your window provides a view of the third and fourth blocks of an object.
Example 3 — Mapping a temporary object
Window services uses a hiperspace as a temporary object. In this example, your window provides a view of the first and second blocks of a temporary object.

Example 4 — Mapping multiple Windows to an object
Window services can map multiple windows to the same object. In this example, one window provides a view of the second and third blocks of an object, and a second window provides a view of the last block.
Example 5 — Mapping multiple objects

Window services can map windows in the same address space to multiple objects. The objects can be temporary objects, permanent objects, or a combination of temporary and permanent objects. In this example, one window provides a view of the second block of a temporary object, and a second window provides a view of the fourth and fifth blocks of a permanent object.
**Access to permanent data objects**

When you have access to a permanent data object, you can:

- **View the object through one or more windows** — Depending on the object size and the window size, a single window can view all or part of a permanent object. If you define multiple windows, each window can view a different part of the object. For example, one window might view the first block of the permanent object and another window might view the second block. You can also have several windows view the same part of the object or have views in multiple windows overlap. For example, one window might view the first and second blocks of a data object while another window views the second and third blocks.

- **Change data that appears in a window** — You can examine or change data that is in a window by using the same instructions you use to examine or change any other data in your program’s storage. These changes do not alter the object on DASD or in the scroll area.
• **Save interim changes in a scroll area** — After changing data in a window, you can have window services save the changed blocks in a scroll area, if you have requested one. Window services replaces blocks in the scroll area with corresponding changed blocks from the window. Saving changes in the scroll area does not alter the object on DASD or alter data in the window.

• **Refresh a window or the scroll area** — After you change data in a window or save changes in the scroll area, you may discover that you no longer need those changes. In that case, you can have window services refresh the changed data. To refresh the window or the scroll area, window services replaces changed data with data from the object as it appears on DASD.

• **Replace the view in a window** — After you finish using data that is in a window, you can have window services replace the view in the window with a different view of the object. For example, if you are viewing the third, fourth, and fifth blocks of an object and are finished with those blocks, you might have window services replace that view with a view of the sixth, seventh, and eighth blocks.

• **Update the object on DASD** — If you have changes available in a window or in the scroll area, you can save the changes on DASD. Window services replaces blocks on DASD with corresponding changed blocks from the window and the scroll area. Updating an object on DASD does not alter data in the window or in the scroll area.

## Access to temporary data objects

When you have access to a temporary data object, you can:

• **View the object through one or more windows** — Depending on the object size and the window size, a single window can view all or part of a temporary object. If you define multiple windows, each window can view a different part of the object. For example, one window might view the first block of the temporary object and another window might view the second block. Unlike a permanent object, however, you cannot define multiple windows that have overlapping views of a temporary object.

• **Change data that appears in a window** — This function is the same for a temporary object as it is for a permanent object: you can examine or change data that is in a window by using the same instructions you use to examine or change any other data in your address space.

• **Update the temporary object** — After you have changed data in a window, you can have window services update the object with those changes. Window services replaces blocks in the object with corresponding changed blocks from the window. The data in the window remains as it was.

• **Refresh a window or the object** — After you change data in a window or save changes in the object, you may discover that you no longer need those changes. In that case, you can have window services refresh the changed data. To refresh the window or the object, window services replaces changed data with binary zeroes.

• **Replace the view in a window** — After you finish using data that is in a window, you can have window services replace the view in the window with a different view of the object. For example, if you are viewing the third, fourth, and fifth blocks of an object and are finished with those blocks, you might have window services replace that view with a view of the sixth, seventh, and eighth blocks.
Chapter 2. Using window services

To use, create, or update a data object, you call a series of programs that window services provides. These programs enable you to:

- Access an existing object, create and save a new permanent object, or create a temporary object
- Obtain a scroll area where you can make interim changes to a permanent object
- Define windows and establish views of an object in those windows
- Change or terminate the view in a window
- Update a scroll area or a temporary object with changes you have made in a window
- Refresh changes that you no longer need in a window or a scroll area
- Update a permanent object on DASD with changes that are in a window or a scroll area
- Terminate access to an object

The window services programs that you call and the sequence in which you call them depends on your use of the data object.

The first step in using any data object is to gain access to the object. To gain access, call CSRIDAC. The object can be an existing permanent object, or a new permanent or temporary object you want to create. For a permanent object, you can request an optional scroll area. A scroll area enables you to make interim changes to an object’s data without affecting the data on DASD. When CSRIDAC grants access, it provides an object identifier that identifies the object. Use that identifier to identify the object when you request other services from window services.

After obtaining access to an object, define one or more windows and establish views of the object in those windows. To establish a view of an object, tell window services which blocks you want to view and in which windows. You can view multiple objects and multiple parts of each object at the same time. To define windows and establish views, call CSRVIEW or CSREVW. After establishing a view, you can examine or change data that is in the window using the same instructions you use to examine or change other data in your program’s storage.

After making changes to the part of an object that is in a window, you will probably want to save those changes. How you save changes depends on whether the object is permanent, is temporary, or has a scroll area.

If the object is permanent and has a scroll area, you can save changes in the scroll area without affecting the object on DASD. Later, you can update the object on DASD with changes saved in the scroll area. If the object is permanent and has no scroll area, you can update it on DASD with changes that are in a window. If the object is temporary, you can update it with changes that are in a window. To update an object on DASD, call CSRSAVE. To update a temporary object or a scroll area, call CSRSCOT.

After making changes in a window and possibly saving them in a scroll area or using them to update a temporary object, you might decide that you no longer need those changes. In this case, you can refresh the changed blocks. After refreshing a block of a permanent object or a scroll area to which a window is
mapped, the refreshed block contains the same data that the corresponding block contains on DASD. After refreshing a block of a temporary object to which a window is mapped, the block contains binary zeroes. To refresh a changed block, call CSRREFR.

After finishing with a view in a window, you can use the same window to view a different part of the object or to view a different object. Before changing the view in a window, you must terminate the current view. If you plan to view a different part of the same object, terminate the current view by calling CSRVIEW. If you plan to view a different object or will not reuse the window, you can terminate the view by calling CSRIDAC.

When you finish using a data object, terminate access to the object by calling CSRIDAC.

The following restrictions apply to using window services:

1. When you attach a new task, you cannot pass ownership of a mapped virtual storage window to the new task. That is, you cannot use the ATTACH or ATTACHX keywords GSPV and GSPL to pass the mapped virtual storage.

2. While your program is in cross-memory mode, your program cannot invoke data-in-virtual services; however, your program can reference and update data in a mapped virtual storage window.

3. The task that obtains the ID (through DIV IDENTIFY) is the only one that can issue other DIV services for that ID.

4. When you identify a data-in-virtual object using the IDENTIFY service, you cannot request a checkpoint until you invoke the corresponding UNIDENTIFY service.

This topic explains how to do the previously described functions and contains the following subtopics:

- “Obtaining access to a data object”
- “Defining a view of a data object” on page 14
- “Defining multiple views of an object” on page 17
- “Saving interim changes to a permanent data object” on page 18
- “Updating a temporary data object” on page 18
- “Refreshing changed data” on page 19
- “Updating a permanent object on DASD” on page 20
- “Changing a view in a window” on page 20
- “Terminating access to a data object” on page 22
- “Handling return codes and abnormal terminations” on page 22

### Obtaining access to a data object

To obtain access to a permanent or temporary data object, call CSRIDAC. Indicate that you want to access an object by specifying BEGIN as the value for op_type. For a description of the CSRIDAC parameters and return codes, see “CSRIDAC — Request or terminate access to a data object” on page 27.

#### Identifying the object

You must identify the data object you wish to access. How you identify the object depends on whether the object is permanent or temporary.
Permanent object
For a permanent object, *object_name* and *object_type* work together. For *object_name* you have a choice: specify either the data set name of the object or the DDNAME to which the object is allocated. The *object_type* parameter must then indicate whether *object_name* is a DDNAME or a data set name:
- If *object_name* is a DDNAME, specify DDNAME as the value for *object_type*.
- If *object_name* is a data set name, specify DSNAME as the value for *object_type*.

If you specify DSNAME for *object_type*, indicate whether the object already exists or whether window services is to create it:
- If the object already exists, specify OLD as the value for *object_state*.
- If window services is to create the object, specify NEW as the value for *object_state*.

Temporary object
To identify a temporary object, specify TEMPSPACE as the value for *object_type*. Window services assumes that a temporary object is new and ignores the value that you specify for *object_state*.

Specifying the object’s size
If the object is permanent and new or is temporary, you must tell window services the size of the object. You specify object size through the *object_size* parameter. The size specified becomes the maximum size that window services will allow for that object. You express the size as a number of 4096-byte blocks. If the number of bytes in the object is not an exact multiple of 4096, round *object_size* to the next whole number. For example:
- If the object size is to be less than 4097 bytes, specify 1.
- If the object size is 5000 bytes, specify 2.
- If the object size is 410,000 bytes, specify 101.

Specifying the type of access
For an existing (OLD) permanent object, you must specify how you intend to access the object. You specify your intentions through the *access_mode* parameter:
- If you intend to only read the object, specify READ for *access_mode*.
- If you intend to update the object, specify UPDATE for *access_mode*.

For a new permanent object and for a temporary object, window services assumes you will update the object and ignores the value you specify for *access_mode*.

Obtaining a scroll area
A scroll area is storage that window services provides for your use. This storage is outside your program’s storage area and is accessible only through window services.

For a permanent object, a scroll area is optional. A scroll area allows you to make interim changes to a permanent object without altering the object on DASD. Later,
if you want, you can update the object on DASD with the interim changes. A scroll area might also improve performance when your program accesses a permanent object.

For a temporary object, the scroll area is the object. Therefore, for a temporary object, a scroll area is required.

To indicate whether you want a scroll area, provide the appropriate value for scroll_area:
- To request a scroll area, supply a value of YES. YES is required for a temporary object.
- To indicate you do not want a scroll area, supply a value of NO.

## Defining a view of a data object

To view all or part of a data object, you must provide window services with information about the object and how you want to view it. You must provide window services with the following information:
- The object identifier
- Where the window is in your address space
- Window disposition — that is, whether window services is to initialize the window the first time you reference data in the window
- Whether you intend to reference blocks of data sequentially or randomly
- The blocks of data that you want to view
- Whether you want to extend the size of the object

To define a view of a data object, call CSRVIEW or CSREVW. Whether you use CSRVIEW or CSREVW depends on how you plan to reference the data. "Defining the expected reference pattern" on page 13 describes the differences between the two services. Specify BEGIN on CSRVIEW or CSREVW as the type of operation. For descriptions of the CALL syntax and return codes from CSRVIEW or CSREVW, see "CSRVIEW — View an object" on page 39 or "CSREVW — View an object and sequentially access it" on page 23.

### Identifying the data object

To identify the object you want to view, specify the object identifier as the value for object_id. Use the same value CSRIDAC returned in object_id when you requested access to the object.

### Identifying a window

You must identify the window through which you will view the object. The window is a virtual storage area in your address space. You are responsible for obtaining the storage, which must meet the following requirements:
- The storage must not be page fixed.
- Pages in the window must not be page loaded (must not be loaded by the PGLOAD macro).
- The storage must start on a 4K boundary and must be a multiple of 4096 bytes in length.

To identify the window, use the window_name parameter. The value supplied for window_name must be the symbolic name you assigned to the window storage area in your program.
Defining a window in this way provides one window through which you can view the object. To define multiple windows that provide simultaneous views of different parts of the object, see “Defining multiple views of an object” on page 17.

Defining the disposition of a window’s contents

You must specify whether window services is to replace or retain the window contents. You do this by selecting either the replace or retain option. This option determines how window services handles the data that is in the window the first time you reference the data. You select the option by supplying a value of REPLACE or RETAIN® for disposition.

Replace option

If you specify the replace option, the first time you reference a block to which a window is mapped, window services replaces the data in the window with corresponding data from the object. For example, assume you have requested a view of the first block of a permanent object and have specified the replace option. The first time you reference the window, window services replaces the data in the window with the first 4096 bytes (the first block) from the object.

If you have selected the replace option and then call CSRSAVE to update a permanent object, or call CSRSCOT to update a scroll area, or call CSRSCOT to update a temporary object, window services updates only the specified blocks that have changed and to which a window is mapped.

Select the replace option when you want to examine, use, or change data that is currently in an object.

Retain option

If you select the retain option, window services retains data that is in the window. When you reference a block in the window the first time, the block contains the same data it contained before the reference.

When you select the retain option, window services considers all of the data in the window as changed. Therefore, if you call CSRSCOT to update a scroll area or a temporary object, or call CSRSAVE to update a permanent object, window services updates all of the specified blocks to which a window or scroll area are mapped.

Select the retain option when you want to replace data in an object without regard for the data that it currently contains. You also use the retain option when you want to initialize a new object.

Defining the expected reference pattern

You must tell window services whether you intend to reference the blocks of an object sequentially or randomly. An intention to access randomly tells window services to bring one block (4096 bytes) of data into the window at a time. An intention to access sequentially tells window services to read more than one block into your window at one time. The performance gain is in having blocks of data already in central storage at the time the program needs to reference them. You specify the intent on either CSRVIEW or CSREVVW, two services that differ on how to specify sequential access.

- CSRVIEW allows you a choice between random or sequential access.
  - If you specify random, when you reference data that is not in your window, window services brings in one block — the one that contains the data your program references.
If you specify **sequential**, when you reference data that is not in your window, window services transfers up to 16 blocks — the one that contains the data your program requests, plus the next 15 consecutive blocks. The number of consecutive blocks varies, depending on the size of the window and availability of central storage. Use CSRVIEW if one of the following is true:

- You are going to access randomly.
- You are going to access sequentially, and you are satisfied with a maximum of 16 blocks coming into the window at a time.

• **CSREVW** is for sequential access only. It allows you to specify the maximum number of consecutive blocks that window services brings into the window at one time. The number ranges from one block through 256 blocks. Use CSREVW if you want fewer than 16 blocks or more than 16 blocks at one time. Programs that benefit from having more than 16 blocks come into a window at one time reference data areas that are greater than one megabyte.

To specify the reference pattern on CSRVIEW, supply a value of **SEQ** or **RANDOM** for **usage**.

To specify the reference pattern on CSREVW, supply a number from 0 through 255 for **pfcount**. **pfcount** represents the number of blocks window services will bring into the window, in addition to the one that it always brings in.

Note that window services brings in multiple pages differently depending on whether your object is permanent or temporary and whether the system has had to move pages of your data from central storage to make those pages of central storage available for other programs. The rule is that **SEQ** on CSRVIEW and **pfcount** on CSREVW apply to:

• A permanent object when movement is from the object on DASD to central storage
• A temporary object when your program has scrolled the data out and references it again

**SEQ** and **pfcount** do not apply after the system has had to move data (either changed or unchanged) to auxiliary or expanded storage, and your program again references it, requiring the system to bring the data back into central storage.

End the view, whether established with CSRVIEW or CSREVW, with **CSRVIEW END**.

**Identifying the blocks you want to view**

To identify the blocks of data you want to view, use **offset** and **span**. The values you assign to **offset** and **span**, together, define a contiguous string of blocks that you want to view:

• The value assigned to **offset** specifies the relative block at which to start the view. An offset of 0 means the first block; an offset of 1 means the second block; an offset of 2 means the third block, and so forth.
• The value assigned to **span** specifies the number of blocks to view. A span of 1 means one block; a span of 2 means two blocks, and so forth. A span of 0 has special meaning; it means the view is to start at the specified offset and extend until the currently defined end of the object.

The following table shows examples of several **offset** and **span** combinations and the resulting view in the window.
Extending the size of a data object

You can use offset and span to extend the size of an object up to the previously defined maximum size for the object. You can extend the size of either permanent objects or temporary objects. For objects created through CSRIDAC, the value assigned to object_size defines the maximum allowable size. When you call CSRIDAC to gain access to an object, CSRIDAC returns a value in high_offset that defines the current size of the object.

For example, assume you have access to a permanent object whose maximum allowable size is four 4096-byte blocks. The object is currently two blocks long. If you define a window and specify an offset of 1 and a span of 2, the window contains a view of the second block and a view of a third block, which does not yet exist in the permanent object. When you reference the window, the content of the second block, as seen in the window, depends on the disposition you selected, replace or retain. The third block, as seen in the window, initially contains binary zeroes. If you later call CSRSAVE to update the permanent object with changes from the window, window services extends the size of the permanent object to three blocks by appending the new block of data to the object.

Defining multiple views of an object

You might need to view different parts of an object at the same time. For a permanent object, you can define windows that have non-overlapping views as well as windows that have overlapping views. For a temporary object, you can define windows that have only non-overlapping views.

- A non-overlapping view means that no two windows view the same block of the object. For example, a view is non-overlapping when one window views the first and second blocks of an object and another window views the ninth and tenth blocks of the same object. Neither window views a common block.
- An overlapping view means that two or more windows view the same block of the object. For example, the view overlaps when the second window in the previous example views the second and third blocks. Both windows view a common block, the second block.

Non-overlapping views

To define multiple windows that have a non-overlapping view, call CSRIDAC once to obtain the object identifier. Then call CSRVIEW or CSREVVW once to define each window. On each call, specify the value BEGIN for operation_type, the same object identifier for object_id, and a different value for window_name. Define each window’s view by specifying values for offset and span that create windows with non-overlapping views.

Overlapping views

To define multiple windows that have an overlapping view of a permanent object, define each window as though it were viewing a different object. That is, define each window under a different object identifier. To obtain the object identifiers, call
CSRIDAC once for each identifier you need. Only one of the calls to CSRIDAC can specify an access mode of UPDATE. Other calls to CSRIDAC must specify an access mode of READ.

After calling CSRIDAC, call CSRVIEW or CSREVW once to define each window. On each call, specify the value BEGIN for the operation type, a different object identifier for object_id, and a different value for window_name. Define each window’s view by specifying values for offset and span that create windows with the required overlapping views.

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**Saving interim changes to a permanent data object**

Window services allows you to save interim changes you make to a permanent object. You must have previously requested a scroll area for the object, however. You request a scroll area when you call CSRIDAC to gain access to the object. Window services saves changes by replacing blocks in the scroll area with corresponding changed blocks from a window. Saving changes in the scroll area does not alter the object on DASD.

After you have a view of the object and have made changes in the window, you can save those changes in the scroll area. To save changes in the scroll area, call CSRSCOT. For a description of the CSRSCOT parameters and return codes, see "CSRSCOT — Save object changes in a scroll area" on page 36.

To identify the object, you must supply an object identifier for object_id. The value supplied for object_id must be the same value CSRIDAC returned in object_id when you requested access to the object.

To identify the blocks in the object that you want to update, use offset and span. The values assigned to offset and span, together, define a contiguous string of blocks in the object:

- The value assigned to offset specifies the relative block at which to start. An offset of 0 means the first block; an offset of 1 means the second block; an offset of 2 means the third block, and so forth.
- The value assigned to span specifies the number of blocks to save. A span of 1 means one block; a span of 2 means two blocks, and so forth. A span of 0 has special meaning: it requests that window services save all changed blocks to which a window is mapped.

Window services replaces each block within the range specified by offset and span providing the block has changed and a window is mapped to the block.

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**Updating a temporary data object**

After making changes in a window to a temporary object, you can update the object with those changes. You must identify the object and must specify the range of blocks that you want to update. To be updated, a block must be mapped to a window and must contain changes in the window. Window services replaces each block within the specified range with the corresponding changed block from a window.

To update a temporary object, call CSRSCOT. For a description of the CSRSCOT parameters and return codes, see "CSRSCOT — Save object changes in a scroll area" on page 36.
To identify the object, you must supply an object identifier for object_id. The value you supply for object_id must be the same value CSRIDAC returned in object_id when you requested access to the object.

To identify the blocks in the object that you want to update, use offset and span. The values assigned to offset and span, together, define a contiguous string of blocks in the object:

- The value assigned to offset specifies the relative block at which to start. An offset of 0 means the first block; an offset of 1 means the second block; an offset of 2 means the third block, and so forth.
- The value assigned to span specifies the number of blocks to save. A span of 1 means one block; a span of 2 means two blocks, and so forth. A span of 0 has special meaning: it requests that window services update all changed blocks to which a window is mapped.

Window services replaces each block within the range specified by offset and span providing the block has changed and a window is mapped to the block.

### Refreshing changed data

You can refresh blocks that are mapped to either a temporary object or to a permanent object. You must identify the object and specify the range of blocks you want to refresh. When you refresh blocks mapped to a temporary object, window services replaces, with binary zeros, all changed blocks that are mapped to the window. When you refresh blocks mapped to a permanent object, window services replaces specified changed blocks in a window or in the scroll area with corresponding blocks from the object on DASD.

To refresh an object, call CSRREFR. For a description of CSRREFR parameters and return codes, see "CSRREFR — Refresh an object" on page 31.

To identify the object, you must supply an object identifier for object_id. The value supplied for object_id must be the same value CSRIDAC returned in object_id when you requested access to the object.

To identify the blocks of the object that you want to refresh, use offset and span. The values assigned to offset and span, together, define a contiguous string of blocks in the object:

- The value assigned to offset specifies the relative block at which to start. An offset of 0 means the first block; an offset of 1 means the second block; an offset of 2 means the third block, and so forth.
- The value assigned to span specifies the number of blocks to save. A span of 1 means one block; a span of 2 means two blocks, and so forth. A span of 0 has special meaning: it requests that window services refresh all changed blocks to which a window is mapped, or that have been saved in a scroll area.

Window services refreshes each block within the range specified by offset and span providing the block has changed and a window or a scroll area is mapped to the block. At the completion of the refresh operation, blocks from a permanent object that have been refreshed appear the same as the corresponding blocks on DASD. Refreshed blocks from a temporary object contain binary zeroes.
Updating a permanent object on DASD

You can update a permanent object on DASD with changes that appear in a window or in the object's scroll area. You must identify the object and specify the range of blocks that you want to update.

To update an object, call CSRSAVE. For a description of the CSRSAVE parameters and return codes, see "CSRSAVE — Save changes made to a permanent object" on page 34.

To identify the object, you must supply an object identifier for `object_id`. The value you provide for `object_id` must be the same value CSRIDAC returned when you requested access to the object.

To identify the blocks of the object that you want to update, use `offset` and `span`. The values assigned to `offset` and `span`, together, define a contiguous string of blocks in the object:

- The value assigned to `offset` specifies the relative block at which to start. An offset of 0 means the first block; an offset of 1 means the second block; an offset of 2 means the third block, and so forth.

- The value assigned to `span` specifies the number of blocks to save. A span of 1 means one block; a span of 2 means two blocks, and so forth. A span of 0 has special meaning: it requests that window services update all changed blocks to which a window is mapped, or have been saved in the scroll area.

When there is a scroll area

When the object has a scroll area, window services first updates blocks in the scroll area with corresponding blocks from windows. To be updated, a scroll area block must be within the specified range, a window must be mapped to the block, and the window must contain changes. Window services next updates blocks on DASD with corresponding blocks from the scroll area. To be updated, a DASD block must be within the specified range and have changes in the scroll area. Blocks in the window remain unchanged.

When there is no scroll area

When there is no scroll area, window services updates blocks of the object on DASD with corresponding blocks from a window. To be updated, a DASD block must be within the specified range, mapped to a window, and have changes in the window. Blocks in the window remain unchanged.

Changing a view in a window

To change the view in a window so you can view a different part of the same object or view a different object, you must first terminate the current view. To terminate the view, whether the view was mapped by CSRVIEW or CSREVW, call CSRVIEW and supply a value of END for `operation_type`. You must also identify the object, identify the window, identify the blocks you are currently viewing, and specify a disposition for the data that is in the window. For a description of CSRVIEW parameters and return codes, see "CSRVIEW — View an object" on page 39.

To identify the object, supply an object identifier for `object_id`. The value supplied for `object_id` must be the value you supplied when you established the view.
To identify the window, supply the window name for `window_name`. The value supplied for `window_name` must be the same value you supplied when you established the view.

To identify the blocks you are currently viewing, supply values for `offset` and `span`. The values you supply must be the same values you supplied for `offset` and `span` when you established the view.

To specify a disposition for the data you are currently viewing, supply a value for `disposition`. The value determines what data will be in the window after the CALL to CSRVIEW completes.

- For a permanent object that has no scroll area:
  - To retain the data that is currently in the window, supply a value of `RETAINT` for `disposition`.
  - To discard the data that is currently in the window, supply a value of `REPLACE` for `disposition`. After the operation completes, the window contents are unpredictable.

For example, assume that a window is mapped to one block of a permanent object that has no scroll area. The window contains the character string AAA......A and the block to which the window is mapped contains BBB......B. If you specify a value of `RETAINT`, upon completion of the CALL, the window still contains AAA......A, and the mapped block contains BBB......B. If you specify a value of `REPLACE`, upon completion of the CALL, the window contents are unpredictable and the mapped block still contains BBB......B.

- For a permanent object that has a scroll area or for a temporary object:
  - To retain the data that is currently in the window, supply a value of `RETAINT` for `disposition`. CSRVIEW also updates the mapped blocks of the scroll area or temporary object so that they contain the same data as the window.
  - To discard the data that is currently in the window, supply a value of `REPLACE` for `disposition`. Upon completion of the operation, the window contents are unpredictable.

For example, assume that a window is mapped to one block of a temporary object. The window contains the character string AAA......A and the block to which the window is mapped contains BBB......B. If you specify a value of `RETAINT`, upon completion of the CALL, the window still contains AAA......A and the mapped block of the object also contains AAA......A. If you specify a value of `REPLACE`, upon completion of the CALL, the window contents are unpredictable and the mapped block still contains BBB......B.

CSRVIEW ignores the values you assign to the other parameters.

When you terminate the view of an object, the type of object that is mapped and the value you specify for `disposition` determine whether CSRVIEW updates the mapped blocks. CSRVIEW updates the mapped blocks of a temporary object or a permanent object’s scroll area if you specify a disposition of `RETAINT`. In all other cases, to update the mapped blocks, call the appropriate service before terminating the view:

- To update a temporary object, or to update the scroll area of a permanent object, call CSRSCOT.
- To update an object on DASD, call CSRSAVE.

Upon successful completion of the CSRVIEW operation, the content of the window depends on the value specified for `disposition`. The window is no longer mapped.
to a scroll area or to an object, however. The storage used for the window is available for other use, perhaps to use as a window for a different part of the same object or to use as a window for a different object.

**Terminating access to a data object**

When you finish using a data object, you must terminate access to the object. When you terminate access, window services returns to the system any virtual storage it obtained for the object: storage for a temporary object or storage for a scroll area. If the object is temporary, window services deletes the object. If the object is permanent and window services dynamically allocated the data set when you requested access to the object, window services dynamically unallocates the data set. Your window is no longer mapped to the object or to a scroll area.

When you terminate access to a permanent object, window services does not update the object on DASD with changes that are in a window or the scroll area. To update the object, call CSRSAVE before terminating access to the object.

To terminate access to an object, call CSRIDAC and supply a value of END for operation_type. To identify the object, supply an object identifier for object_id. The value you supply for object_id must be the same value CSRIDAC returned when you obtained access to the object.

Upon successful completion of the call, the storage used for the window is available for other use, perhaps as a window for viewing a different part of the same object or to use as a window for viewing a different object.

**Handling return codes and abnormal terminations**

Each time you call a service, your program receives either a return code and reason code or an abend code and a reason code. These codes indicate whether the service completed successfully, encountered an unusual condition, or was unable to complete successfully.

When you receive a return code that indicates a problem or an unusual condition, your program can either attempt to correct the problem or can terminate its execution. Return codes and reason codes are explained in Chapter 3, “Window services,” on page 23 with the description of each callable service program.

When an abend occurs, the system passes control to a recovery routine, if you or your installation have provided one. A recovery routine might be able to correct the problem that caused the abend and allow your program to continue execution. If a recovery routine has been provided, it can handle the abend condition the same way it handles other abend conditions. If a recovery routine has not been provided, the system terminates execution of your program. For an explanation of the abend codes, see z/OS MVS System Codes.
Chapter 3. Window services

To use window services, you issue CALLs that invoke the appropriate window services program. Each service program performs one or more functions and requires a set of parameters coded in a specific order on the CALL statement.

Depending on the function requested from a service, there might be one or more parameter values that the service ignores. Although a service might ignore a parameter value, you must still code that parameter on the CALL statement. Because the service ignores the parameter value, you can assign the parameter any value that is acceptable for the parameter’s data type. If the service uses a particular parameter value, the CALL statement description in this topic defines the allowable values that you can assign to the parameter.

This topic describes the CALL statements that invoke window services. Each description includes a syntax diagram, parameter descriptions, and return code and reason code explanations with recommended actions. Return codes and reason codes are shown in hexadecimal followed by the decimal equivalent enclosed in parentheses. For examples of how to code the CALL statements, see “Window services coding examples,” on page 45.

This topic contains the following subtopics:

- “CSREVW — View an object and sequentially access it” on page 27
- “CSRSCOT — Save object changes in a scroll area” on page 36
- “CSRSAVE — Save changes made to a permanent object” on page 34
- “CSRREFR — Refresh an object” on page 31
- “CSRIDAC — Request or terminate access to a data object” on page 27
- “CSRVIEW — View an object” on page 39

CSREVW — View an object and sequentially access it

Call CSREVW if you reference data in a sequential pattern and you want to:

- Map a window to one or more blocks (4096 bytes) of a data object. If you specified scrolling when you called CSRIDAC to identify the object, CSREVW maps the window to the blocks in the scroll area and maps the scroll area to the object.
- Specify how many blocks window services is to bring into the window each time CSREVW needs more data from the object.

Mapping a data object enables your program to access the data that is viewed through the window the same way it accesses other data in your storage.

The CSREVW and CSRVIEW services differ on how to specify sequential access:

- If you use CSRVIEW and specify sequential, when you reference data that is not in your window, window services reads up to 16 blocks — the one that contains the data your program requests, plus the next 15 consecutive blocks. The number of consecutive blocks varies, depending on the size of the window and the availability of central storage.
CSREVW

- If you use CSREVW, you can specify the number of additional consecutive blocks that window services reads into the window at one time. The number ranges from 0 through 255.

Use CSREVW if your program has sequential access and can benefit from having more than 16 blocks come into a window at one time, or fewer than 16 blocks at one time.

Code the CALL following the syntax of the high-level language you are using and specifying all parameters in the order shown below. For parameters that CSREVW uses to obtain input values, assign appropriate values. For parameters that CSREVW ignores, assign any value that is valid for the particular parameter's data type.

- To map a window to a data object and begin viewing the object, specify BEGIN and SEQ and assign values, acceptable to CSREVW, to:
  - object_id
  - offset
  - span
  - window_name
  - disposition
  - pfcount

- CSREVW returns values in return_code and in reason_code. To end the view and unmap the data object, use CSRVIEW END and specify all values, except for pfcount, that you specified when you mapped the window.

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL CSREVW</td>
<td>(operation_type, object_id, offset, span, window_name, disposition, pfcount, return_code, reason_code)</td>
</tr>
</tbody>
</table>

operation_type
- Specify BEGIN to request that CSREVW map a data object.

object_id
- Specifies the object identifier. Supply the object identifier that CSRIDAC returned when you obtained access to the object.
  - Define object_id as character data of length 8.

offset
- Specifies the offset of the view into the object. Specify the offset in blocks of 4096 bytes.
  - Define offset as integer data of length 4.

span
- Specifies the window size in blocks of 4096 bytes.
Define *span* as integer data of length 4.

*,window_name*

Specifies the symbolic name you assigned to the window in your address space.

*,usage*

Specify SEQ to tell CSREVW that the expected pattern of references to data in the object will be sequential.

Define this field as character data of length 6. Pad the string on the right with 1 blank.

*,disposition*

Defines how CSREVW is to handle data that is in the window when you begin a view. When you specify CSREVW BEGIN and a disposition of:

**REPLACE**

The first time you reference a block to which the window is mapped, CSREVW replaces the data in the window with the data from the referenced block.

**RETAIN**

When you reference a block to which the window is mapped, the data in the window remains unchanged. When you call CSRSAVE to save the mapped blocks, CSRSAVE saves all of the mapped blocks because CSRSAVE considers them changed.

Define *disposition* as character data of length 7. If you specify RETAIN, pad the string on the right with 1 blank.

*,pfcount*

Specifies the number of additional blocks you want window services to bring into the window each time your program references data that is not already in the window. The number you specify is added to the minimum of one block that window services always brings in. That is, if you specify a value of 20, window services brings in a total of 21. The number of additional blocks ranges from zero through 255.

Define *pfcount* as integer data of length 4.

*,return_code*


Return codes and reason codes are explained under "Return codes and reason codes" on page 26.

*,reason_code*

When CSREVW completes, *reason_code* contains the reason code. Define *reason_code* as integer data of length 4.

Return codes and reason codes are explained under "Return codes and reason codes" on page 26.

**Abend codes**

CSREVVW issues abend code X'019'. For more information, see z/OS MVS System Codes.
Return codes and reason codes

When CSREVW returns control to your program, `return_code` contains a return code and `reason_code` contains a reason code. Return codes and reason codes are shown in hexadecimal followed by the decimal equivalent enclosed in parentheses. [Table 1](#) identifies return code and reason code combinations, tells what each means, and recommends an action that you should take.

A return code of X’4’ with a reason code of X’0125’ or a return code of X’C’ with any reason code means that data-in-virtual encountered a problem or an unexpected condition. Data-in-virtual reason codes, which are two bytes long and right justified, are explained in [z/OS MVS Programming: Assembler Services Reference](#) ABE-HSP. To resolve a data-in-virtual problem, request help from your system programmer.

Table 1. CSREVW Return and Reason Codes

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00000000 (0) | 00000000 (0) | **Meaning**: The operation was successful.  
**Action**: Continue normal program execution. |
| 00000004 (4) | xxxx0125 (293) | **Meaning**: The operation was successful. The service could not retain all the data that was in the scroll area, however.  
**Action**: Notify your system programmer. |
| 00000012 (18) | xxxx000A (10) | **Meaning**: There is another service currently executing with the specified ID.  
**Action**: Use a different ID or wait until the other service completes. If the problem persists, notify your system programmer. |
| 0000000C (12) | xxxx0017 (23) | **Meaning**: An I/O error has occurred.  
**Action**: Notify your system programmer. |
| 0000000C (12) | xxxx001A (26) | **Meaning**: The specified range does not encompass any mapped area of the object.  
**Action**: If you expect this reason code, take whatever action the design of your program dictates. If the reason code is unexpected, check your program for errors: you might have specified the wrong range of blocks on CSRVIEW or on CSRREFR. If you do not find any errors in your program, notify your system programmer. |
| 0000000C (12) | xxxx001C (28) | **Meaning**: The object cannot be accessed at the current time.  
**Action**: Try running your program at a later time. If the problem persists, notify your system programmer. |
| 0000000C (12) | xxxx0040 (64) | **Meaning**: The specified MAP range would cause the hiperspace data-in-virtual object to be extended such that the installation data space limits would be exceeded.  
**Action**: Change the MAP range you have specified or request your system programmer to increase the installation’s data space limits. |
| 0000000C (12) | xxxx0801 (2049) | **Meaning**: System error — Insufficient storage available to build the necessary data-in-virtual control block structure.  
**Action**: Notify your system programmer. |
| 0000000C (12) | xxxx0802 (2050) | **Meaning**: System error — I/O driver failure.  
**Action**: Notify your system programmer. |
### CSREVW

**Table 1. CSREVW Return and Reason Codes (continued)**

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0000000C (12) xxxx0803 (2051) | **Meaning:** System error — A necessary page table could not be read into real storage.  
**Action:** Notify your system programmer. |
| 0000000C (12) xxxx00804 (2052) | **Meaning:** System error — Catalog update failed.  
**Action:** Notify your system programmer. |
| 0000000C (12) xxxx0806 (2054) | **Meaning:** System error — I/O error.  
**Action:** Notify your system programmer. |
| 0000000C (12) xxxx0808 (2056) | **Meaning:** System error — I/O from a previous request has not completed.  
**Action:** Notify your system programmer. |
| 0000002C (44) 00000004 (4) | **Meaning:** Window services have not been defined to your system or the link to the service failed.  
**Action:** Notify your system programmer. |

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**CSRIDAC — Request or terminate access to a data object**

Call CSRIDAC to:

- Request access to a data object
- Terminate access to a data object

Code the CALL following the syntax of the high-level language you are using and specifying all parameters in the order shown below. For parameters that CSRIDAC uses to obtain input values, assign values that are acceptable to CSRIDAC. For parameters that CSRIDAC ignores, assign any value that is valid for the particular parameter’s data type.

The parameter values that CSRIDAC uses depends on whether you are requesting access to an object or terminating access.

- To request access to a data object, specify BEGIN for `operation_type`, and assign values, acceptable to CSRIDAC, to the following parameters:
  - `object_type`
  - `object_name` if the object is permanent
  - `scroll_area`
  - `object_state` if the object is permanent and `object_type` specifies DSNAME
  - `access_mode` if the object exists and is permanent
  - `object_size` if the object is new or temporary
  - `object_size` if the object is new or temporary

CSRIDAC ignores other parameter values. CSRIDAC returns values in `object_id`, `high_offset`, `return_code`, and `reason_code`.

- To terminate access to a data object, specify END for `operation_type`, and assign a value, acceptable to CSRIDAC, to `object_id`. CSRIDAC ignores other parameter values. CSRIDAC returns values in `return_code` and `reason_code`. 

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Chapter 3. Window services 27
CALL statement

<table>
<thead>
<tr>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>operation_type</td>
</tr>
<tr>
<td>object_type</td>
</tr>
<tr>
<td>object_name</td>
</tr>
<tr>
<td>scroll_area</td>
</tr>
<tr>
<td>object_state</td>
</tr>
<tr>
<td>access_mode</td>
</tr>
<tr>
<td>object_size</td>
</tr>
<tr>
<td>object_id</td>
</tr>
<tr>
<td>high_offset</td>
</tr>
<tr>
<td>return_code</td>
</tr>
<tr>
<td>reason_code</td>
</tr>
</tbody>
</table>

**operation_type**

Specifies the type of operation the service is to perform:

- To request access to an object, specify **BEGIN**.
- To terminate access to an object, specify **END**. If the object is temporary, CSRIDAC deletes it.

Define `operation_type` as character data of length 5. If you specify END, pad the string on the right with 1 or 2 blanks.

**object_type**

Specifies the type of object. The types are:

**DDNAME**
The object is an existing (OLD) VSAM linear data set allocated to the file whose DDNAME is specified by `object_name`.

**DSNAME**
The object is the linear VSAM data set whose name is specified by `object_name`. The data set may already exist or may be a new data set that you want window services to create.

**TEMPSPACE**
The object is a temporary data object. Window services deletes the object when your program calls CSRIDAC and `operation_type` equals END.

If `operation_type` is **BEGIN**, you must supply a value.

Define this parameter as character data of length 9. If you specify either DDNAME or DSNAME, pad the string on the right with 1 to 3 blanks.

**object_name**

Specifies the data set name of a permanent object or the DDNAME of a data definition (DD) statement that defines a permanent object.

- If `object_type` is **DDNAME**, `object_name` must contain the name of a DD statement.
- If `object_type` is **DSNAME**, `object_name` must contain the data set name of the permanent object.

If `operation_type` is **BEGIN** and `object_type` is DDNAME or DSNAME, you must supply a value for `object_name`.

Define `object_name` as character data of length 1 to 45. If `object_name` contains fewer than 45 characters, pad the name on the right with a blank.
scroll_area
Specifies whether window services is to create a scroll area for the data object.

YES    Create a scroll area.
NO     Do not create a scroll area.

If operation_type is BEGIN and object_type is TEMPSPACE, specify YES.
Define scroll_area as character data of length 3. If you specify NO, pad the string on the right with a blank.

object_state
Specifies the state of the object.
OLD     The object exists.
NEW    The object does not exist and window services must create it.

If operation_type is BEGIN and object_type is DSNAME, you must supply a value for object_state.
Define object_state as character data of length 3.

access_mode
Specifies the type of access required.
READ    READ access.
UPDATE    UPDATE access.

If operation_type is BEGIN and object_type is DDNAME or DSNAME, you must supply a value for access_mode. For a new or temporary data object, window services assumes UPDATE.
Define access_mode as character data of length 6. If you specify READ, pad the string on the right with 1 or 2 blanks.

object_size
Specifies the maximum size of the new object in units of 4096 bytes.

This parameter is required if either of the following conditions is true:
• Operation_type is BEGIN, object_type is DSNAME, and object_state is NEW
• Operation_type is BEGIN and object_type is TEMPSPACE

Define object_size as integer data of length 4.

object_id
Specifies the object identifier.

When operation_type is BEGIN, the service returns the object identifier in this parameter. Use the identifier to identify the object to other window services.

When operation_type is END, you must supply the object identifier in this parameter.

Define object_id as character data of length 8.

high_offset
When CSRIDAC completes, high_offset contains the size of the existing object expressed in blocks of 4096 bytes.

Define high_offset as integer data of length 4.
When CSRIDAC completes, `return_code` contains the return code. Define `return_code` as integer data of length 4.

Return codes and reason codes are explained under “Return codes and reason codes.”

When CSRIDAC completes, `reason_code` contains the reason code. Define `reason_code` as integer data of length 4.

Return codes and reason codes are explained under “Return codes and reason codes.”

**Abend codes**

CSRIDAC issues abend code X’019’. For more information, see `z/OS MVS System Codes`.

**Return codes and reason codes**

When CSRIDAC returns control to your program, `return_code` contains a return code and `reason_code` contains a reason code. Return codes and reason codes are shown in hexadecimal followed by the decimal equivalent enclosed in parentheses. Table 2 identifies return code and reason code combinations, tells what each means, and recommends an action that you should take.

A return code of X’C’ means that data-in-virtual encountered a problem or an unexpected condition. The associated reason codes are data-in-virtual reason codes. Data-in-virtual reason codes are two bytes long and right justified. To resolve a data-in-virtual problem, request help from your system programmer. For information about data-in-virtual, see the `z/OS MVS Programming: Assembler Services Guide`.

**Table 2. CSRIDAC Return and Reason Codes**

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00000000 (0) | 00000000 (0) | **Meaning:** The operation was successful.  
**Action:** Continue normal program execution. |
| 00000008 (8) | 00000118 (280) | **Meaning:** The system could not obtain enough storage to create a hiperspace for the temporary object or the scroll area.  
**Note:** Hiperspace™ is the name the system uses to identify the storage it uses to create a temporary object or a scroll area for a permanent object.  
**Action:** Notify your system programmer. The system programmer might have to increase the SMF limit for data spaces and hiperspace that are intended for the user. |
| 00000008 (8) | 00000119 (281) | **Meaning:** The system could not delete or unidentify the temporary object or the scroll area.  
**Action:** Notify your system programmer. |
| 00000008 (8) | 0000011A (282) | **Meaning:** The system was unable to create a new VSAM linear data set. DFP 3.1 must be running and SMS must be active.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxxx000A (10) | **Meaning:** Another service currently is executing with the specified ID.  
**Action:** Use a different ID or wait until the other service completes. If the problem persists, notify your system programmer. |
Table 2. CSRIDAC Return and Reason Codes (continued)

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0000000C (12) xxxx001C (28) | | **Meaning:** The object cannot be accessed at the current time.  
**Action:** Try running your program at a later time. If the problem persists, notify your system programmer. |
| 0000000C (12) xxxx0037 (55) | | **Meaning:** The caller invoked ACCESS. The access is successful, but the system is issuing a warning that the data set was not allocated with a SHAREOPTIONS(1,3).  
**Action:** Notify your system programmer. |
| 0000000C (12) xxxx003E (62) | | **Meaning:** The hiperspace data-in-virtual object may not be accessed at this time. (If MODE=READ, the object is already accessed under a different ID for UPDATE. If MODE=UPDATE, the object is already accessed under at least one other ID.)  
**Action:** Try running your program at a later time. If the problem persists, notify your system programmer. |
| 0000000C (12) xxxx0801 (2049) | | **Meaning:** System error — Insufficient storage available to build the necessary data-in-virtual control block structure.  
**Action:** Notify your system programmer. |
| 0000000C (12) xxxx0802 (2050) | | **Meaning:** System error — I/O driver failure.  
**Action:** Notify your system programmer. |
| 0000000C (12) xxxx0805 (2053) | | **Meaning:** System error — A system error of indeterminate origin has occurred.  
**Action:** Notify your system programmer. |
| 0000000C (12) xxxx0808 (2056) | | **Meaning:** System error — I/O from a previous request has not completed.  
**Action:** Notify your system programmer. |
| 00000010 (16) rrrrnnnn | | **Meaning:** The system was unable to allocate or unallocate the data set specified as object_name. The value rrrr is the return code from dynamic allocation. The value nnnn is the two-byte reason code from dynamic allocation. See z/OS MVS Programming[1] for dynamic allocation return and reason codes.  
**Action:** If object_state is NEW, make sure that a data set of the same name does not already exist. If one does already exist, either use the existing data set or change the name of your data set. If you are unable to correct the problem, notify your system programmer. |
| 0000002C (44) 00000004 (4) | | **Meaning:** Window services have not been defined to your system or the link to the service failed.  
**Action:** Notify your system programmer. |

CSRREFR — Refresh an object

To refresh changed data that is in a window, a scroll area, or a temporary object, call CSRREFR. CSRREFR refreshes changed data within specified blocks as follows:

- If the object is permanent, CSRREFR replaces specified changed blocks in windows or the scroll area with corresponding blocks from the object on DASD.
- For a temporary object, CSRREFR refreshes specified changed blocks in windows and the object by setting the blocks to binary zeroes.
Code the CALL following the syntax of the high-level language you are using and specifying all parameters in the order shown below. For parameters that CSRREFR uses to obtain input values, assign values that are acceptable to CSRREFR. For parameters that CSRREFR ignores, assign any value that is valid for the particular parameter’s data type.

Assign values, acceptable to CSRREFR, to object_id, offset, and span. CSRREFR ignores other parameter values. CSRREFR returns values in return_code and reason_code.

### CALL statement Parameters

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL CSRREFR</td>
<td>(object_id, offset, span, return_code, reason_code)</td>
</tr>
</tbody>
</table>

#### object_id

Specifies the object identifier. Supply the same object identifier that CSRIDAC returned when you obtained access to the object.

Define object_id as character data of length 8.

#### offset

Specifies the offset into the object in blocks of 4096 bytes. A value of 0 specifies the first block of 4096 bytes or bytes 0 to 4095 of the object; a value of 1 specifies the second block of 4096 bytes, or bytes 4096 to 8191 of the object, and so forth.

Define offset as integer data of length 4.

offset and span, together, determine which part of the object window services refreshes. To refresh the entire object, specify 0 for offset and 0 for span.

#### span

Specifies how many 4096-byte blocks CSRREFR is to refresh.

Define span as integer data of length 4.

#### return_code

When CSRREFR completes, return_code contains the return code. Define return_code as integer data of length 4.

Return codes and reason codes are explained under “Return codes and reason codes” on page 33.

#### reason_code

When CSRREFR completes, reason_code contains the reason code. Define reason_code as integer data of length 4.

Return codes and reason codes are explained under “Return codes and reason codes” on page 33.

### Abend codes

CSRREFR issues abend code X’019’. For more information, see z/OS MVS System Codes.
**Return codes and reason codes**

When CSRREFR returns control to your program, `return_code` contains a return code and `reason_code` contains a reason code. Return codes and reason codes are shown in hexadecimal followed by the decimal equivalent enclosed in parentheses. Table 3 identifies return code and reason code combinations, tells what each means, and recommends an action that you should take.

A return code of X'C' means that data-in-virtual encountered a problem or an unexpected condition. The associated reason codes are data-in-virtual reason codes. Data-in-virtual reason codes are two bytes long and right justified. To resolve a data-in-virtual problem, request help from your system programmer.

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00000000 (0) | 00000000 (0) | Meaning: The operation was successful.  
Action: Continue normal program execution. |
| 00000008 (8) | 00000152 (338) | Meaning: The system could not refresh all of the temporary object within the specified span.  
Action: Notify your system programmer. |
| 0000000C (12) | xxxx000A (10) | Meaning: There is another service currently executing with the specified ID.  
Action: Use a different ID or wait until the other service completes. If the problem persists, notify your system programmer. |
| 0000000C (12) | xxxx0017 (23) | Meaning: An I/O error has occurred.  
Action: Notify your system programmer. |
| 0000000C (12) | xxxx001A (26) | Meaning: The specified range does not include any mapped block of the object.  
Action: If you expect this reason code, take whatever action the design of your program dictates. If the reason code is unexpected, check your program for errors; you might have specified the wrong range of blocks on CSRVIEW or on CSRREFR. If you do not find any errors in your program, notify your system programmer. |
| 0000000C (12) | xxxx0801 (2049) | Meaning: System error — Insufficient storage available to build the necessary data-in-virtual control block structure.  
Action: Notify your system programmer. |
| 0000000C (12) | xxxx0803 (2051) | Meaning: System error — A necessary page table could not be read into real storage.  
Action: Notify your system programmer. |
| 0000000C (12) | xxxx0805 (2053) | Meaning: System error — A system error of indeterminate origin has occurred.  
Action: Notify your system programmer. |
Action: Notify your system programmer. |
| 0000000C (12) | xxxx0808 (2056) | Meaning: System error — I/O from a previous request has not completed.  
Action: Notify your system programmer. |
CSRREFR

Table 3. CSRREFR Return and Reason Codes (continued)

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0000002C (44) | 00000004 (4) | **Meaning**: Window services have not been defined to your system or the link to the service failed.  
**Action**: Notify your system programmer. |

CSRSAVE — Save changes made to a permanent object

To update specified blocks of a permanent object with changes, call CSRSAVE. The changes can be in blocks that are mapped to the scroll area, in blocks that are mapped to windows, or in a combination of these places.

**Note**: You cannot use CSRSAVE to save changes made to a temporary object. If you call CSRSAVE for a temporary object, CSRSAVE ignores the request and returns control to your program with a return code of 8. To save changes made to a temporary object, call CSRSCOT.

Code the CALL following the syntax of the high-level language you are using and specifying all parameters in the order shown below. For parameters that CSRSAVE uses to obtain input values, assign values that are acceptable to CSRSAVE. For parameters that CSRSAVE ignores, assign any value that is valid for the particular parameter’s data type.

Assign values, acceptable to CSRSAVE, to **object_id**, **offset**, and **span**. CSRSAVE ignores other parameter values. CSRSAVE returns values in **new_hi_offset**, **return_code**, and **reason_code**.

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL CSRSAVE</td>
<td>(object_id, offset, span, new_hi_offset, return_code, reason_code)</td>
</tr>
</tbody>
</table>

**object_id**

Specifies the object identifier. Supply the same object identifier that CSRIDAC returned when you obtained access to the object.

Define **object_id** as character data of length 8.

**offset**

Specifies the offset into the object in blocks of 4096 bytes. A value of 0 specifies the first block of 4096 bytes or bytes 0 to 4095 of the object; a value of 1 specifies the second block of 4096 bytes, or bytes 4096 to 8191 of the object, and so forth.

Define **offset** as integer data of length 4.

offset and span, together, determine which part of the object window services saves. To save the entire object, specify 0 for offset and 0 for span.

**span**

Specifies how many 4096-byte blocks CSRSAVE is to save.
Define *span* as integer data of length 4.

*, new_hi_offset*

When CSRSAVE completes, *new_hi_offset* contains the new size of the object expressed in units of 4096 bytes.

Define *new_hi_offset* as integer data of length 4.

*, return_code*


Return codes and reason codes are explained under "Return codes and reason codes."

*, reason_code*

When CSRSAVE completes, *reason_code* contains the reason code. Define *reason_code* as integer data of length 4.

Return codes and reason codes are explained under "Return codes and reason codes."

**Abend codes**

CSRSAVE issues abend code X'019'. For more information, see *z/OS MVS System Codes*.

**Return codes and reason codes**

When CSRSAVE returns control to your program, *return_code* contains a return code and *reason_code* contains a reason code. Return codes and reason codes are shown in hexadecimal followed by the decimal equivalent enclosed in parentheses. Table 4 identifies return code and reason code combinations, tells what each means, and recommends an action that you should take.

A return code of X'4' with a reason code of X'0807' or a return code of X'C' with any reason code means that data-in-virtual encountered a problem or an unexpected condition. Data-in-virtual reason codes are two bytes long and right justified. To resolve a data-in-virtual problem, request help from your system programmer. For information about data-in-virtual, see the *z/OS MVS Programming: Assembler Services Guide*.

**Table 4. CSRSAVE Return and Reason Codes**

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00000000 (0) | 00000000 (0) | **Meaning:** The operation was successful.  
**Action:** Continue normal program execution. |
| 00000004 (4) | xxxx0807 (2055) | **Meaning:** Media damage may be present in allocated DASD space. The damage is beyond the currently saved portion of the object. The SAVE operation completed successfully.  
**Action:** Notify your system programmer. |
| 00000008 (8) | xxxx0143 (323) | **Meaning:** You cannot use the SAVE service for a temporary object.  
**Action:** Use the scrollout (CSRSCOT) service. |
| 0000000C (12) | xxxx000A (10) | **Meaning:** There is another service currently executing with the specified ID.  
**Action:** Use a different ID or wait until the other service completes. If the problem persists, notify your system programmer. |
<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0000000C (12) | xxxx0017 (23) | **Meaning:** An I/O error has occurred.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxxx001A (26) | **Meaning:** The specified range does not encompass any mapped area of the object.  
**Action:** If you expect this reason code, take whatever action the design of your program dictates. If the reason code is unexpected, check your program for errors; you might have specified the wrong range of blocks on CSRVIEW or on CSRREFR. If you do not find any errors in your program, notify your system programmer. |
| 0000000C (12) | xxxx0801 (2049) | **Meaning:** System error — Insufficient storage available to build the necessary data-in-virtual control block structure.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxxx0802 (2050) | **Meaning:** System error — I/O driver failure.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxxx0803 (2051) | **Meaning:** System error — A necessary page table could not be read into real storage.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxxx0804 (2052) | **Meaning:** System error — Catalog update failed.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxxx0806 (2054) | **Meaning:** System error — I/O error.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxxx0808 (2056) | **Meaning:** System error — I/O from a previous request has not completed.  
**Action:** Notify your system programmer. |
| 000002C (44) | 00000004 (4) | **Meaning:** Window services have not been defined to your system or the link to the service failed.  
**Action:** Notify your system programmer. |

**CSRSCOT — Save object changes in a scroll area**

Call CSRSCOT to:

- Update specified blocks of a permanent object’s scroll area with changes that appear in a window you have defined for the object. CSRSCOT requires that the permanent object have a scroll area. CSRSCOT changes only the content of the scroll area and not the content of the permanent data object.
- Update specified blocks of a temporary data object with the changes that appear in a window you have defined for the data object.

Code the CALL following the syntax of the high-level language you are using and specifying all parameters in the order shown below. For parameters that CSRSCOT uses to obtain input values, assign values that are acceptable to CSRSCOT. For parameters that CSRSCOT ignores, assign any value that is valid for the particular parameter’s data type.
Assign values, acceptable to CSRSCOT, to object_id, offset, and span. CSRSCOT ignores other parameter values. CSRSCOT returns values in return_code and reason_code.

```
CALL CSRSCOT
```

**object_id**
Specifies the object identifier. Supply the same object identifier that CSRIDAC returned when you obtained access to the object.
Define **object_id** as character data of length 8.

**offset**
Specifies the offset into the object in blocks of 4096 bytes. A value of 0 specifies the first block of 4096 bytes or bytes 0 to 4095 of the object; a value of 1 specifies the second block of 4096 bytes, or bytes 4096 to 8191 of the object, and so forth.
Define **offset** as integer data of length 4.
offset and span, together, determine which part of the object CSRSCOT updates.
To update the entire object, specify 0 for offset and 0 for span.

**span**
Specifies how many 4096-byte blocks CSRSCOT is to update.
Define **span** as integer data of length 4.

**return_code**
When CSRSCOT completes, **return_code** contains the return code. Define **return_code** as integer data of length 4.

Return codes and reason codes are explained under "Return codes and reason codes."

**reason_code**
When CSRSCOT completes, **reason_code** contains the reason code. Define **reason_code** as integer data of length 4.

Return codes and reason codes are explained under "Return codes and reason codes."

**Abend codes**
CSRSCOT issues abend code X'019'. For more information, see z/OS MVS System Codes.

**Return codes and reason codes**
When CSRSCOT returns control to your program, **return_code** contains a return code and **reason_code** contains a reason code. Return codes and reason codes are shown in hexadecimal followed by the decimal equivalent enclosed in parentheses. Table 5 on page 38 identifies return code and reason code combinations, tells what each means, and recommends an action that you should take.
A return code of X'C' means that data-in-virtual encountered a problem or an unexpected condition. The associated reason codes are data-in-virtual reason codes. Data-in-virtual reason codes are two bytes long and right justified. For information about data-in-virtual, see [z/OS MVS Programming: Assembler Services Guide](#) To resolve the problem, request help from your system programmer.

### Table 5. CSRSCOT Return and Reason Codes

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000000 (0)</td>
<td>00000000 (0)</td>
<td><strong>Meaning</strong>: The operation was successful.</td>
<td><strong>Action</strong>: Continue normal program execution.</td>
</tr>
<tr>
<td>00000004 (4)</td>
<td>xxxx0807 (2055)</td>
<td><strong>Meaning</strong>: Media damage may be present in allocated DASD space. The damage is beyond the currently saved portion of the object. The SAVE operation completed successfully.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx000A (10)</td>
<td><strong>Meaning</strong>: There is another service currently executing with the specified ID.</td>
<td><strong>Action</strong>: Use a different ID or wait until the other service completes. If the problem persists, notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx0017 (23)</td>
<td><strong>Meaning</strong>: An I/O error has occurred.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx001A (26)</td>
<td><strong>Meaning</strong>: The specified range does not encompass any mapped area of the object.</td>
<td><strong>Action</strong>: If you expect this reason code, take whatever action the design of your program dictates. If the reason code is unexpected, check your program for errors: you might have specified the wrong range of blocks on CSRVIEW or on CSRREFR. If you do not find any errors in your program, notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx0801 (2049)</td>
<td><strong>Meaning</strong>: System error — Insufficient storage available to build the necessary data-in-virtual control block structure.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx0802 (2050)</td>
<td><strong>Meaning</strong>: System error — I/O driver failure.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx0803 (2051)</td>
<td><strong>Meaning</strong>: System error — A necessary page table could not be read into real storage.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx0804 (2052)</td>
<td><strong>Meaning</strong>: System error — Catalog update failed.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx0806 (2054)</td>
<td><strong>Meaning</strong>: System error — I/O error.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>xxxx0808 (2056)</td>
<td><strong>Meaning</strong>: System error — I/O from a previous request has not completed.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
<tr>
<td>0000002C (44)</td>
<td>00000004 (4)</td>
<td><strong>Meaning</strong>: Window services have not been defined to your system or the link to the service failed.</td>
<td><strong>Action</strong>: Notify your system programmer.</td>
</tr>
</tbody>
</table>
CSRVIEW — View an object

Call CSRVIEW to:

- Map a window to one or more blocks of a data object. If you specified scrolling when you called CSRIDAC to identify the object, CSRVIEW maps the window to the scroll area and the scroll area to the object.
- Specify that the reference pattern you are using is either random or sequential.
- End a view that you previously created through CSRVIEW or CSREVW and unmap the object.

Mapping a data object enables your program to access the data that is viewed through the window the same way it accesses other data in your storage.

The CSREVW service also maps a data object. Use that service if your program can benefit from having more than 16 blocks come into a window at one time or if it can benefit from having fewer than 16.

Code the CALL following the syntax of the high-level language you are using and specifying all parameters in the order shown below. For parameters that CSRVIEW uses to obtain input values, assign values that are acceptable to CSRVIEW. For parameters that CSRVIEW ignores, assign any value that is valid for the particular parameter’s data type.

The type of function you request determines which parameter values CSRVIEW uses to obtain input values:

- To map a window to a data object and begin viewing the object, specify BEGIN for operation_type, and assign values, acceptable to CSRVIEW, to:
  - object_id
  - offset
  - span
  - window_name
  - usage
  - disposition
  CSRVIEW ignores other parameter values. CSRVIEW returns values in return_code and in reason_code.

- To end a view set by either CSRVIEW or CSREVW and to unmap the data object, specify END for operation_type, and assign values, acceptable to CSRVIEW, to:
  - object_id
  - offset
  - span
  - window_name
  - usage
  - disposition
  CSRVIEW ignores other parameter values. CSRVIEW returns values in return_code and reason_code.
CALL statement Parameters

CALL CSRVIEW (operation_type, object_id, offset, span, window_name, usage, disposition, return_code, reason_code)

operation_type
Specifies the type of operation CSRVIEW is to perform. To begin viewing an object, specify BEGIN. To end a view, specify END.

Define operation_type as character data of length 5. If you specify END, pad the string on the right with 1 or 2 blanks.

.object_id
Specifies the object identifier. Supply the object identifier that CSRIDAC returned when you obtained access to the object.

Define object_id as character data of length 8.

.offset
Specifies the offset of the view into the object. Specify the offset in blocks of 4096 bytes.

Define offset as integer data of length 4.

.span
Specifies the window size in blocks of 4096 bytes.

Define span as integer data of length 4.

.window_name
Specifies the symbolic name you assigned to the window in your address space.

.usage
Specifies the expected pattern of references to pages in the object. Specify one of the following values:

SEQ The reference pattern is expected to be sequential. If you specify SEQ, window services brings up to 16 blocks of data into the window at a time, depending on the size of the window.

RANDOM The reference pattern is expected to be random. If you specify RANDOM, window services brings data into the window one block at a time.

Define usage as character data of length 6. If you specify SEQ, pad the string on the right with 1 to 3 blanks.

.disposition
Defines how CSRVIEW is to handle data that is in the window when you begin or end a view.
When you specify CSRVIEW with an operation_type of BEGIN and a disposition of:

**REPLACE**

The first time you reference a block to which the window is mapped, CSRVIEW replaces the data in the window with the data from the referenced block.

**RETAIN**

When you reference a block to which the window is mapped, the data in the window remains unchanged. When you call CSRSAVE to save the mapped blocks, CSRSAVE saves all of the mapped blocks because CSRSAVE considers them changed.

• When you specify CSRVIEW with an operation_type of END and a disposition of:

**REPLACE**

CSRVIEW discards the data that is in the window making the window contents unpredictable. CSRVIEW does not update mapped blocks of the object or scroll area.

**RETAIN**

If the object is permanent and has no scroll area, CSRVIEW retains the data that is in the window. CSRVIEW does not update mapped blocks of the object. If the object is permanent and has a scroll area, or if the object is temporary, CSRVIEW retains the data that is in the window and updates the mapped blocks of the object or scroll area.

Define disposition as character data of length 7. If you specify RETAIN, pad the string on the right with a blank.

• **return_code**

  When CSRVIEW completes, return_code contains the return code. Define return_code as integer data of length 4.

  Return codes and reason codes are explained under "Return codes and reason codes."

• **reason_code**

  When CSRVIEW completes, reason_code contains the reason code. Define reason_code as integer data of length 4.

  Return codes and reason codes are explained under "Return codes and reason codes."

**Abend codes**

CSRVIEW issues abend code X'019'. For more information, see "z/OS MVS System Codes."

**Return codes and reason codes**

When CSRVIEW returns control to your program, return_code contains a return code and reason_code contains a reason code. Return codes and reason codes are shown in hexadecimal followed by the decimal equivalent enclosed in parentheses. Table 6 on page 42 identifies return code and reason code combinations, tells what each means, and recommends an action that you should take.

A return code of X'4' with a reason code of X'0125' or a return code of X'C' with any reason code means that data-in-virtual encountered a problem or an unexpected condition. Data-in-virtual reason codes are two bytes long and right
justified. For information about data-in-virtual, see [z/OS MVS Programming: Assembler Services Guide](#). To resolve the problem, request help from your system programmer.

**Table 6. CSRVIEW Return and Reason Codes**

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00000000 (0) | 00000000 (0) | **Meaning:** The operation was successful.  
**Action:** Continue normal program execution. |
| 00000004 (4) | xxx0125 (293) | **Meaning:** The operation was successful. The service could not retain all the data that was in the scroll area, however.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxx000A (10) | **Meaning:** There is another service currently executing with the specified ID.  
**Action:** Use a different ID or wait until the other service completes. If the problem persists, notify your system programmer. |
| 0000000C (12) | xxx0017 (23) | **Meaning:** An I/O error has occurred.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxx001A (26) | **Meaning:** The specified range does not encompass any mapped area of the object.  
**Action:** If you expect this reason code, take whatever action the design of your program dictates. If the reason code is unexpected, check your program for errors: you might have specified the wrong range of blocks on CSRVIEW or on CSRREFR. If you do not find any errors in your program, notify your system programmer. |
| 0000000C (12) | xxx001C (28) | **Meaning:** The object cannot be accessed at the current time.  
**Action:** Try running your program at a later time. If the problem persists, notify your system programmer. |
| 0000000C (12) | xxx0040 (64) | **Meaning:** The specified MAP range would cause the hiperspace data-in-virtual object to be extended such that the installation data space limits would be exceeded.  
**Action:** Change the MAP range you have specified or request your system programmer to increase the installation’s data space limits. |
| 0000000C (12) | xxx0801 (2049) | **Meaning:** System error — Insufficient storage available to build the necessary data-in-virtual control block structure.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxx0802 (2050) | **Meaning:** System error — I/O driver failure.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxx0803 (2051) | **Meaning:** System error — A necessary page table could not be read into real storage.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxx0804 (2052) | **Meaning:** System error — Catalog update failed.  
**Action:** Notify your system programmer. |
| 0000000C (12) | xxx0806 (2054) | **Meaning:** System error — I/O error.  
**Action:** Notify your system programmer. |
<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0000000C (12) | xxxx0808 (2056) | **Meaning:** System error — I/O from a previous request has not completed.  
**Action:** Notify your system programmer. |
| 0000002C (44) | 00000004 (4) | **Meaning:** Window services have not been defined to your system or the link to the service failed.  
**Action:** Notify your system programmer. |
Chapter 4. Window services coding examples

The following examples show how to invoke window services from each of the supported languages. Following each program example is an example of the JCL needed to compile, link edit, and execute the program example. Use these examples to supplement and reinforce information that is presented in other topics within this information.

Note: Included in the FORTRAN example is the code for a required assembler language program. This program ensures that the window for the FORTRAN program is aligned on a 4K boundary.

The examples are presented in Chapter 4, “Window services coding examples”:
- “ADA example” on page 50
- “C/370 example” on page 53
- “COBOL example” on page 57
- “FORTRAN example” on page 57
- “Pascal example” on page 61
- “PL/I example” on page 65

ADA example

```
with EBCDIC; use EBCDIC;
with System;
with Text_Io;
with Unchecked_Conversion;
with Td_Standard; use Td_Standard;

procedure CRTPAN06 is

subtype Str3 is EString (1..3);
subtype Str5 is EString (1..5);
subtype Str6 is EString (1..6);
subtype Str7 is EString (1..7);
subtype Str8 is EString (1..8);
subtype Str9 is EString (1..9);

function Integer_Address is new Unchecked_Conversion
  (System.Address, Integer);

function Int_To_32 is new Unchecked_Conversion
  (Integer, Integer_32);

Orig, -- Index to indicate the 'start'
  Ad, I : Integer; -- Temporary variables
Voffset, -- Offset passed as parameter
Vofset2, -- Offset passed as parameter
```

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ADA Example

Vobjsiz, -- Object size, as parameter
Wwinsiz, -- Window size, as parameter
High_Offset, -- Size of object in pages
New_Hi_Offset, -- New max size of the object
Return_Code, -- Return code
Reason_Code : Integer_32; -- Reason code
Object_Id : Str8; -- Identifying token
Cscroll : Str3; -- Scroll area YES/NO
Cobstate : Str3; -- Object state NEW/OLD
Coptype : Str5; -- Operation type BEGIN/END
Caaccess : Str6; -- Access RANDOM/SEQ
Cusage : Str6; -- Usage READ/UPDATE
Cdisp : Str7; -- Disposition RETAIN/REPLACE
Csptype : Str9; -- Object type DSNAME/DDNAME/TEMPSPACE
Cobname : Str7; -- Object name
K : constant Integer := 1024; -- One kilo-byte
Pagesize : constant Integer := 4*K; -- Page (4K) boundary
Offset : constant Integer_32 := 0; -- Start of permanent object
Window_Size : constant Integer := 40; -- Window size in pages
Num_Win_ELEM : constant Integer := Window_Size*K; -- Num of 4-byte
-- elements in window
Object_Size : constant Integer := 3*Window_Size; -- Chosen object
-- size in pages
Num_Sp_ELEM : constant Integer := (Window_Size+1)*K; -- Num of
-- 4-byte elements in space

type S is array (positive range <>) of Integer; -- Define byte
-- aligned space
Sp : S (1..Num_Sp_ELEM); -- Space allocated for window

procedure CSRIDAC (Op_Type : in Str5;
Object_Type : in Str9;
Object_Name : in Str7;
Scroll_Area : in Str3;
Object_State: in Str3;
Access_Mode : in Str6;
Vobjsiz : in Integer_32;
Object_Id : out Str8;
High_Offset : out Integer_32;
Return_Code : out Integer_32;
Reason_Code : out Integer_32);
pragma Interface (Assembler, CSRIDAC);

procedure CSRVIEW (Op_Type : in Str5;
Object_Id : in Str8;
Offset : in Integer_32;
Window_Size : in Integer_32;
Window_Name : in S;
Usage : in Str6;
Disposition : in Str7;
Return_Code : out Integer_32;
Reason_Code : out Integer_32);
pragma Interface (Assembler, CSRVIEW);

procedure CSRSCOT (Object_Id : in Str8;
Offset : in Integer_32;
Span : in Integer_32;
Return_Code : out Integer_32;
Reason_Code : out Integer_32);
pragma Interface (Assembler, CSRSCOT);

procedure CSRSAVE (Object_Id : in Str8;
Offset : in Integer_32;
Span : in Integer_32;
New_Hi_Offset : out Integer_32;
Return_Code : out Integer_32;
Reason_Code : out Integer_32);
pragma Interface (Assembler, CSRSAVE);

procedure CSRREFR (Object_Id  : in Str8;
                   Offset    : in Integer_32;
                   Span      : in Integer_32;
                   Return_Code : out Integer_32;
                   Reason_Code : out Integer_32);

begin
  Text_Io.Put_Line ("<<Begin Window Services Interface Validation>>");
  Text_Io.New_Line;

  Vobjsiz := Int_To_32(Object_Size); -- Set object size in variable
  Voffset := Offset; -- Set offset to 0 for 1st map
  Vwinsiz := Int_To_32(Window_Size); -- Set window size in variable
  Vofset2 := Offset+Vwinsiz; -- Set offset to 40 for 2nd map

  Coptype := "BEGIN";
  Csptype := "DDNAME ";
  Cobname := "CSRDD1 ";
  Cscroll := "YES";
  Cobstate := "OLD";
  Caccess := "UPDATE";

  CSRIDAC (Coptype, -- Set up access to the
           Csptype, -- permanent object and
           Cobname, -- request a scroll area
           Cscroll,
           Cobstate,
           Caccess,
           Vobjsiz,
           Object_Id,
           High_Offset,
           Return_Code,
           Reason_Code);

  -- When you want to map a window to your object, data window services
  -- expects the address of the start of the window to be on a page (4K)
  -- boundary, and the length of the window to be a multiple of 4096 bytes.
  -- If your window is an array, the address of the first element
  -- of the array must be on a page boundary. If this is not the case,
  -- you can appropriately choose one slice of your array that starts
  -- on a 4K boundary and is a multiple of 4096 bytes in length to map
  -- onto your object.
  -- To illustrate, consider the array A(1..max_len). If the address of
  -- A(1) is not on page boundary, you cannot map A(1..max_len) to your
  -- object. You can, however, map A(n..m) to your object if you choose
  -- some appropriate values n and m such that A(n) starts on a 4K
  -- boundary and A(n..m) is a multiple of 4096 bytes in length.

  Ad := Integer_Address(Sp(1)'Address); -- Get address of start of array
  -- Determine the first element whose address is on page boundary
  -- and use that element as the origin of the array.

  Orig := (Ad mod Pagesize); -- See where the start of
  -- array is in page

  if Orig = 0 then
    Orig := 1; -- If already on page boundary
  else
    Orig := (Pagesize - Orig) / 4 + 1; -- Need new origin
  end if;

  Coptype := "BEGIN";
  Cusage := "RANDOM";
-- You can pass an array slice as a parameter to a non-Ada subprogram, -- and because the slice is a composite object, the parameter list -- contains the actual address of the first element in the slice. -- To elaborate further: -- Scalar data is passed by copy, but composite data is passed by -- reference. If the scalar value was passed as a scalar, the assembler\ -- program would receive the address of the copy and not the address of -- the scalar. By passing the scalar value as an array slice, a -- composite data type is being passed and thus is passed by reference. -- Using this technique, the assembler code receives the actual address -- of the scalar, not a copy of the scalar.

CSRVIEW (Coptype, -- Now map a window (the array) Object_Id, -- to the permanent object. Voffset, -- (Actually, CSRVIEW will map the Vwinsiz, -- window to the blocks in the Sp(Orig..Num_Sp_Elem), -- scroll area and map the scroll Cusage, -- area to the object.) Cdisp, Return_Code, Reason_Code);

for I in 0 .. Num_Win_Elem-1 loop -- Put data in window area Sp(I+Orig) := I+1; end loop;

CSRSCOT (Object_Id, -- Capture the view in window. Voffset, Vwinsiz, -- Note: only the scroll area Return_Code, -- is updated, the permanent Reason_Code);

Coptype := "END "; Cusage := "RANDOM";
Cdisp := "REPLACE ";

CSRVIEW (Coptype, -- End the view in window Object_Id, Voffset, Vwinsiz, Sp(Orig..Num_Sp_Elem), Cusage, Cdisp, Return_Code, Reason_Code);

Coptype := "BEGIN";
Cusage := "RANDOM";
Cdisp := "REPLACE ";

CSRVIEW (Coptype, -- Now map the same window Object_Id, Voffset2, -- to different part of the Vwinsiz, -- permanent object. Sp(Orig..Num_Sp_Elem), Cusage, Cdisp, Return_Code, Reason_Code);

for I in 0 .. Num_Win_Elem-1 loop -- Put data in window area Sp(I+Orig) := I+1;
end loop;
ADA Example

```ada
CSRSAVE (Object_Id, -- Capture the view in window.
    Voffset2, -- Note: this time the permanent
    Vwinsiz, -- object is updated with the
    New_Hi_Offset, -- changes.
    Return_Code,
    Reason_Code);

Coptype := "END ";
CUsage := "RANDOM";
Cdisp := "RETAIN ";

CSRVIEW (Coptype, -- End the current view in
    Object_Id, -- the window
    Voffset,
    Vwinsiz,
    Sp(Orig..Num_Sp_Elem),
    Cusage,
    Cdisp,
    Return_Code,
    Reason_Code);

Coptype := "BEGIN";
CUsage := "RANDOM";
Cdisp := "REPLACE";

CSRVIEW (Coptype, -- Now go back to reestablish
    Object_Id, -- the 1st map using the same
    Voffset, -- window area
    Vwinsiz,
    Sp(Orig..Num_Sp_Elem),
    Cusage,
    Cdisp,
    Return_Code,
    Reason_Code);

CSRREFR (Object_Id, -- Refresh the data in the window
    Voffset,
    Vwinsiz,
    Return_Code,
    Reason_Code);

Coptype := "END ";
CUsage := "RANDOM";
Cdisp := "RETAIN ";

CSRVIEW (Coptype, -- End the view in window
    Object_Id,
    Voffset,
    Vwinsiz,
    Sp(Orig..Num_Sp_Elem),
    Cusage,
    Cdisp,
    Return_Code,
    Reason_Code);

Coptype := "END ";
Csptype := "DDNAME ";
Cobname := "CSRDD1 ";
Cscroll := "YES";
Cobstate := "OLD";
Caccess := "UPDATE";

CSRIDAC (Coptype, -- Terminate access to the
    Csptype,
    Cobname,
    Cscroll,
    Cobstate,
```

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ADA Example

```
Caccess,
Vwinsiz,
Object_Id,
High_Offset,
Return_Code,
Reason_Code);
end CRTPAN06;
//ADAJOB JOB 00000100
//** JCL USED TO COMPILE, LINK, AND EXECUTE THE ADA PROGRAM CRTPAN06 00000600
//** THAT USES DATA WINDOW SERVICES 00000700
//** ********************************** 00000800
//** JOBPARM T=2,L=99 00050000
//ADACOB1 EXEC PGM=IKJEFT01,DYNAMNBR=133 00055813
//SYSTSPRT DD SYSOUT=* 00055913
//SYSTSIN DD * 00056008
ALLOC FI(SYSLIB) DS('SYS1.CSSLIB') SHR 00056147
EX 'HLQ.SEVGEXE1(ADA)' 'USERID.DWS.ADA'' (MAI CRE' 00056251
/* 00057008
//ADARUN EXEC PGM=CRTPAN06,DYNAMNBR=133 00070036
//STEPLIB DD DISP=SHR,DSN=HLQ.SEVHMOD1 00100051
// DD DISP=SHR,DSN=USERID.LOAD 00110051
//CSRDD1 DD DSN=USERID.ADA.DWSTEST.DATA,DISP=SHR 00120051
//CONOUT DD SYSOUT=*, 00130013
// DCB=(LRECL=133,RECFM=F) 00140027
```

C/370 example

The following example, coded in C/370™, creates and uses a temporary data object.
```
#include <stdio.h>
#include <stdlib.h>
/* Defined macros that will be used in the program. */
#define SIZE 8*1024
#define OBJ_SIZE 8
#define PAGE_SIZE (4*1024)
#define DWS_FILE "DWS.FILE1"
#define TRUE 1
#define FALSE 0
char windows[SIZE];
char *view;
void init_mem(char init_value, char *low_mem, int size);
int chk_code(long int ret, long int reason, int linenumber);
main()
{
    /* Initialized variables that will be used in the Callable */
    /* Services. */
    char op_type1[5] = "BEGIN";
    char op_type2[5] = "END";
    char object_type[9] = "TEMSPACE";
    char object_name[45] = DWS_FILE;
    char scroll_area[3] = "YES";
    char object_state[3] = "NEW";
    char access_mode[6] = "UPDATE";
    long int object_size = OBJ_SIZE;
    char disposition[7] = "REPLACE";
    char usage[6] = "SEQ";
    char object_id[8];
    long int high_offset, return_code, reason_code;
    long int offset, window_size, window_addr;
    long int span, new_hi_offset;
    long int addr;
    int i, ret, origin, errflag = FALSE;
    double id;
    /* Set up access to a Hiperspace object using TEMPSPACE. */
```
/* Check for return code and reason code after the call. */
csridac(op_type1, object_type, object_name, scroll_area, object_state,
       access_mode,&object_size,&object_id,&high_offset,&return_code,;
       &reason_code);
chk_code(return_code,reason_code,__LINE__);
/* Define a window in a 4K region and initialize */
/* variables for CSRVIEW. Define the window for the */
/* TEMPSPACE and verify the return code and reason code. */
init_mem('0',windows,SIZE);
addr = (int) windows % 4096;
if (addr != 0) view = windows + 4096 - addr;
offset = 0; window_size = 1;
csview(op_type1,&object_id,&offset,&window_size,view,;
       usage, disposition, &return_code, &reason_code);
chk_code(return_code,reason_code,__LINE__);
/* Change values in the window into 1. */
init_mem('1',view,4096);
/* Capture the view in the 1st window. */
offset = 0; window_size = 1;
csrsco(&object_id, &offset, &window_size, &return_code,;
       &reason_code);
chk_code(return_code,reason_code,__LINE__);
/* Make sure that CSRSAVE will not save changes for temporary */
/* object. The return code should be equal to 8 and control */
/* will be returned to the program. */
offset = 0; window_size = 1;
csrsave( &object_id, &offset, &window_size, &high_offset,;
       &return_code, &reason_code);
if (return_code != 8) {
  errflag = TRUE;
  printf("return_code was not set to proper value.\n");
}
/* Terminate the view to the window. */
offset = 0; window_size = 1;
csview(op_type2,&object_id,&offset,&window_size,view,;
       usage, disposition, &return_code, &reason_code);
chk_code(return_code,reason_code,__LINE__);
/* Change values in the window array into 0's. */
init_mem('0',view,4096);
/* View the window again. */
offset = 0; window_size = 1;
csview(op_type1,&object_id,&offset,&window_size,view,;
       usage, disposition, &return_code, &reason_code);
chk_code(return_code,reason_code,__LINE__);
/* The values in the window should remain to 1's. */
for (i=0; i<4096; i++) {
  if (errflag == TRUE) printf("%d %c ", i, view[i]);
  if (view[i] != '1') errflag = TRUE;
}
/* Refresh the window to 0's. */
offset = 0; window_size = 1;
csrefr(&object_id, &offset, &window_size,;
       &return_code, &reason_code);
chk_code(return_code,reason_code,__LINE__);
/* The values inside the window should equal to 0's. */
for (i=0; i<4096; i++) {
  if (errflag == TRUE) printf("%d %c ", i, view[i]);
  if (view[i] != 0) errflag = TRUE;
}
/* Terminate the view to the window. */
offset = 0; window_size = 1;
csview(op_type2,&object_id,&offset,&window_size,view,;
       usage, disposition, &return_code, &reason_code);
chk_code(return_code,reason_code,__LINE__);
/* Terminate the access to the Hiperspace object. */
csridac(op_type2, object_type, object_name, scroll_area, object_state,
       access_mode,&object_size,&object_id,&high_offset,&return_code,;
&reason_code);
chk_code(return_code,reason_code,_LINE_);
/* Report the status of the test. */
if (errflag) {
    printf("Test failed at line %d\n", _LINE_);
    exit(1);
} else {
    printf("Test successful : %s\n", __FILE__);
    exit(0);
}
/* Functions that will be used in the program. */
/* chk_code will check return code and reason code returned from*/
/* the Callable Services. It will report an error if the code(s)*/
/* is not equal to 0. */
t long int ret, long int reason, int linenumber)
{
    if (ret != 0)
        printf("return_code = %ld instead of 0 at line %d\n", ret, linenumber);
    if (reason != 0)
        printf("reason_code = %ld instead of 0 at line %d\n", reason, linenumber);
}
/* init_mem will initialize a block of memory starting at a */
/* given location to a specified value. */
void init_mem(char init_val, char *low_mem, int size)
{
    int i;
    for (i=0; i<size; i++) *(low_mem+i) = init_val;
}

/* JCL USED TO COMPILE, LINK, AND, EXECUTE THE C/370 PROGRAM */
/* -------------------------------------------------------------------- */
/* DPTTST1A JOB 'DPT04P,DPT,?,S=I','DPTTST1',MSGCLASS=H, */
/* CLASS=J,NOTIFY=DPTTST1,MSGLEVEL=(1,1) */
/* CC EXEC EDCC,INFILE='DPTTST1.DWS.SOURCE(DWS1)', */
/* CPARM='NOOPT,SOURCE,NOSEQ,NOMAR', */
/* OUTFILE='DPTTST1.DWS.OBJECT(DWS1)' */
/* -------------------------------------------------------------------- */
/* LINK STEP */
/* -------------------------------------------------------------------- */
/* LKED EXEC PGM=IEWL,PARM='MAP,RMODE=ANY,AMODE=31' */
/* SYSLIB DD DSN=CEE.SCEELKED,DISP=SHR */
/* DD DSN=SYS1.CSSLIB,DISP=SHR */
/* OBJECT DD DSN=DPTTST1.DWS.OBJECT,DISP=SHR */
/* SYSLIN DD */
/* ENTRY CEESTART */
/* INCLUDE OBJECT(DWS1) */
/* NAME DWS1(R) */
/* SYSLMOD DD DSN=DPTTST1.DWS.LOAD,DISP=SHR */
/* SYSPRINT DD SYSOUT= */
/* SYST1 DD DSN=&SYSUT1,UNIT=SYSDA,DISP=(NEW,DELETE,DELETE), */
/* SPACE=(32000,(30,30)) */
/* GO STEP. THIS STEP DEFINES A NAME FOR A PERMANENT OBJECT THAT */
/* THE DDNAME OBJECT TYPE WILL REFERENCE. */
/* -------------------------------------------------------------------- */
/* GO EXEC PGM=DWS1,REGION=4M */
/* STEPLIB DD DSN=CEE.SCEERUN,DISP=SHR */
/* DD DSN=DPTTST1.DWS.LOAD,DISP=SHR */
/* SYSPRINT DD SYSOUT=,DCB=(RECFM=VB,LRECL=125,BLKSIZ=6000) */
C/370 Example

IDENTIFICATION DIVISION.
*****************************************************************
* Program using COBOL to create a 40-page window            *
* aligned on a page boundary. This is done by locating a    *
* page boundary within a 4040964095 byte work area.         *
* The DWS interface validation routine is then called passing *
* the 40 page window.                                        *
*****************************************************************

PROGRAM-ID. DWSCBSAM.
ENVIRONMENT DIVISION.
DATA DIVISION.
WORKING-STORAGE SECTION.
1 WORKAREA.
2 FILLER PIC X OCCURS 167935 TIMES.
PROCEDURE DIVISION.
DISPLAY " DWSCBSAM CALLING DWSCB4K "
CALL "DWSCB4K" USING WORKAREA
DISPLAY " DWSCBSAM BACK FROM DWSCB4K "
GOBACK.

---------------------------------------------------------------------
IDENTIFICATION DIVISION.
PROGRAM-ID. DWSCB4K.
ENVIRONMENT DIVISION.
DATA DIVISION.
WORKING-STORAGE SECTION.
1 P POINTER.
1 PR REDEFINES P PIC 9(9) COMP.
1 DUMMY PIC 9(9) COMP.
1 R PIC 9(9) COMP.
LINKAGE SECTION.
1 INWORK PIC X(167935).
1 WINDOW.
2 FILLER PIC X(4096) OCCURS 40 TIMES.
PROCEDURE DIVISION USING INWORK.
SET P TO ADDRESS OF INWORK
DIVIDE PR BY 4096
GIVING DUMMY
REMAINDER R
IF R NOT EQUAL 0 THEN
COMPUTE PR = PR + 4096 - R
SET ADDRESS OF WINDOW TO P
DISPLAY " DWSCB4K CALLING DWSCB2 "
CALL "DWSCB2" USING WINDOW,
DISPLAY " DWSCB4K BACK FROM DWSCB2 "
GOBACK.

---------------------------------------------------------------------
IDENTIFICATION DIVISION.
PROGRAM-ID. DWSCB2.
ENVIRONMENT DIVISION.
DATA DIVISION.
WORKING-STORAGE SECTION.
* WINDOW SIZE CHOSEN TO BE 40 PAGES
1 NWINPG PIC 9(9) COMP VALUE 40.
1 NWINEL PIC 9(9) COMP.
1 NWLAST PIC 9(9) COMP.
1 NOBJPG PIC 9(9) COMP.
* WINDOWS WILL BEGIN ORIGIN-ING AT OFFSET 0 IN DATA OBJECT
1 WINOFF PIC 9(9) COMP VALUE 0.
1 RETRNL PIC 9(9) COMP.
**COBOL Example**

```cobol
1    REASON PIC 9(9) COMP.
1    NEWOFF PIC 9(9) COMP.
1    OBSIZ PIC 9(9) COMP.
1    TOKEN PIC X(8).
1    K    PIC 9(9) COMP.

LINKAGE SECTION.

1    WINDOW.
    2    FILLER PIC X(4096) OCCURS 40 TIMES.
1    WINDOW-ARRAY REDEFINES WINDOW.
    2    A PIC S9(8) COMP OCCURS 40960 TIMES.

PROCEDURE DIVISION USING WINDOW.
    DISPLAY "Begin Data Windowing Services Interface Validation"
    * WINDOW COMPOSED OF 4-BYTE ELEMENTS
      COMPUTE NWINEL = 1024 * NWINPG.
      * WINDOW MAY NOT BEGIN AT ARRAY ELEMENT 1, SO LEAVE ROOM
      COMPUTE NWLAST = 1024 * NWINPG + 1023
      * IN THE FOLLOWING, ARBITRARILY SET OBJECT SIZE = 3 WINDOWS WORTH
      COMPUTE NOBJPG = 3 * NWINPG
      * SET UP ACCESS TO A HIPERSPACE OBJECT
      CALL "CSRIDAC" USING
      BY CONTENT
        "BEGIN",
        "TEMPSPACE",
        "MY FIRST HIPERSPACE",
        "YES",
        "NEW",
        "UPDATE",
      BY REFERENCE
        NOBJPG,
        TOKEN,
        OBSIZ,
        RETRN1,
        REASON
      * PUT SOME DATA INTO THE WINDOW AREA
      MOVE ALL "DATA" TO WINDOW
      * NOW VIEW SOMETHING IN THE WINDOW
      CALL "CSRVIEW" USING
      BY CONTENT
        "BEGIN",
      BY REFERENCE
        TOKEN,
        WINOFF,
        NWINPG,
      "RANDOM",
      BY CONTENT
        "REPLACE",
      BY REFERENCE
        RETRN1,
        REASON
      * CALCULATE SOMETHING IN THE WINDOW AREA
      PERFORM VARYING K FROM 1 BY 1 UNTIL K = NWINEL
      MOVE K TO A(K)
      END-PERFORM
      * CAPTURE THE VIEW IN THE WINDOW
      CALL "CSRSCT" USING
      TOKEN,
      WINOFF,
      NWINPG,
      RETRN1,
      REASON
      * END THE VIEW IN THE WINDOW
      CALL "CSRVIEW" USING
      BY CONTENT
        "END",
      BY REFERENCE
        TOKEN,
```
COBOL Example

WINOFF,
NWINPG,
WINDOW,
BY CONTENT
"RANDOM",
"REMAIN",
BY REFERENCE
RETRN1,
REASON
* NOW VIEW SOMETHING ELSE (2ND WINDOW"S WORTH OF DATA) IN WINDOW
ADD NWINPG TO WINOFF
CALL "CSRVIEW" USING
BY CONTENT
"BEGIN",
BY REFERENCE
TOKEN,
WINOFF
NWINPG,
WINDOW,
BY CONTENT
"RANDOM",
"REMAIN",
BY REFERENCE
RETRN1,
REASON
* CALCULATE SOMETHING NEW IN THE WINDOW AREA
PERFORM VARYING K FROM 1 BY 1 UNTIL K = NWINEL
   COMPUTE A(K) = - K
END-PERFORM
* SAVE THE DATA IN THE WINDOW
CALL "CSRSCOT" USING
TOKEN,
WINOFF,
NWINPG,
RETRN1,
REASON
* NOW END THE CURRENT VIEW IN WINDOW
CALL "CSRVIEW" USING
BY CONTENT
"END",
BY REFERENCE
TOKEN,
WINOFF
NWINPG,
WINDOW,
BY CONTENT
"RANDOM",
"REMAIN",
BY REFERENCE
RETRN1,
REASON
* NOW GO BACK TO THE FIRST VIEW IN THE WINDOW
MOVE 0 TO WINOFF
CALL "CSRVIEW" USING
BY CONTENT
"BEGIN",
BY REFERENCE
TOKEN,
WINOFF
NWINPG,
WINDOW,
BY CONTENT
"RANDOM",
"REPLACE",
BY REFERENCE
RETRN1,
REASON
**COBOL Example**

* REFRESH THE DATA IN THE WINDOW FOR THIS VIEW
  CALL "CSRREFR" USING
  TOKEN,
  WINOFF,
  WNINPG,
  RETRN1,
  REASON

* NOW END THE VIEW IN THE WINDOW
  CALL "CSRVIEW" USING
  BY CONTENT
  "END",
  BY REFERENCE
  TOKEN,
  WINOFF,
  WNINPG,
  WINDOW,
  BY CONTENT
  "RANDOM",
  "REtain",
  BY REFERENCE
  RETRN1,
  REASON

* TERMINATE ACCESS TO THE HIPERSPACE OBJECT
  CALL "CSRIDAC" USING
  BY CONTENT
  "END",
  "TEMPSPACE",
  "MY FIRST HIPERSPACE ENDS HERE",
  "YES",
  "NEW",
  "UPDATE",
  BY REFERENCE
  NOBJPG,
  TOKEN,
  OBSIZ,
  RETRN1,
  REASON

DISPLAY "**** Run ended with Object Size in pages = " NEWOFF
GOBACK

**************************************************
** JCL FOR COBOL EXAMPLE **
**************************************************

* JCL FOR COBOL EXAMPLE *
* *
**************************************************

/Job1XXX JOB 'A9907P,B922095'
  'A.A.USER',RD=R,
  MSGCLASS=H,NOTIFY=AAUSER,
  MSGLEVEL=(1,1),CLASS=7

EXEC PGM=IEWL,PARM='SIZE=(1024K,512K),LIST,XREF,LET,MAP',
  REGION=1024K

SYSLIN DD DDNAME=SYSIN

SYSLMOD DD DSNAME=AAUSER.USER.LOAD(CRTCON01),DISP=SHR

SYSLIB DD DSNAME=CEE.SCEELED,DISP=SHR

MYLIB DD DSN=AAUSER.FF310.OBJ,DISP=SHR

MYLIB DD DSN=AAUSER.FF310.OBJ,DISP=SHR

THE CSR STUBS ARE IN SYS1.CSSLIB

INLIB DD DSN=SYS1.CSSLIB,DISP=SHR

SYSPRINT DD SYSOUT=

SYSSIN DD *

INCLUDE MYLIB(DWSCBSAM,DWSCB4K,DWSCB2)

LIBRARY INLIB(CSRSCOT,CSRSSAVE,CSRREFR,CSRSSAVE,CSRVIEW,CSRIDAC)

NAME CRTCON01(R)

00010000
00020000
00030000
00040000
00050000
00060000
00070000
00080000
00090000
00100000
00110000
00120000
00130000
00140000
00150000
00160000
00170000
00180000
00190000
00200000
00210000
00220000
00230000
00240000
00250000
FORTRAN Example

FORTRAN example

******************************************************************************
* *
* FORTRAN EXAMPLE. THE FORTRAN EXAMPLE IS FOLLOWED BY AN *
* ASSEMBLER PROGRAM CALLED ADDR. YOU MUST LINKEDIT THIS *
* ASSEMBLER PROGRAM WITH THE FORTRAN PROGRAM OBJECT *
* CODE AND THE CSR STUBS. THE ASSEMBLER PROGRAM ENSURES *
* THAT YOUR WINDOW IS ALIGNED ON A 4K BOUNDARY. *
* *
******************************************************************************

@PROCESS DC(WINCOM)

PROGRAM CRTFON01

C
C Test Program for Data Window Services
C
C Window size chosen to be 40 pages
PARAMETER (NWINPG = 40)
C Window composed of 4-byte elements
PARAMETER (NWINEL = 1024*NWINPG)
C Window may not begin at array element 1, so leave room
PARAMETER (NWLAST = 1024*NWINPG+1023)
C In the following, arbitrarily set object size = 3 windows worth
PARAMETER (NOBJPG = 3*NWINPG)
C Windows will begin origin-ing at offset 0 in data object
INTEGER WINOFF
PARAMETER (WINOFF = 0)
C
INTEGER RETRN1, REASON, HIOFF, NEWOFF, OBSIZ, OFF
INTEGER ADDR, PAGE, A
INTEGER JUNK /-1599029040/
REAL*8 TOKEN
COMMON /WINCOM/ A(NWLAST)
C
C WRITE (6, 91)
91 FORMAT('1*** Begin Data Windowing Services Interface Validation')
C
C Set up access to a Hiperspace object
CALL CSRIDAC('BEGIN',
  * 'TEMSPACE',
  * 'MY FIRST HIPERSPACE',
  * 'YES',
  * 'NEW',
  * 'UPDATE',
  * NOBJPG,
  * TOKEN,
  * OBSIZ,
  * RETRN1,
  * REASON )
C
C Determine first page-boundary element in Window Array "A"
PAGE = ADDR(A(1))
PAGE = MOD(PAGE, 4096)
IF (PAGE .NE. 0) PAGE = (4096 - PAGE) / 4
PAGE = PAGE + 1
C
C Put data into the window
DO 100 K = 1, NWINEL
  A(K+PAGE-1) = JUNK
100 CONTINUE
C
C Now view data in the window
CALL CSRVIEW('BEGIN',
  * TOKEN,
  * WINOFF,
FORTRAN Example

* NWINPG,
* A(PAGE),
* 'RANDOM',
* 'REPLACE',
* RETRN1,
* REASON )

C Calculate a value in the window area
DO 101 K = 1, NWINEL
  A(K+PAGE-1) = K
101 CONTINUE

C Capture the view in the window
CALL CSRSCOT( TOKEN,
* WINOFF,
* NWINPG,
* RETRN1,
* REASON )

C End the view in the window
CALL CSRVIEW('END ',
* TOKEN,
* WINOFF,
* NWINPG,
* A(PAGE),
* 'RANDOM',
* 'RETAI N ',
* RETRN1,
* REASON )

C Now view other data (2nd window's worth of data) in window
CALL CSRVIEW('BEGIN',
* TOKEN,
* WINOFF + NWINPG,
* NWINPG,
* A(PAGE),
* 'RANDOM',
* 'REPLACE',
* RETRN1,
* REASON )

C Calculate a new value in the window
DO 102 K = 1, NWINEL
  A(K+PAGE-1) = -K
102 CONTINUE

C Capture the view in the window
CALL CSRSCOT( TOKEN,
* WINOFF + NWINPG,
* NWINPG,
* RETRN1,
* REASON )

C Now end the current view in window
CALL CSRVIEW('END ',
* TOKEN,
* WINOFF + NWINPG,
* NWINPG,
* A(PAGE),
* 'RANDOM',
* 'RETAI N ',
* RETRN1,
* REASON )

C Now go back to the first view in window
CALL CSRVIEW('BEGIN',
* TOKEN,
FORTRAN Example

*          WINOFF,
*          NWINPG,
*          A(PAGE),
*          'RANDOM',
*          'REPLACE',
*          RETRN1,
*          REASON )

C Refresh the data in the window for this view
CALL CSRREFR( TOKEN,
*          WINOFF,
*          NWINPG,
*          RETRN1,
*          REASON )

C Now end the view in the window
CALL CSRVIEW('END ',
*          TOKEN,
*          WINOFF,
*          NWINPG,
*          A(PAGE),
*          'RANDOM',
*          'RETAIN ',
*          RETRN1,
*          REASON )

C Terminate access to the Hiperspace object
CALL CSRIDAC('END ',
*          'TEMPSPACE',
*          'MY FIRST HIPERSPACE ENDS HERE ',
*          'YES',
*          'NEW',
*          'UPDATE',
*          NOBJPG,
*          TOKEN,
*          OBSIZ,
*          RETRN1,
*          REASON )

C STOP
END

********************************************************************
**  **
**  THIS ASSEMBLER PROGRAM ENSURES THAT YOUR WINDOW IS ALIGNED  **
**  ON A 4K BOUNDARY. ASSEMBLE THIS PROGRAM AND LINKEDIT THE     **
**  OBJECT CODE WITH THE FORTRAN CODE AND THE CSR STUBS.          **
**  **
********************************************************************

ADDR TITLE 'LOC/ADDR Function for Fortran'
*
*  Calling Sequence:
*  *
*   INTEGER ADDR
*   *
*   L = LOC(x)
*   L = ADDR(x)
*  *
*   Returns address of "x" in R0, with high-order bit set to zero
*  *
ADDR CSECT
ENTRY LOC
LOC EQU *
USING *,15
L  0,0,(1)     Get pointer to x
N  0,MASK     Set sign bit to 0
BR  14        Return
FORTRAN Example

** Mask DC A(X'7FFFFFFF') Mask with high-order bit 0

********************************************************************
** JCL TO COMPIL AND LINKEDIT THE ASSEMBLER PROGRAM, THE **
** FORTRAN PROGRAM, AND THE STUBS. **
**
********************************************************************
//FORTJOB JOB 00255013
//*00003100
//* 00003100
//* Compile and linkedit for FORTRAN 00003100
//* 00003100
//* 00003100
//VSF2CL PROC FVPGM=FORTVS2,FVREGN=2100K,FVPDECK=NODECK, 00001000
// FVPOLST=NOLIST,FVPOPT=0,FVTERM='SYSOUT=A', 00002000
// PGMNAME=MAIN,PGMLIB='&GOSET',FVLNSPC='3200,(25,6)' 00003000
//*00003100
//* PARAMETER DEFAULT-VALUE USAGE 00003900
//* 00004000
//* FVPGM FORTVS2 COMPILER NAME 00005000
//* FVREGN 2100K FORT-STEP REGION 00006000
//* FVPDECK NODECK COMPILER DECK OPTION 00007000
//* FVPOLST NOLIST COMPILER LIST OPTION 00008000
//* FVPOPT 0 COMPILER OPTIMIZATION 00009000
//* FVTERM SYSOUT=A FORT.SYSTERM OPERAND 00010000
//* FVLNSPC 3200,(25,6) FORT.SYSLIN SPACE 00011000
//* PGMLIB MAIN LKED.SYSLMOD DSNAME 00012000
//* PGMNAME MAIN LKED.SYSLMOD MEMBER NAME 00013000
//*00014000
//FORT EXEC PGM=&FVPGM,REGION=&FVREGN,COND=(4,LT), 00015000
// PARM='&FVPDECK,&FVPOLST,OPT(&FVPOPT)' 00016000
//STEPLIB DD DSN=HLLDS.FORT230.VSF2COMP,DISP=SHR 00017000
//SYSPRINT DD SYSOUT=A,DCB=BLKSIZE=3429 00018000
//SYSTERM DD &FVTERM 00019000
//SYSPUNCH DD SYSOUT=B,DCB=BLKSIZE=3440 00020000
//SYSLIN DD DSN=&LOADSET,DISP=(MOD,PASS),UNIT=SYSDA, 00021000
// SPACE=(&FVLNSPC),DCB=BLKSIZE=3200 00022000
//LKED EXEC PGM=HEWL,REGION=768K,COND=(4,LT), 00023000
// PARM='LET,LST,XREF' 00024000
//SYSPRINT DD SYSOUT=A 00025000
//SYSLIB DD DSN=CEE.SCEELKED,DISP=SHR 00026000
//SYSLIB DD DSN=WINDOW.USER.LOAD,DISP=SHR 00027000
// SYSLIB DD DSN=WINDOW.USER.LOAD,DISP=SHR,UNIT=3380, 00028000
// VOL=SER=VM2TSO 00029000
//LKED IN DD DSN=SYS1.CSSLIB,DISP=SHR 00030000
// DD DSN=WINDOW.TEST.OBJ,DISP=SHR 00031000
// PEND
// EXEC VSF2CL,FVTERM='SYSOUT=H', 00032000
// PGMNAME=CRFTOFO1,PGMLIB='WINDOW.USER.LOAD' 00033000
//FORT.SYSLIB DD DSN=WINDOW.XAMPLE.LIB(CRFTOFO1),DISP=SHR 00034000
//LKED.SYSLIB DD DSN=WINDOW.USER.LOAD,DISP=SHR,UNIT=3380, 00035000
// VOL=SER=VM2TSO 00036000
//LKED.SYSIN DD * 00037000
// LIBRARY IN(CSRSCOT,CSRSAVE,CSRVIEW,CRSIDAC,ADD) 00038000
// NAME CRFTOFO1(R) 00039000
//
/* The CSR stubs are available in SYS1.CSSLIB.
*/
/* The object code for the ADDR routine is in
*/
/* TEST.OBJ
*/
/*
*/
*/*
********************************************************************
FORTRAN Example

```fortran
/* JCL TO EXECUTE THE FORTRAN PROGRAM. */
********************************************************************
//FON01 JOB MSGLEVEL=(1,1)
//VSF2G PROC GOPGM=MAIN,GOREGN=100K,
//    GOF5DD='DDNAME=SYSIN',
//    GOF6DD='SYSOUT=A',
//    GOF7DD='SYSOUT=B'
//*
//* PARAMETER DEFAULT-VALUE USAGE
//*
//* GOPGM MAIN PROGRAM NAME
//* GOREGN 100K GO-STEP REGION
//* GOF5DD DDNAME=SYSIN GO.FT05F001 DD OPERAND
//* GOF6DD SYSOUT=A GO.FT06F001 DD OPERAND
//* GOF7DD SYSOUT=B GO.FT07F001 DD OPERAND
//*
//*
//GO EXEC PGM=&GOPGM,REGION=&GOREGN,COND=(4,LT)
//STEPLIB DD DSN=CEE.SCEERUN,DISP=SHR
//FT05F001 DD &GOF5DD
//FT06F001 DD &GOF6DD
//FT07F001 DD &GOF7DD
// PEND
//GO EXEC VSF2G,GOPGM=CRTFON01,GOREGN=999K
//GO,STEPLIB DD DSN=CEE.SCEERUN,DISP=SHR
// DD DSN=WINDOW.USER.LOAD,DISP=SHR,VOL=SER=VM2TSO,UNIT=3380
```

Pascal example

```pascal
program CRTPAN06;
const
K = 1024; (* One kilo-byte *)
PAGESIZE = 4 * K; (* 4K page boundary *)
OFFSET = 0; (* Windows starts *)
WINDOW_SIZE = 40; (* Window size in pages *)
NUM_WIN_ELEM = WINDOW_SIZE*K; (* Num of 4-byte elements *)
OBJECT_SIZE = 3*WINDOW_SIZE; (* Chosen object size in pages *)
SPACE_SIZE = (WINDOW_SIZE+1)*4*K; (* Space allocated for window *)
type
S = space[SPACE_SIZE] of INTEGER; (* Define byte aligned space *)
STR3 = packed array (. 1..3 .) of CHAR;
STR5 = packed array (. 1..5 .) of CHAR;
STR6 = packed array (. 1..6 .) of CHAR;
STR7 = packed array (. 1..7 .) of CHAR;
STR9 = packed array (. 1..9 .) of CHAR;
STR44 = packed array (. 1..44 .) of CHAR;
var
SP : @S; (* Declare pointer to space *)
ORIG, (* Start address of window *)
AD, I, (* Temporary variables *)
VOFFSET, (* Offset passed as parameter *)
VOFSET2, (* Offset passed as parameter *)
VOBJ_SIZE, (* Object size, as parameter *)
WIN_SIZE, (* Window Size, as parameter *)
HIGH_OFFSET, (* Size of object in pages *)
NEW_HI_OFFSET, (* New max size of the object *)
```

Chapter 4. Window services coding examples

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Pascal Example

```pascal
RETURN_CODE, (* Return code *)
REASON_CODE : INTEGER; (* Reason code *)
OBJECT_ID : REAL; (* Identifying token *)
CSCROLL : STR3; (* Scroll area YES/NO *)
COBSTATE : STR3; (* Object state NEW/OLD *)
COPTYPE : STR5; (* Operation type BEGIN/END *)
CACCESS : STR6; (* Access RANDOM/SEQ *)
CUSAGE : STR6; (* Usage READ/UPDATE *)
CDISP : STR7; (* Disposition RETAIN/REPLACE *)
CSPTYPE : STR9; (* Object type DSNAME/DDNAME/TEMPSPACE *)
COBNAME : STR44; (* Object name *)

procedure CSRIDAC ( var OP_TYPE : STR5;
                     var OBJECT_TYPE : STR9;
                     var OBJECT_NAME : STR44;
                     var SCROLL_AREA : STR3;
                     var OBJECT_STATE : STR3;
                     var ACCESS_MODE : STR6;
                     var RETURN_CODE : INTEGER;
                     var REASON_CODE : INTEGER); FORTRAN;

procedure CSRVIEW ( var OP_TYPE : STR5;
                    var OBJECT_ID : REAL;
                    var OFFSET : INTEGER;
                    var WINDOW_SIZE : INTEGER;
                    var WINDOW_NAME : INTEGER;
                    var USAGE : STR6;
                    var DISPOSITION : STR7;
                    var RETURN_CODE : INTEGER;
                    var REASON_CODE : INTEGER ); FORTRAN;

procedure CSRSCOT ( var OBJECT_ID : REAL;
                     var OFFSET : INTEGER;
                     var SPAN : INTEGER;
                     var RETURN_CODE : INTEGER;
                     var REASON_CODE : INTEGER ); FORTRAN;

procedure CSRSAVE ( var OBJECT_ID : REAL;
                    var OFFSET : INTEGER;
                    var SPAN : INTEGER;
                    var NEW_HI_OFFSET : INTEGER;
                    var RETURN_CODE : INTEGER;
                    var REASON_CODE : INTEGER ); FORTRAN;

procedure CSRREFR ( var OBJECT_ID : REAL;
                    var OFFSET : INTEGER;
                    var SPAN : INTEGER;
                    var RETURN_CODE : INTEGER;
                    var REASON_CODE : INTEGER ); FORTRAN;

begin
  TERMOUT(OUTPUT); (* Output to terminal *)
  WRITELN ('<< Begin Data Windowing Services Interface Validation >>');
  WRITELN;
  VOBJSIZ := OBJECT_SIZE; (* Set object size variable *)
  VOFFSET := OFFSET; (* Set offset variable to 0 *)
  VWINSIZ := WINDOW_SIZE; (* Set window size variable *)
  VOFFSET2 := OFFSET+WINDOW_SIZE; (* Set offset variable to 0 *)
  COPTYPE := 'BEGIN';
  CSPTYPE := 'DDNAME';
  COBNAME := 'CSRDD1';
  CSCROLL := 'YES';
  COBSTATE := 'NEW';
  CACCESS := 'UPDATE';
  CSRIDAC (COPTYPE,
            CSPTYPE,
            COBNAME,
            CSCROLL,
            COBSTATE,
            CACCESS,
Pascal Example

VOBSIZE,
OBJECT_ID,
HIGH_OFFSET,
RETURN_CODE,
REASON_CODE);

NEW(SP); (* Allocate space *)
AD := ADDR(SP0); (* or ORD(SP) *)
ORIG := AD mod PAGESIZE; (* See where space is in page *)
if ORIG <> 0 then (* If not on page boundary *)
    ORIG := PAGESIZE-ORIG; (* then locate page boundary *)
for I := 0 to NUM_WIN_ELEM-1 do (* Put data into window *)
    SP@[4*I+ORIG] := 999999; (* area *)
COPTYPE := 'BEGIN' ;
CUSAGE := 'RANDOM' ;
CDISP := 'REPLACE' ;
CSRVIEW (COPTYPE, (* Now view data in 1st window *)
    OBJECT_ID,
    VOFFSET,
    VWINSIZ,
    SP@[ORIG],
    CUSAGE,
    CDISP,
    RETURN_CODE,
    REASON_CODE);

for I := 0 to NUM_WIN_ELEM-1 do (* Calculate a value in 1st window *)
    SP@[4*I+ORIG] := I+1;
CSRSCOT (OBJECT_ID, (* Capture the view in 1st window *)
    VOFFSET,
    VWINSIZ,
    RETURN_CODE,
    REASON_CODE);
COPTYPE := 'END' ;
CUSAGE := 'RANDOM' ;
CDISP := 'RETAIN' ;
CSRVIEW (COPTYPE, (* End the view in 1st window *)
    OBJECT_ID,
    VOFFSET,
    VWINSIZ,
    SP@[ORIG],
    CUSAGE,
    CDISP,
    RETURN_CODE,
    REASON_CODE);

for I := 0 to NUM_WIN_ELEM-1 do (* Calculate a new value in the window *)
    SP@[4*I+ORIG] := I-101;
CSRSAVE (OBJECT_ID,
    VOFFSET,
    VWINSIZ,
    NEW_HI_OFFSET,
    RETURN_CODE,
    REASON_CODE);
COPTYPE := 'END' ;
CUSAGE := 'RANDOM' ;
CDISP := 'RETAIN' ;
CSRVIEW (COPTYPE, (* End the current view in *)
    OBJECT_ID,
    VOFFSET,
    VWINSIZ,
    NEW_HI_OFFSET,
    RETURN_CODE,
    REASON_CODE);
Pascal Example

```pascal
OBJECT_ID, (* window *)
VOFSET2,
VWINSIZ,
SP@[ORIG],
CUSAGE,
CDISP,
RETURN_CODE,
REASON_CODE);

COPTYPE := 'BEGIN' ;
CUSAGE := 'RANDOM' ;
CDISP := 'REPLACE' ;
CSRVIEW (COPTYPE, (* Now go back to the view in *)
OBJECT_ID, (* the 1st window *)
VOFFSET,
VWINSIZ,
SP@[ORIG],
CUSAGE,
CDISP,
RETURN_CODE,
REASON_CODE);

CSRREFR (OBJECT_ID, (* Refresh the data in 1st *)
VOFFSET, (* window *)
VWINSIZ,
RETURN_CODE,
REASON_CODE);

COPTYPE := 'END' ;
CUSAGE := 'RANDOM' ;
CDISP := 'RETAIN' ;
CSRVIEW (COPTYPE, (* End the view in 1st window *)
OBJECT_ID,
VOFFSET,
VWINSIZ,
SP@[ORIG],
CUSAGE,
CDISP,
RETURN_CODE,
REASON_CODE);

COPTYPE := 'END' ;
CSPTYPE := 'DDNAME ' ;
COBNAME := 'CSRDD1 ' ;
CSCROLL := 'YES' ;
COBSTATE := 'NEW' ;
CACCESS := 'UPDATE' ;
CSRIDAC (COPTYPE, (* Terminate access to the *)
CSPTYPE, (* Hiperspace object *)
COBNAME,
CSCROLL,
COBSTATE,
CACCESS,
VWINSIZ,
OBJECT_ID,
HIGH_OFFSET,
RETURN_CODE,
REASON_CODE);
end.
```

* JCL to compile and linkedit *

```
//PASCIJOB JOB 00010000
//GO EXEC PAS22CL 00050000
//* Compile and linkedit for PASCAL 00050200
//* 00050300
//PASC.SYSIN DD DSN=WINDOW.XAMPLE.LIB(CRTPAN06),DISP=SHR,
//LKED.SYSLMOD DD DSN=WINDOW.USER.LOAD,DISP=SHR,UNIT=3380,
```

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**Pascal Example**

```pascal
CRTPLN3: PROCEDURE OPTIONS (MAIN);

DCL
  ( K INIT(1024), /* ONE KILO-BYTE */
    PAGESIZE INIT(4096), /* 4K PAGE BOUNDARY */
    OFFSET INIT(0), /* WINDOWS STARTS */
    WINDOW_SIZE INIT(20), /* WINDOW SIZE IN PAGES */
    NUM_WIN_ELEM INIT (20480), /* NUM OF 4-BYTE ELEMENTS */
    OBJECT_SIZE INIT (60)) /* CHOSEN OBJECT SIZE IN PGS */
  FIXED BIN(31);

DCL
  /* 32767 IS UPPER LIMIT FOR ARRAY BOUND. */
  S(32767) BIN(31) FIXED BASED(SP); /* DEFINE WORD ALIGNED SPACE */

DCL SP PTR;

DCL
  ( ORIG, /* START ADDRESS OF WINDOW */
    AD, I, /* TEMPORARY VARIABLES */
    HIGH OFFSET, /* SIZE OF OBJECT IN PAGES */
    NEW_HI_OFFSET, /* NEW MAX SIZE OF THE OBJECT */
    RETURN_CODE, /* RETURN CODE */
    REASON_CODE) FIXED BIN(31); /* REASON CODE */

DCL
  OBJECT_ID CHAR(8); /* IDENTIFYING TOKEN */
```

**PL/I example**

```pli
CRTPLN3: PROCEDURE OPTIONS (MAIN);

DCL
  ( K INIT(1024), /* ONE KILO-BYTE */
    PAGESIZE INIT(4096), /* 4K PAGE BOUNDARY */
    OFFSET INIT(0), /* WINDOWS STARTS */
    WINDOW_SIZE INIT(20), /* WINDOW SIZE IN PAGES */
    NUM_WIN_ELEM INIT (20480), /* NUM OF 4-BYTE ELEMENTS */
    OBJECT_SIZE INIT (60)) /* CHOSEN OBJECT SIZE IN PGS */
  FIXED BIN(31);

DCL
  /* 32767 IS UPPER LIMIT FOR ARRAY BOUND. */
  S(32767) BIN(31) FIXED BASED(SP); /* DEFINE WORD ALIGNED SPACE */

DCL SP PTR;

DCL
  ( ORIG, /* START ADDRESS OF WINDOW */
    AD, I, /* TEMPORARY VARIABLES */
    HIGH OFFSET, /* SIZE OF OBJECT IN PAGES */
    NEW_HI_OFFSET, /* NEW MAX SIZE OF THE OBJECT */
    RETURN_CODE, /* RETURN CODE */
    REASON_CODE) FIXED BIN(31); /* REASON CODE */

DCL
  OBJECT_ID CHAR(8); /* IDENTIFYING TOKEN */
```
PL/I Example

/***********************************************
DCL CSRIDAC ENTRY(CHAR(5), /* OP_TYPE */ CHAR(9), /* OBJECT_TYPE */ CHAR(44), /* OBJECT_NAME */ CHAR(3), /* SCROLL_AREA */ CHAR(3), /* OBJECT_STATE */ CHAR(6), /* ACCESS_MODE */ FIXED BIN(31), /* OBJECT_SIZE */ CHAR(8), /* OBJECT_ID */ FIXED BIN(31), /* HIGH_OFFSET */ FIXED BIN(31), /* RETURN_CODE */ FIXED BIN(31) ) /* REASON_CODE */ OPTIONS(ASSEMBLER);

DCL CSRVIEW ENTRY(CHAR(5), /* OP_TYPE */ CHAR(8), /* OBJECT_ID */ FIXED BIN(31), /* OFFSET */ FIXED BIN(31), /* WINDOW_SIZE */ FIXED BIN(31), /* WINDOW_NAME */ CHAR(6), /* USAGE */ CHAR(7), /* DISPOSITION */ FIXED BIN(31), /* RETURN_CODE */ FIXED BIN(31) ) /* REASON_CODE */ OPTIONS(ASSEMBLER);

DCL CSRSOT ENTRY(CHAR(8), /* OBJECT_ID */ FIXED BIN(31), /* OFFSET */ FIXED BIN(31), /* SPAN */ FIXED BIN(31), /* RETURN_CODE */ FIXED BIN(31) ) /* REASON_CODE */ OPTIONS(ASSEMBLER);

DCL CSRSAVE ENTRY(CHAR(8), /* OBJECT_ID */ FIXED BIN(31), /* OFFSET */ FIXED BIN(31), /* SPAN */ FIXED BIN(31), /* NEW_HI_OFFSET */ FIXED BIN(31), /* RETURN_CODE */ FIXED BIN(31) ) /* REASON_CODE */ OPTIONS(ASSEMBLER);

DCL CSRSREFR ENTRY(CHAR(8), /* OBJECT_ID */ FIXED BIN(31), /* OFFSET */ FIXED BIN(31), /* SPAN */ FIXED BIN(31), /* RETURN_CODE */ FIXED BIN(31) ) /* REASON_CODE */ OPTIONS(ASSEMBLER);

/***********************************************
PUT SKIP LIST ('<< BEGIN DATA WINDOWING SERVICES INTERFACE VALIDATION >>');
PUT SKIP LIST ('.');
CALL CSRIDAC ('BEGIN', /* SET UP ACCESS TO A HIPER- 'TEMPSPACE', /* SPACE OBJECT */ 'MY FIRST HIPERSPACE', 'YES', 'NEW', 'UPDATE', OBJECT_SIZE,
/*****/
OBJECT_ID,
HIGH_OFFSET,
RETURN_CODE,
REASON_CODE);

ALLOC S; /* ALLOCATE SPACE */
AD = UNSPEC(SP); /* GET ADDRESS OF SPACE */
ORIG = MOD(AD,PAGESIZE); /* SEE WHERE SPACE IS IN PAGE */
IF ORIG ¬= 0 THEN /* IF NOT ON PAGE BOUNDARY */
    ORIG = (PAGESIZE-ORIG) / 4; /* THEN LOCATE PAGE BOUNDARY */
ORIG = ORIG + 1;

DO I = 1 TO NUM_WIN_ELEM; /* PUT SOME DATA INTO WINDOW */
    S(I+ORIG-1) = 99; /* AREA */
END;

CALL CSRVIEW ('BEGIN', /* NOW VIEW DATA IN FIRST */
    OBJECT_ID, /* WINDOW */
    OFFSET,
    WINDOW_SIZE,
    S(ORIG),
    'RANDOM',
    'REPLACE',
    RETURN_CODE,
    REASON_CODE);

DO I = 1 TO NUM_WIN_ELEM; /* CALCULATE VALUE IN 1ST */
    S(I+ORIG-1) = I+1; /* WINDOW */
END;

CALL CSRSCOT( OBJECT_ID, /* CAPTURE THE VIEW IN 1ST */
    OFFSET, /* WINDOW */
    WINDOW_SIZE,
    RETURN_CODE,
    REASON_CODE);

CALL CSRVIEW ('END ', /* END THE VIEW IN 1ST WINDOW */
    OBJECT_ID, /* WINDOW */
    OFFSET,
    WINDOW_SIZE,
    S(ORIG),
    'RANDOM',
    'REPLACE',
    RETURN_CODE,
    REASON_CODE);

CALL CSRVIEW ('BEGIN', /* NOW VIEW OTHER DATA IN */
    OBJECT_ID, /* 2ND WINDOW */
    OFFSET+WINDOW_SIZE,
    WINDOW_SIZE,
    S(ORIG),
    'RANDOM',
    'REPLACE',
    RETURN_CODE,
    REASON_CODE);

DO I = 1 TO NUM_WIN_ELEM; /* CALCULATE NEW VALUE IN */
    S(I+ORIG-1) = I-101; /* WINDOW */
END;

CALL CSRSCOT (OBJECT_ID, /* CAPTURE THE VIEW IN 2ND */
    OFFSET+WINDOW_SIZE,
    RETURN_CODE,
    REASON_CODE);
PL/I Example

WINDOW_SIZE,
RETURN_CODE,
REASON_CODE);

CALL
CSRVIEW ('END ', /* END THE CURRENT VIEW IN */
OBJECT_ID, /* WINDOW */
OFFSET+WINDOW_SIZE,
WINDOW_SIZE,
S(ORIG),
'RETAIN ',
RETURN_CODE,
REASON_CODE);

CALL
CSRVIEW ('BEGIN ', /* NOW GO BACK TO THE VIEW IN */
OBJECT_ID, /* THE 1ST WINDOW */
OFFSET,
WINDOW_SIZE,
S(ORIG),
'REPLACE ',
RETURN_CODE,
REASON_CODE);

CALL
CSRREFR (OBJECT_ID, /* REFRESH THE DATA IN 1ST */
OFFSET, /* WINDOW */
WINDOW_SIZE,
RETURN_CODE,
REASON_CODE);

CALL
CSRVIEW ('END ', /* END THE VIEW IN 1ST WINDOW */
OBJECT_ID,
OFFSET,
WINDOW_SIZE,
S(ORIG),
'RETAIN ',
RETURN_CODE,
REASON_CODE);

CALL
CSRIDAC ('END ', /* TERMINATE ACCESS TO THE */
'TEMPSPACE', /* HIPERSPACE OBJECT */
'MY FIRST HIPERSPACE ENDS HERE ',
'YES',
'NEW',
'UPDATE',
WINDOW_SIZE,
OBJECT_ID,
RETURN_CODE,
RETURN_CODE);

FREE S;
END CRTPLN3;

***********************************************************************
**
* JCL TO COMPIL AND LINKEDIT PL/I PROGRAM.
**
* **
* **
***********************************************************************
PL/I Example

//PLIJOB JOB 00010007
//* 00041001
//* PL/I Compile and Linkedit 00042001
//* 00043001
//* Change all CRTPLNx to CRTPLNy 00044001
//* 00045001
//* GO EXEC PLIXCL 00050000
//PLI.SYSIN DD DSN=WINDOW.XAMPLE.LIB(CRTPLN3),DISP=SHR 00060008
//LKED.SYSLMOD DD DSN=WINDOW.USER.LOAD,UNIT=3380,VOL=SER=VM2TSO, 00070000
// DISP=SHR 00080000
//LKED.SYSIN DD * 00090000
LIBRARY IN(CSRSCOT,CSRSAVE,CSRREFR,CSRSAVE,CSRVIEW,CSRIDAC) 00100001
/* 00120000
//** 00121001
//** SYS1.CSSLIB is source of CSR stubs 00130001
//** 00190000
//LKED.IN DD DSN=SYS1.CSSLIB,DISP=SHR 00200000
***********************************************************************
** * * 
** JCL TO EXECUTE. 
** * * 
** * * 
** * * 
***********************************************************************
//PLIRUN JOB MSGLEVEL=(1,1) 00010000
//* 00011001
//* EXECUTE A PL/I TESTCASE 00012001
//* 00013001
//GO EXEC PGM=CRTPLN3 00020000
STEPLIB DD DSN=WINDOW.USER.LOAD,DISP=SHR, 00030000
UNIT=3380,VOL=SER=VM2TSO 00040000
SYSLIB DD DSN=CCE.SCEERUN,DISP=SHR 00050000
SYSABEND DD SYSOUT=** 00070000
SYSLUT DD SYSOUT=** 00080000
SYSPRINT DD SYSOUT=** 00090000
PL/I Example
Part 2. Reference pattern services
Chapter 5. Introduction to reference pattern services

Reference pattern services allow HLL programs to define a reference pattern for a specified area of virtual storage that the program is about to reference. Additionally, the program specifies how much data it wants the operating system to bring into central storage at one time. Data and instructions in virtual storage must reside in central storage before they can be processed. The system honors the request according to the availability of central storage. By bringing in more data at one time, the system might improve the performance of your program.

The term reference pattern refers to the order in which a program’s instructions process a range of data, such as an array or part of an array.

Programs that benefit most from reference pattern services are those that reference amounts of data that are greater than one megabyte. The program should reference the data in a sequential manner and in a consistent direction, either forward or backward. In forward direction, the program references data elements in order of ascending addresses. In backward direction, the program references data elements in order of decreasing addresses. In addition, if the program “skips over” certain areas, and these areas are of uniform size and are repeated at regular intervals throughout the area, reference pattern services might provide additional performance improvement.

Two reference pattern services are available through program CALLs:
- CSRIRP identifies the range of data and the reference pattern, and defines the number of bytes that the system is requested to bring into central storage at one time. These activities are called “defining the reference pattern”.
- CSRRRP removes the definition; it tells the system that the program has stopped using the reference pattern with the range of data.

A program might have a number of different ways of referencing a particular area. In this case, the program can issue multiple pairs of CSRIRP and CSRRRP services for the area. Only one pattern can be in effect at a time.

Although reference pattern services can be used for data structures other than arrays, for simplicity, examples in Chapter 5, “Introduction to reference pattern services” and Chapter 6, “Using reference pattern services,” on page 79 use the services with arrays.

How does the system manage data?
Before you can evaluate the performance advantage that reference pattern services offer, you must understand some facts about how the operating system handles the data your program references. The system divides the data into 4096-byte chunks; each chunk is called a “page”. For the processor to execute an instruction, the page that contains the data that the instruction requires must reside in central storage. Central storage contains pages of data for many programs — your program, plus other programs that the system is working on. The system brings a page of your data into central storage when your program needs data on that page. If the program uses the data in a sequential manner, once the program finishes using the data on that page, it will not immediately use the page again. After your program finishes using that page, the system might remove the page from central storage to
make room for another page of your data or maybe a page of some other program’s data. The system allows pages to stay in central storage if they are referenced frequently enough and if the system does not need those pages for other programs.

The process that the system goes through when it pauses to bring a page into central storage is called a “page fault”. This interruption causes the system to stop working on your program (or “suspend” your program) while more of your program’s data comes into central storage. Then, when the page is in central storage and the system is available to your program again, the system resumes running your program at the instruction where it left off.

Reference pattern services can change the way the system handles your program’s data. With direction from reference pattern services, the system moves multiple pages into central storage at a time. By bringing in many pages at a time, the system takes fewer page faults. Fewer page faults mean possible performance gains for your program.

An example of how the system manages data in an array

To evaluate the performance advantage reference pattern services offers, you need to understand how the system handles a range of data. The best way to describe this is through an example of a simple two-dimensional array. As array A(i,j) of 3 rows and 4 columns illustrates, the system stores arrays in FORTRAN programs in column-major order and stores arrays in COBOL, Pascal, PL/1, and C programs in row-major order.

- A(1,1) A(1,2) A(1,3) A(1,4)
- A(2,1) A(2,2) A(2,3) A(2,4)
- A(3,1) A(3,2) A(3,3) A(3,4)

The system stores the elements of the arrays in the following order:

<table>
<thead>
<tr>
<th>Sequence of Element in Storage</th>
<th>FORTRAN Array Element</th>
<th>COBOL, Pascal, PL/1, C Array Element</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A(1,1)</td>
<td>A(1,1)</td>
</tr>
<tr>
<td>2</td>
<td>A(2,1)</td>
<td>A(1,2)</td>
</tr>
<tr>
<td>3</td>
<td>A(3,1)</td>
<td>A(1,3)</td>
</tr>
<tr>
<td>4</td>
<td>A(1,2)</td>
<td>A(1,4)</td>
</tr>
<tr>
<td>5</td>
<td>A(2,2)</td>
<td>A(2,1)</td>
</tr>
<tr>
<td>6</td>
<td>A(3,2)</td>
<td>A(2,2)</td>
</tr>
<tr>
<td>7</td>
<td>A(1,3)</td>
<td>A(2,3)</td>
</tr>
<tr>
<td>8</td>
<td>A(2,3)</td>
<td>A(2,4)</td>
</tr>
<tr>
<td>9</td>
<td>A(3,3)</td>
<td>A(3,1)</td>
</tr>
<tr>
<td>10</td>
<td>A(1,4)</td>
<td>A(3,2)</td>
</tr>
<tr>
<td>11</td>
<td>A(2,4)</td>
<td>A(3,3)</td>
</tr>
<tr>
<td>12</td>
<td>A(3,4)</td>
<td>A(3,4)</td>
</tr>
</tbody>
</table>

Examples in Chapter 5, “Introduction to reference pattern services,” on page 73 and Chapter 6, “Using reference pattern services,” on page 79 depict data as a horizontal string. The elements in the arrays, therefore, would look like the following:

<table>
<thead>
<tr>
<th>Location of elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
</tr>
</tbody>
</table>

Consider a two-dimensional array, ARRAY1, that has 1024 columns and 1024 rows and each element is eight bytes in size. The size of the array, therefore, is 1048576 elements or 8388608 bytes. For simplicity, assume the array is aligned on a page.
boundary. Also, assume the data is not in central storage. The program references each element in the array in a forward direction, starting with the first element.

First, consider how the system brings data into central storage without information from reference pattern services. At the first reference of ARRAY1, the system takes a page fault and brings into central storage the page (of 4096 bytes) that contains the first element. After the program finishes processing the 512th (4096 divided by 8) element in the array, the system takes another page fault and brings in a second page. The system takes a page fault every 512 elements, throughout the array.

The following linear representation shows the elements in the array and the page faults the system takes as a program processes the array.

```
0 512th element 1024th element
  ↑    ↑    ↑    ↑    ↑    ↑    ↑    ↑    ↑    ↑
1 page fault each 512 elements (1 page)
```

By bringing in one page at a time, the system takes 2048 page faults (8388608 divided by 4096), each page fault adding to the elapsed time of the program.

Suppose, through CSRIRP, the system knew in advance that a program would be using the array in a consistently forward direction. The system could then assume that the program’s use of the pages of the array would be sequential. To decrease the number of page faults, each time the program requested data that was not in central storage, the system could bring in more than one page at a time. Suppose the system brought the next 20 consecutive pages (81920 bytes) of the array into central storage on each page fault. In this case, the system takes not 2048 page faults, but 103 (8388608 divided by 81920=102.4). Page faults occur in the array as follows:

```
0 512th element 1024th element
  ↑    ↑    ↑    ↑    ↑    ↑    ↑    ↑    ↑    ↑
1 page fault each 10240 elements (20 pages)
```

The system brings in successive pages only to the end of the array.

Consider another way of referencing ARRAY1. The program references the first twenty elements, then skips over the next 1004 elements, and so forth through the array. CSRIRP allows you to tell the system to bring in only the pages that contain the data the program references. In this case, the reference pattern includes a repeating gap of 8032 bytes (1004×8) every 8192 bytes (1024×8). The pattern looks like this:
The grouping of consecutive bytes that the program references is called a **reference unit**. The grouping of consecutive bytes that the program skips over is called a **gap**. Reference units and gaps alternate throughout the array at regular intervals. The reference pattern is as follows:

- The reference unit is 20 elements in size — 160 consecutive bytes that the program references.
- The gap is 1004 elements in size — 8032 consecutive bytes that the program skips over.

Figure 7 shows this reference pattern and the pages that the system does not bring into central storage.

**What pages does the system bring in when a gap exists?**

When a gap exists, the number of pages the system brings in depends on the size of the gap, the size of the reference unit, and where the page boundary lies in relation to the gap and the reference unit. The following examples illustrate those factors.

**Example 1**

Figure 7 illustrates ARRAY1, the 1024-by-1024 array of eight-byte elements, where the program references 20 elements, then skips over the next 1004, and so forth in a forward direction throughout the array. The reference pattern includes a reference unit of 160 and a gap of 8032 bytes. The reference units begin on every other page boundary.

Figure 7. Illustration of a Reference Pattern with a Gap

Every other consecutive page of the data does not come into central storage; those pages contain only the “skipped over” data.

**Example 2**

In example 2, the reference pattern includes a reference unit of 4800 bytes and a gap of 3392 bytes. The example assumes that the area to be referenced starts on a page boundary.
Because each page contains data that the program references, the system brings in all pages.

**Example 3**

In example 3, the area to be referenced does not begin on a page boundary. The reference pattern includes a reference unit of 2000 bytes and a gap of 5000 bytes. When you specify a reference pattern that includes a gap, the reference unit must be at the start of the area, as the following illustration shows:

Because the gap is larger than 4096 bytes, some pages do not come into central storage. Notice that the system does not bring in the fifth page.

**Summary of how the size of the gap affects the number of pages the system brings into central storage:**

- If the gap is less than 4096 bytes, the system has to bring into central all pages of the array.
- If the gap is greater than 4095 bytes and less than 8192, the system might not have to bring in certain pages. Pages that contain only data in the gap do not come in.
- If the gap is greater than 8191 bytes, the system definitely does not have to bring in certain pages that contain the gap.
Chapter 6. Using reference pattern services

The two reference pattern services are CSRIRP and CSRRRP. First, you issue CALL CSRIRP to define a reference pattern for an area; then, issue CALL CSRRRP to remove the definition of reference pattern for the area. To avoid unnecessary processing, issue the calls outside of the loops that control processing of the data elements contained in the area.

Defining the reference pattern for a data area

On CSRIRP, you tell the system:

- The lowest address of the area to be referenced
- The size of the area
- The direction of reference
- The reference pattern, in terms of reference unit and gap (if one exists)
- The number of reference units the system is to bring into central storage on a page fault

The system will not process CSRIRP unless the values you specify can result in a performance gain for your program. To make sure the system processes CSRIRP, ask the system to bring in more than three pages (that is, 12288 bytes) on each page fault.

Your program can have only one pattern defined for that area at one time. If your program will later reference the same area with another reference pattern, use CSRRRP to remove the definition, and then use CSRIRP to define another pattern.

Although the system brings in pages 4096 bytes at a time, you do not have to specify values on CSRIRP or CSRRRP in increments of 4096.

Defining the range of the area

On CSRIRP, you define the range of the area to be referenced:

- low_address identifies the lowest addressed byte in the range.
- size identifies the size, in bytes, of the range.

When reference is forward, low_address identifies the first element that the program can reference in the range. When reference is backward, low_address identifies the last element that the program can reference in the range: reference proceeds from the high-address end in the range towards low_address.

The following parameters define the lowest address and the size of ARRAY1, a 1024-by-1024 array that consists of 8-byte elements. ARRAY1(1,1) identifies the element in the first row and the first column.

CSRIRP with low_address of ARRAY1(1,1)
size of 1024*1024*8 bytes

When a gap exists, define the range according to the following rules:

- If direction is forward, low_address must be the first data element in a reference unit.
• If direction is backward, the value you use for size must be such that the first
data element the program references is the high-address end of a reference unit.

These two rules are described and illustrated in “Using CSRIRP when a gap exists”
on page 81.

**Identifying the direction of the reference**

On direction, you specify the direction of reference through the array. Forward
reference means instructions start with the element indicated by low_address and
proceed through the range of data specified by size. Backward reference means the
program starts processing the high-address end of the range specified by size and
proceeds toward the low_address end.

• “+1” indicates forward direction.
• “-1” indicates backward direction.

An example of forward reference through ARRAY1 is specified as follows:

```plaintext
CSRIRP with direction of +1
```

“Using CSRIRP when a gap exists” on page 81 contains examples of forward and
backward references when a gap exists.

**Defining the reference pattern**

Figure 8 identifies two reference patterns that characterize most of the reference
patterns that reference pattern services applies to.

**Pattern #1: No uniform gap**

```
| 0  | 4096 | 8192 | 12288 | 16384 | 20480 |
```

Characteristics of pattern:
- No uniform gap
- Reference in regular intervals (such as every element) or in irregular intervals

**Pattern #2: Uniform gap**

```
| 0  | 20  | 5020 | 5040  | 10040 | 10060 | 15060 | 15080 | 20080 |
```

Characteristics of pattern:
- Gaps of uniform size
- Reference units, uniform in size, that occur in a repeating pattern

*Figure 8. Two Typical Reference Patterns*

How you define the reference pattern depends on whether your program’s
reference pattern is like pattern #1 or pattern #2.

• With pattern #1 where no uniform gap exists, the program uses every element,
every other element, or at least most elements on each page of array data. No
definable gap exists. Do not use reference pattern services if the reference
pattern is irregular and includes skipping over many areas larger than a page.
  - The **unitsize** parameter identifies the reference pattern; it indicates the number
    of bytes you want the system to use as a reference unit. Look at logical
    groupings of bytes, such as one row, a number of rows, or one element, if the
elements are large in size. Or, you might choose to divide the area to be referenced, and bring in that area on a certain number of page faults. Use the value 0 on gapsize.

- The units parameter tells the system how many reference units to try to bring in on a page fault. For a reference pattern that begins on a page boundary and has no gaps, the total number of bytes the system tries to bring into central storage at a time is the value on \( \text{unitsize} \) times the number on units, rounded up to the near multiple of 4096. See “Choosing the number of bytes on a page fault” on page 82 for more information on how to choose the total number of bytes.

- With pattern #2 where a uniform gap exists, the pattern includes alternating gaps and reference units. Specify the reference pattern carefully. If you identify a reference pattern and do not adhere to it, the system will work harder than if you had not used the service.

- The \( \text{unitsize} \) and gapsize parameters identify the reference pattern. Pattern #2 in Figure 8 on page 80 includes a reference unit of 20 bytes and a gap of 5000 bytes. Because the gap is greater than 4095, some pages of the array might not be brought into central storage.

- The units parameter tells the system how many reference units to try to bring into central storage at a time. “What pages does the system bring in when a gap exists?” on page 76 can help you understand how many bytes come into central storage at one time when a gap exists.

**Using CSRIRP when a gap exists**

When a gap exists, you have to follow one of two rules in coding the two parameters, \( \text{low_address} \) and \( \text{size} \), that define the range of data. The direction of reference determines which rule you follow:

- When reference is forward, \( \text{low_address} \) must identify the beginning of a reference unit.

  Figure 9 illustrates forward reference through a range of data that includes gaps. Consider the reference pattern where the program references 2000 bytes and skips the next 5000 bytes, and so forth throughout the array. The range of data starts at \( \text{low_address} \) and ends at the point identified in the figure by A. A can be any part of a gap or reference unit.

  ![Figure 9. Illustration of Forward Direction of Reference](image)

  - When reference is backward, the value you code on size determines the location of the first element the program actually references. Calculate that value so that the first element the program references is the high-address end of a reference unit.

    Figure 10 on page 82 illustrates backward reference through the same array as in Figure 9. Again, the program references 2000 bytes and skips the next 5000 bytes, and so forth throughout the array. The range starts at \( \text{low_address} \) and ends at
the point identified in the figure by B, where B must be the high-address end of a reference unit. low_address can be any part of a gap or reference unit.

Choosing the number of bytes on a page fault

An important consideration in using reference pattern services is how many bytes to ask the system to bring in on a page fault. To determine this, you need to understand some factors that affect the performance of your program.

Pages do not stay in central storage if they are not referenced frequently enough and other programs need that central storage. The longer it takes for a program to begin referencing a page in central storage, the greater the chance that the page has been moved out before being referenced. When you tell the system how many bytes it should try and bring into central at one time, you have to consider the following:

1. Contention for central storage:
   - Your program contends for central storage along with all other submitted jobs. The greater the size of central storage, the more bytes you can ask the system to bring in on a page fault. The system responds with as much of the data you request as possible, given the availability of central storage.

2. Contention for processor time:
   - Your program contends for the processor’s attention along with all other submitted jobs. The more competition, the less the processor can do for your program and the smaller the number of bytes you should request.

3. The elapsed time of processing one page of your data:
   - How long it takes a program to process a page depends on the number of references per page and the elapsed time per reference. If your program uses only a small percentage of elements on a page and references them only once or twice, the program completes the use of pages quickly. If the processing of each referenced element includes processor-intensive operations or a time-intensive operation, such as I/O, the time the program takes to process a page increases.

Conditions might vary between the peak activity of the daytime period and the low activity of the nighttime. You might be able to request a greater number at night than during the day.

What if you specify too many bytes? What if you ask the system to bring in so many pages that, by the time your program needs to use some of those pages, they have left central storage? The answer is that the system will have to bring them in again. This action causes an extra page fault and extra system overhead and decreases the benefit of reference pattern services.
For example, suppose you ask the system to bring in 204800 bytes, or 50 pages, at a time. But, by the time your program begins referencing the data on the 30th page, the system has moved that page and the ones after it out of central storage. It moved them out because the program did not use them soon enough. In this case, your program has lost the benefit of moving the last 21 pages in. Your program would get more benefit by requesting fewer than 30 pages.

What if you specify too few bytes? If you specify too small a number, the system will take more page faults than it needs to and you are not taking full advantage of reference pattern services.

For example, suppose you ask the system to bring in 40960 bytes (or 10 pages) at a time. Your program’s use of each page is not time-intensive, meaning that the program finishes using the pages quickly. The program can request a number greater than 10 without causing additional page faults.

IBM® recommends that you use one of the following approaches, depending on whether you want to involve your system programmer in the decision.

• The first approach is the simple one. Choose a conservative number of bytes, around 81920 (20 pages), and run the program. Look for an improvement in the elapsed time. If you like the results, you might increase the number of bytes. If you continue to increase the number, at some point you will notice a diminishing improvement or even an increase in elapsed time. Do not ask for so much that your program or other programs suffer from degraded performance.

• The second approach is for the program that needs very significant performance improvements — those programs that require amounts in excess of 50 pages. If you have such a program, you and your system programmer should examine the program’s elapsed time, paging speeds, and processor execution times. In fact, the system programmer can tune the system with your program in mind, providing the needed paging resources. z/OS MVS Initialization and Tuning Guide can provide information on tuning the system.

Reference pattern services affects movement of pages from auxiliary and expanded storage to central storage. To gain insight into the effectiveness of your reference patterns, you and your system programmer will need the kind of information that the SMF Type 30 record provides. A Type 30 record includes counts of pages moved in anticipation of your program’s use of those pages. The record provides counts of pages moved between expanded and central and between auxiliary and central. It also provides elapsed time values. Use this information to calculate rates of movement in determining whether to specify a very large number of bytes — for example, amounts greater than 204800 bytes (50 pages).

Examples of using CSRIRP to define a reference pattern

To clarify the relationships between the unitsize, gapsize, and units parameters, this topic contains three examples of defining a reference pattern. So that you can compare the three examples with what the system does without information from CSRIRP, the following call approximates the system’s normal paging operation:

```plaintext
CSRIRP with unitsize of 4096 bytes
gapsize of 0 bytes
units of 1 reference unit (that is, one page)
```

Each time the system takes a page fault, it brings in 4096 bytes (one page), the system’s reference unit. It brings in one reference unit at a time.
Example 1: The program processes all elements in an array in a forward direction. The processing of each element is fairly simple. The program runs during the peak hours, and many programs compete for processor time and central storage. A reasonable value to choose for the number of bytes to come into central on a page fault might be 80000 bytes (around 20 pages); unitsize can be 4000 bytes and units can be 20. The following CSRIRP service communicates this pattern to the system:

```
CSRIRP with unitsize of 4000 bytes
gapsize of 0 bytes
units of 20
direction of +1
```

Example 2: The program performs the same process as in Example 1, except the program does not reference every element in the array. The program runs during the night hours when contention for the processor and for central storage is light. In this case, a reasonable value to choose for the number of bytes to come into central storage on a page fault might be 200000 bytes (around 50 pages). unitsize can again be 4000 bytes and units can be 50. The following CSRIRP service communicates this pattern:

```
CSRIRP with unitsize of 4000 bytes
gapsize of 0 bytes
units of 50
direction of +1
```

Example 3: The program references in a consistently forward direction through the same large array. The pattern of reference in this example includes a gap. The program references 8192 bytes, then skips the next 4096 bytes, references the next 8192 bytes, skips the next 4096 bytes throughout the array. The program chooses to bring in data 8 pages at a time. Because of the placement of reference units and gaps on page boundaries, the system does not bring in the data in the gaps.

The following CSRIRP service reflects this reference pattern:

```
CSRIRP with unitsize of 4096*2 bytes
gapsize of 4096 bytes
units of 4
direction of +1
```

where the system is to bring into central storage 8 pages (4×4096×2 bytes) on a page fault. The system’s response to CSRIRP is illustrated as follows:

4×8194 bytes on each page fault

not brought into central storage

---

Removing the definition of the reference pattern

When a program is finished referencing the array in the way you specified on CSRIRP, use CSRRRP to remove the definition. The following example tells the system that the program in “Defining the range of the area” on page 79 has stopped referencing the array. low_address and size have the same values you coded on the CSRIRP service that defined the reference pattern for that area.

```
CSRRRP with low_address of ARRAY1(1,1)
size of 1024×1024×8 bytes
```
Handling return codes

Each time you call CSRIRP or CSRRRP, your program receives a return code and a reason code. These codes indicate whether the service completed successfully or whether the system rejected the service.

When you receive a return code that indicates a problem or an unusual condition, try to correct the problem, and rerun the program. Return codes and reason codes are described in Chapter 7, “Reference pattern services,” on page 87, with the description of each reference pattern service.
Chapter 7. Reference pattern services

To use reference pattern services, you issue CALLs that invoke the appropriate reference pattern services program. Each service program performs one or more functions and requires a set of parameters coded in a specific order on the CALL statement.

This topic describes the CALL statements that invoke reference pattern services. Each description includes a syntax diagram, parameter descriptions, and return code and reason code explanations with recommended actions. For examples of how to code the CALL statements, see Chapter 8, "Reference pattern services coding examples," on page 91.

This topic contains the following subtopics:
- "CSRIRP — Define a reference pattern"
- "CSRRRP — Remove a reference pattern" on page 89.

CSRIRP — Define a reference pattern

Call CSRIRP to define a reference pattern for a large data area, such as an array, that you are about to reference. Through CSRIRP, you identify the data area and describe the reference pattern. Additionally, you tell the system how many bytes of data you want it to bring into central storage on a page fault (that is, each time the program references data that is not in central storage). This action might significantly improve the performance of the program.

Two parameters define the reference pattern:
- \textit{unitsize} refers to a reference unit — a grouping of consecutive bytes that the program references.
- \textit{gapsize} refers to a gap — a grouping of consecutive bytes that the program repeatedly skips over; when a pattern has a gap, reference units and gaps alternate throughout the data area.

Reference units and gaps must each be uniform in size and appear throughout the data area at repeating intervals.

Another parameter, \textit{units}, allows you to specify how many reference units you want the system to bring into central storage each time the program references data that is not in central storage.

When you end the reference pattern in that data area, call the CSRRRP service.

Code the CALL following the syntax of the high-level language you are using and specifying all parameters in the order shown below. For parameters that CSRIRP uses to obtain input values, assign appropriate values.

On entry to CSRIRP, register 1 points to the reference pattern service parameter list. Note that when a FORTRAN program calls CSRIRP, and it is running in access register (AR) mode, register 1 does not point to the reference pattern service parameter list; it points to a list of parameter addresses. Each address in this list points to the data in the corresponding parameter of the reference pattern service parameter list. To use reference pattern services in this environment, the caller
must provide an assembler interface routine to convert the FORTRAN parameter
list to the form expected by reference services.

Assign values, acceptable to CSRIRP, to low_address, size, direction, unitsize, gapsize,
and units. CSRIRP returns values in return_code and reason_code.

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
</table>
| CALL CSRIRP    | (low_address
|                | ,size
|                | ,direction
|                | ,unitsize
|                | ,gapsize
|                | ,units
|                | ,return_code
|                | ,reason_code) |

The parameters are explained as follows:

low_address
   Specifies the beginning point of the data to be referenced.
   low_address is the name of the data that resides at the beginning of the data
   area. When the direction is forward and a gap exists, low_address must identify
   the beginning of a reference unit.

size
   Identifies the size, in bytes, of the data area to be accessed. When direction is
   backward and a gap exists, the value of size must be such that the first data
   element the program references is the high-address end of a reference unit.
   Define size as integer data of length 4.

direction
   Indicates the direction of reference, either “+1” for forward or “-1” for
   backward.
   Define direction as integer data of length 4.

unitsize
   Specifies the size of a reference unit.
   If the pattern does not have a gap, define the reference unit as a logical
   grouping according to the structure of the data array. Examples are: one row, a
   number of rows, one element, or one page (4096 bytes). If the pattern has a
   gap, define unitsize as the grouping of bytes that the program references and
   gap as the grouping of bytes that the program skips over.
   Define unitsize as integer data of length 4.

gapsize
   Specifies the size, in bytes, of a gap. If the pattern has a gap, define the gap as
   the grouping of bytes that the program skips over. If the pattern does not have
   a gap, use the value “0”.
   Define gapsize as integer data of length 4.

units
   Indicates how many reference units the system is to bring into central storage
   each time the program needs data that is not in central storage.
Define *units* as integer data of length 4.

```c

,return_code
When CSRIRP completes, *return_code* contains the return code. Define *return_code* as integer data of length 4.

,reason_code
When CSRIRP completes, *reason_code* contains the reason code. Define *reason_code* as integer data of length 4.

Return codes and reason codes
When CSRIRP returns control to your program, *return_code* contains a return and *reason_code* contains a reason code. The following table identifies return code and reason code combinations and tells what each means.

Return and reason codes, in hexadecimal, from CSRIRP are:

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>None</td>
<td>CSRIRP completed successfully.</td>
</tr>
<tr>
<td>04</td>
<td>xx001xx</td>
<td>CSRIRP completed successfully; however, the system did not accept the reference pattern the caller specified. The system decided that bringing in pages of 4096 bytes would be more efficient.</td>
</tr>
<tr>
<td>08</td>
<td>xx002xx</td>
<td>Unsuccessful completion. The range that the caller specified overlaps the range that a previous request specified.</td>
</tr>
<tr>
<td>08</td>
<td>xx003xx</td>
<td>Unsuccessful completion. The number of CSRIRP requests for the user exceeds 100, the maximum number the system allows.</td>
</tr>
<tr>
<td>08</td>
<td>xx004xx</td>
<td>Unsuccessful completion. Storage is not available for the CSRIRP service.</td>
</tr>
<tr>
<td>08</td>
<td>0000004</td>
<td>Unsuccessful completion. The direction that the caller specified is not valid.</td>
</tr>
</tbody>
</table>
```

**CSRRRP — Remove a reference pattern**

Call CSRRRP to remove the reference pattern for a data area, as specified by the CSRIRP service. On CSRRRP, you identify the beginning of the data area and its size. Code *low_address* and *size* exactly as you coded them on the CSRIRP service that defined the reference pattern.

Code the CALL following the syntax of the high-level language you are using and specifying all parameters in the order shown below. For parameters that CSRRRP uses to obtain input values, assign values that are acceptable to CSRRRP.

Assign values to CSRRRP, to *low_address* and *size*. CSRRRP returns values in *return_code* and *reason_code*. 

---
CALL statement Parameters

CALL CSRRRP

<table>
<thead>
<tr>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>(low_address, size, return_code, reason_code)</td>
</tr>
</tbody>
</table>

The parameters are explained as follows:

- **low_address**
  - Specifies the beginning point of the data to be referenced.
  - low_address is the name of the data that resides at the beginning of the data area.

- **size**
  - Specifies the size, in bytes, of the data area.
  - Define size as integer data of length 4.

- **return_code**
  - When CSRRRP completes, return_code contains the return code. Define return_code as integer data of length 4.

- **reason_code**
  - When CSRRRP completes, reason_code contains the reason code. Define reason_code as integer data of length 4.

### Return codes and reason codes

When CSRRRP returns control to your program, return_code contains a hexadecimal return code and reason_code contains a hexadecimal reason code. The following table identifies return code and reason code combinations and tells what each means.

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Reason Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>None</td>
<td>CSRRRP completed successfully.</td>
</tr>
<tr>
<td>08</td>
<td>xx0101xx</td>
<td>Unsuccessful completion. No CSRIRP service request was in effect for the specified data area. Check to see if the system rejected the previous CSRIRP request for the data area.</td>
</tr>
</tbody>
</table>
Chapter 8. Reference pattern services coding examples

The following examples show how to invoke reference pattern services from each of the supported languages. Following each program example is an example of the JCL needed to compile, link edit, and execute the program example. Use these examples to supplement and reinforce information that is presented in other topics within this information.

**Note:** Included in the FORTRAN example is the code for a required assembler language program. This program ensures that the reference pattern for the FORTRAN program is aligned on a 4K boundary.

The programs in this topic are similar. They each process two arrays, A and B. The arrays are 200×200 in size, each element consisting of 4 bytes. Processing is as follows:

- Declare the arrays.
- Define reference patterns for A and B.
- Initialize A and B.
- Remove the definitions of the reference patterns for A and B.
- Define new reference patterns for A and B.
- Multiply A and B, generating array C.
- Remove the definitions of the reference patterns for A and B.

The examples are presented in the following topics:

- "C/370 example"
- "COBOL example" on page 94
- "FORTRAN example" on page 98
- "Pascal example" on page 101
- "PL/I example" on page 103

**C/370 example**

The following example is coded in C/370:

```c
#include <stdio.h>
#include <stdlib.h>
#include "csrbpc"

#define m 200
#define n 200
#define p 200
#define kelement_size 4

int chk_code(long int ret, long int reason, int linenumber);

main()
{
    long int A[m] [n];
    long int B[m] [n];
    long int C[m] [n];
    long int i;
    long int j;
    long int k;
    long int rc;
    long int rsn;
```
long int arraysize;
long int direction;
long int unitsize;
long int gap;
long int units;

arraysize = m*n*kelement_size;
direction = csr_forward;
unitsize = kelement_size*n;
gap = 0;
units = 20;

csrrip(A, &arraysize, &direction,
    &unitsize,
    &gap,
    &units,
    &rc,
    &rsn);
chk_code(rc, rsn, __LINE__);

arraysize = m*p*kelement_size;
csrrip(B, &arraysize, &direction,
    &unitsize,
    &gap,
    &units,
    &rc,
    &rsn);
chk_code(rc, rsn, __LINE__);

for (i=0; i<m; i++) {
    for (j=0; j<n; j++) {
        A[i][j] = i + j;
    }
}
for (i=0; i<n; i++) {
    for (j=0; j<p; j++) {
        B[i][j] = i + j;
    }
}

arraysize = m*n*kelement_size;
cssrrp(A, &arraysize,
    &rc,
    &rsn);
chk_code(rc, rsn, __LINE__);

arraysize = m*p*kelement_size;
cssrrp(B, &arraysize,
    &rc,
    &rsn);
chk_code(rc, rsn, __LINE__);

arraysize = m*n*kelement_size;
units = 25;
csrrip(A, &arraysize, &direction,
    &unitsize,
    &gap,
    &units,
    &rc,
    &rsn);
chk_code(rc, rsn, __LINE__);

arraysize = n*p*kelement_size;
gap = (p-1)*kelement_size;
units = 50;
csrirp(B, &arraysize, &direction, \
  &unitsize, \
  &gap, \
  &units, \
  &rc, \
  &rsn);
chk_code(rc, rsn, __LINE__);
for (i=0; i<m; i++) 
  for (j=0; j<p; j++) {
    C[i][j] = 0;
    for (k=0; k<n; k++) {
      C[i][j] = C[i][j] + A[i][k] * B[k][j];
    }
  }
arraysize = m*n*kelement_size;
csrrrp(A, &arraysize, \
  &rc, \
  &rsn);
chk_code(rc, rsn, __LINE__);
avarraysize = n*p*kelement_size;
csrrrp(B, &arraysize, \
  &rc, \
  &rsn);
chk_code(rc, rsn, __LINE__);

/* chk_code will check return code and reason code from previous */
/* calls to HLL services. It will print a message if any of the */

int chk_code(long int ret, long int reason, int linenumber)
{
  if (ret != 0)
    printf("return_code = %ld instead of 0 at line %d\n", ret, linenumber);
  if (reason != 0)
    printf("reason_code = %ld instead of 0 at line %d\n", reason, linenumber);
}

ADDRESS "C/370 example"
IDENTIFICATION DIVISION.

*****************************************************************
* MULTIPLY ARRAY A TIMES ARRAY B GIVING ARRAY C *
* USE THE REFERENCE PATTERN CALLABLE SERVICES TO IMPROVE THE *
* PERFORMANCE. *
*****************************************************************

PROGRAM-ID. TESTCOB.
ENVIRONMENT DIVISION.
DATA DIVISION.
WORKING-STORAGE SECTION.

* COPY THE INCLUDE FILE (WHICH DEFINES CSRFORWARD, CSRBACKWARD)
COPY CSRBPCOB.

* DIMENSIONS OF ARRAYS - A IS M BY N, B IS N BY P, C IS M BY P
1 M PIC 9(9) COMP VALUE 200.
1 N PIC 9(9) COMP VALUE 200.
1 P PIC 9(9) COMP VALUE 200.

* ARRAY DECLARATIONS FOR ARRAY A - M = 200, N = 200
1 A1.
 2 A2 OCCURS 200 TIMES.
 3 A3 OCCURS 200 TIMES.
 4 ARRAY-A PIC S9(8).

* ARRAY DECLARATIONS FOR ARRAY B - N = 200, P = 200
1 B1.
 2 B2 OCCURS 200 TIMES.
 3 B3 OCCURS 200 TIMES.
 4 ARRAY-B PIC S9(8).

* ARRAY DECLARATIONS FOR ARRAY C - M = 200, P = 200
1 C1.
 2 C2 OCCURS 200 TIMES.
 3 C3 OCCURS 200 TIMES.
 4 ARRAY-C PIC S9(8).

 1 I PIC 9(9) COMP.
 1 J PIC 9(9) COMP.
 1 K PIC 9(9) COMP.
 1 X PIC 9(9) COMP.
 1 ARRAY-A-SIZE PIC 9(9) COMP.
 1 ARRAY-B-SIZE PIC 9(9) COMP.
 1 UNITSIZE PIC 9(9) COMP.
 1 GAP PIC 9(9) COMP.
 1 UNITS PIC 9(9) COMP.
 1 RETCODE PIC 9(9) COMP.
 1 RSCNCODE PIC 9(9) COMP.
PROCEDURE DIVISION.
    DISPLAY * BPAGE PROGRAM START *

* CALCULATE CSRIRP PARAMETERS FOR Initializing ARRAY A
* UNITSIZE WILL BE THE SIZE OF ONE ROW.
* UNITS WILL BE 25
* SO WE'RE ASKING FOR 25 ROWS TO COME IN AT A TIME
**COBOL example**

```
COMPUTE ARRAY-A-SIZE = M * N * 4
COMPUTE UNITSIZE = N * 4
COMPUTE GAP = 0
COMPUTE UNITS = 25

CALL "CSRIRP" USING
  ARRAY-A(1, 1),
  ARRAY-A-SIZE,
  CSRFORWARD,
  UNITSIZE,
  GAP,
  UNITS,
  RETCODE,
  RSCNRCODE

DISPLAY "FIRST RETURN CODE IS 
DISPLAY RETCODE

* CALCULATE CSRIRP PARAMETERS FOR INITIALIZING ARRAY B
* UNITSIZE WILL BE THE SIZE OF ONE ROW.
* UNITS WILL BE 25
* SO WE'RE ASKING FOR 25 ROWS TO COME IN AT A TIME

COMPUTE ARRAY-B-SIZE = N * P * 4
COMPUTE UNITSIZE = P * 4
COMPUTE GAP = 0
COMPUTE UNITS = 25
CALL "CSRIRP" USING
  ARRAY-B(1, 1),
  ARRAY-B-SIZE,
  CSRFORWARD,
  UNITSIZE,
  GAP,
  UNITS,
  RETCODE,
  RSCNRCODE

DISPLAY "SECOND RETURN CODE IS 
DISPLAY RETCODE

* INITIALIZE EACH ARRAY A ELEMENT TO THE SUM OF ITS INDICES
PERFORM VARYING I FROM 1 BY 1 UNTIL I = M
  PERFORM VARYING J FROM 1 BY 1 UNTIL J = N
    COMPUTE X = I + J
    MOVE X TO ARRAY-A(I, J)
  END-PERFORM
END-PERFORM

* INITIALIZE EACH ARRAY B ELEMENT TO THE SUM OF ITS INDICES
PERFORM VARYING I FROM 1 BY 1 UNTIL I = N
  PERFORM VARYING J FROM 1 BY 1 UNTIL J = P
    COMPUTE X = I + J
    MOVE X TO ARRAY-B(I, J)
  END-PERFORM
END-PERFORM

* REMOVE THE REFERENCE PATTERN ESTABLISHED FOR ARRAY A
CALL "CSRIRP" USING
  ARRAY-A(1, 1),
  ARRAY-A-SIZE,
  RETCODE,
  RSCNRCODE

DISPLAY "THIRD RETURN CODE IS 
DISPLAY RETCODE
```
COBOL example

* REMOVE THE REFERENCE PATTERN ESTABLISHED FOR ARRAY B
CALL "CSRRRP" USING
   ARRAY-B(1, 1),
   ARRAY-B-SIZE,
   RETCODE,
   RSNCODE
DISPLAY "FOURTH RETURN CODE IS "
DISPLAY RETCODE

* CALCULATE CSRIRP PARAMETERS FOR ARRAY A
* UNITSIZE WILL BE THE SIZE OF ONE ROW.
* UNITS WILL BE 20
* SO WE'RE ASKING FOR 20 ROWS TO COME IN AT A TIME
COMPUTE ARRAY-A-SIZE = M * N * 4
COMPUTE UNITSIZE = N * 4
COMPUTE GAP = 0
COMPUTE UNITS = 20
CALL "CSRIRP" USING
   ARRAY-A(1, 1),
   ARRAY-A-SIZE,
   CSRFORWARD,
   UNITSIZE,
   GAP,
   UNITS,
   RETCODE,
   RSNCODE
DISPLAY "FIFTH RETURN CODE IS "
DISPLAY RETCODE

* CALCULATE CSRIRP PARAMETERS FOR ARRAY B
* UNITSIZE WILL BE THE SIZE OF ONE ELEMENT.
* GAP WILL BE (N-1)*4 (IE. THE REST OF THE ROW).
* UNITS WILL BE 50
* SO WE'RE ASKING FOR 50 ELEMENTS OF A COLUMN TO COME IN
* AT ONE TIME
COMPUTE ARRAY-B-SIZE = N * P * 4
COMPUTE UNITSIZE = 4
COMPUTE GAP = (N - 1) * 4
COMPUTE UNITS = 50
CALL "CSRIRP" USING
   ARRAY-B(1, 1),
   ARRAY-B-SIZE,
   CSRFORWARD,
   UNITSIZE,
   GAP,
   UNITS,
   RETCODE,
   RSNCODE
DISPLAY "SIXTH RETURN CODE IS "
DISPLAY RETCODE

* MULTIPLY ARRAY A TIMES ARRAY B GIVING ARRAY C
PERFORM VARYING I FROM 1 BY 1 UNTIL I = M
   PERFORM VARYING J FROM 1 BY 1 UNTIL J = P
      COMPUTE ARRAY-C(I, J) = 0
   END-PERFORM
END-PERFORM
END-PERFORM
* REMOVE THE REFERENCE PATTERN ESTABLISHED FOR ARRAY A
CALL "CSRRRP" USING
  ARRAY-A(1, 1),
  ARRAY-A-SIZE,
  RETCODE,
  RSNCODE

  DISPLAY "SEVENTH RETURN CODE IS "
  DISPLAY RETCODE

* REMOVE THE REFERENCE PATTERN ESTABLISHED FOR ARRAY B
CALL "CSRRRP" USING
  ARRAY-B(1, 1),
  ARRAY-B-SIZE,
  RETCODE,
  RSNCODE

  DISPLAY "EIGHTH RETURN CODE IS "
  DISPLAY RETCODE

  DISPLAY " BPAGE PROGRAM END "
  GOBACK.
**FORTRAN example**

********************************************************************
**
* This is FORTRAN. Followed by an assembler routine
* called ADDR that has to be linked with the object
* code from this test case, and the CSR stubs.
*
********************************************************************

@PROCESS DC(BPAGEFOR)
   PROGRAM BPAGEFOR
   INCLUDE 'SYS1.SAMPLIB(CSRBPFOR)'

MULTIPLY two arrays together - testing CSRIRP, CSRRRP services

INTEGER M /200/
INTEGER N /200/
INTEGER P /200/
PARAMETER (NKELEMENT_SIZE=4)
INTEGER RC, RSN
COMMON /WINCOM/A(200,200)
COMMON /WINCOM/B(200,200)
COMMON /WINCOM/C(200,200)

Initialize the arrays

CALL CSRRRP(A(1,1),
   * M*N*NKELEMENT_SIZE,
   * RC,
   * RSN)

DO 102 J = 1, N
   DO 100 I = 1, M
      A(I,J) = I + J
100 CONTINUE
102 CONTINUE

CALL CSRRRP(B(1,1),
   * N*P*NKELEMENT_SIZE,
   * RC,
   * RSN)

DO 106 J = 1, P
   DO 104 I = 1, N
      B(I,J) = I + J
104 CONTINUE
106 CONTINUE

CALL CSRRRP(A(1,1),
   * M*N*NKELEMENT_SIZE,
   * RC,
   * RSN)
CALL CSRRRP(B(1,1),
        * N*P*NKELEMENT_SIZE,
        * RC,
        * RSN)
C
C Multiply the two arrays together
C
CALL CSIRRP (A(1,1),
        * M*N*NKELEMENT_SIZE,
        * CSR_FORWARD,
        * NKELEMENT_SIZE,
        * (N-1)*NKELEMENT_SIZE,
        * RC,
        * RSN)
CALL CSIRRP (B(1,1),
        * N*P*NKELEMENT_SIZE,
        * CSR_FORWARD,
        * NKELEMENT_SIZE*N,
        * 0,
        * 20,
        * RC,
        * RSN)
DO 112 I = 1, M
DO 110 J = 1, N
DO 108 K = 1, P
   C(I,J) = C(I,J) + A(I,K) * B(K,J)
108 CONTINUE
110 CONTINUE
112 CONTINUE
CALL CSRRRP (A(1,1),
        * M*N*NKELEMENT_SIZE,
        * RC,
        * RSN)
CALL CSRRRP (B(1,1),
        * N*P*NKELEMENT_SIZE,
        * RC,
        * RSN)
STOP
END
FORTRAN example

```fortran
// EXEC PGM=FVS2CL,REGION=REGION2,COND=(4,LT),
// PARM='&FVPDECK,&FVPOLST,OPT(&FVPOPT)' 00430000
// STEPLIB DD DSN=DSN24PP,FORT230.VSF2COMP,DISP=SHR 00440000
// SYSPRINT DD SYSOUT=A,DCB=BLKSIZE=3429 00450000
// SYSTEM DD &FVTERM 00460000
// SYSPUNCH DD SYSOUT=B,DCB=BLKSIZE=3440 00470000
// SYSLIN DD DSN=DSN24PP,DISP=(MOD,PASS),UNIT=SYSDA,
// SPACE=(&FVLNSPC),DCB=BLKSIZE=3200 00480000
// LKED EXEC PGM=HEWL,REGION=768K,COND=(4,LT),
// PARM='LET,LIST,XREF' 00490000
// SYSPRINT DD SYSOUT=A 00500000
// SYSLIB DD DSN=DSN24PP,DISP=SHR 00510000
// SYSLMOD DD DSN=DSN24PP,DISP=(,PASS),UNIT=SYSDA,
// SPACE=(TRK,(10,10,1),RLSE) 00520000
// SYSLIN DD DSN=DSN24PP,DISP=(OLD,DELETE) 00530000
// DD DDNAME=SYSIN 00540000
// EXEC VSF2CL,SYSTERM='SYSOUT=H',
// PGMNAME=FORTAN,PGLIB='REFPAT.USER.LOAD'
// SYSFORT DD DSN=DSN24PP,DISP=SHR 00550000
// LKED.SYSLIB DD DSN=DSN24PP,DISP=SHR 00560000
// LKED.SYSLMOD DD DSN=DSN24PP,DISP=SHR 00570000
// INCLUDE IN(CSRIRP,CSRRRP,ADDR)
// NAME BPGFORT(R)
// EXECUTE A FORTRAN TESTCASE - CHANGE ALL CRTFONXX TO CRTFONZZ
// * THIS IS THE JCL I USE TO EXECUTE THE PROGRAM.
// * COPYRT 5668-806
// (C) COPYRIGHT IBM CORP 1985, 1988
// LICENSED MATERIALS - PROPERTY OF IBM
// REFER TO COPYRT INSTRUCTIONS FORM NUMBER G120-2083
// STATUS: 02.03.00 (VV.RR.MM)
// PARAMETER DEFAULT-VALUE USAGE
```
**FORTRAN example**

```fortran
//** GOPGM MAIN PROGRAM NAME 00270000
//** GOREGN 100K GO-STEP REGION 00280000
//** GO5DD DDNAME=SYSIN GO.FT05F001 DD OPERAND 00290000
//** GO6DD SYSOUT=A GO.FT06F001 DD OPERAND 00300000
//** GO7DD SYSOUT=B GO.FT07F001 DD OPERAND 00310000
//** 00320000
//** 00330000
//GO EXEC PGM=&GOPGM,REGION=&GOREGN,COND=(4,LT) 00340000
//STEPLIB DD DSN=CEE.SCEERUN,DISP=SHR 00350004
//FT05F001 DD &GOF5DD 00360000
//FT06F001 DD &GOF6DD 00370000
//FT07F001 DD &GOF7DD 00380000
// PEND 00390000
//GO EXEC VSF2G,GOPGM=BPGFORT,GOREGN=999K 00400004
//GO.STEPLIB DD DSN=WINDOW.D24PP.FORTLIB,DISP=SHR, 00410004
// VOL=SER=VM2TSO,UNIT=3380 00410104
// DSN=WINDOW.R40.VSF2LOAD,DISP=SHR, 00411004
// VOL=SER=VM2TSO,UNIT=3380 00412004
// DSN=REFPAT.USER.LOAD,DISP=SHR, 00420003
// VOL=SER=VM2TSO,UNIT=3380 00430004
```

**Pascal example**

```pascal
program BPAGEPAS;
%
include CSRBPPAS

const
m = 250;
 n = 250;
p = 250;
kelement_size = 4;
a_size = m*n*kelement_size;
b_size = n*p*kelement_size;
c_size = m*p*kelement_size;

var
a : array (.1..m, 1..n.) of integer;
b : array (.1..n, 1..p.) of integer;
c : array (.1..m, 1..p.) of integer;
i : integer;
j : integer;
k : integer;
rc : integer;
rsn : integer;

begin
  csrirp (a(.1,1.), a_size, csr_forward,
        kelement_size=m,
        0, 50,
        rc, rsn);
  csrirp (b(.1,1.), b_size, csr_forward,
        kelement_size=n,
        0, 20,
        rc, rsn);
for i:=1 to m do
  for j:=1 to n do
```

Chapter 8. Reference pattern services coding examples 101
a(.i,j) := i + j;
for i:=1 to n do
  for j:=1 to p do
    b(.i,j) := i + j;
    csrrrp (a(.i,1.), a_size,
            rc,
            rsn);
    csrrrp (b(.1,1.), b_size,
            rc,
            rsn);
/* Multiply the two arrays together */
    csrirp (a(.1,1.), m*n*kelement_size, csr_forward,
            kelement_size*n,
            0,
            20,
            rc,
            rsn);
    csrirp (b(.1,1.), n*p*kelement_size, csr_forward,
            (p-1)*kelement_size,
            0,
            50,
            rc,
            rsn);
for i:=1 to m do
  for J:=1 to p do
    begin;
      c(.i,j) := 0;
      for k:=1 to n do
        c(.i,j) := c(.i,j) + a(.i,k) * b(.k,j);
    end;
    csrrrp (a(.1,1.), m*n*kelement_size,
            rc,
            rsn);
    csrrrp (b(.1,1.), n*p*kelement_size,
            rc,
            rsn);
END.
Pascal example

```pascal
PASC1JOB JOB 00010005
//GO EXEC PAS22CL 00050000
// Compile and linkedit for PASCAL 00050202
//PASC.SYSIN DD DSN=WINDOW.XAMPLE.LIB(CRTPAN06),DISP=SHR 00060006
//LKED.SYSLMOD DD DSN=WINDOW.USER.LOAD,DISP=SHR,UNIT=3380, 00560000
// VOL=SER=VM2TSO 00570000
//LKED.SYSIN DD * 00580000
LIBRARY IN(CSRSCOT,CSRSAVE,CSRREFR,CSRSAVE,CSRVIEW,CSRIDAC) 00590000
NAME CRTPAN06(R) 00600006
/* 00610000
SYS1.CSSLIB is the source of the CSR stubs 00620002
//LKED.IN DD DSN=SYS1.CSSLIB,DISP=SHR 00690000
**********************************************************************
**
** JCL TO EXECUTE. THIS ONE NEEDS A DD STATEMENT FOR THE
** PERMANENT DIV OBJECT - CSRDD1. DATASET ALREADY EXISTS.
*******
//PASCGO JOB MSGLEVEL=(1,1),TIME=1440 00080002
// GO EXEC PGM=BPGPASC 00140000
//STEPLIB DD DSN=REFPAT.USER.LOAD, 00190000
// DISP=SHR,UNIT=3380, 00200003
//CSRDD1 DD DSN=DIV.TESTDS,DISP=SHR 00210000
//OUTPUT DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=133) 00220000
//SYSPRINT DD SYSOUT=A,DCB=(RECFM=VBA,LRECL=133) 00230000
---------------------------
```

PL/I example

```pli
/* PLI example */
**
** **
** **
** **
** **
** **
** **

BPGPLI: PROCEDURE OPTIONS(MAIN);
0010023
0020002

%INCLUDE SYSLIB(CSRBPPLI);
0020122
0020222

/* INITs */
DCL M INIT(512) FIXED BIN(31);
0022035
DCL N INIT(512) FIXED BIN(31);
0023035
DCL P INIT(512) FIXED BIN(31);
0024035

/* Arrays */
DCL A (M,N) BIN FIXED(31); /* First array */
0029113
DCL B (N,P) BIN FIXED(31); /* Second array */
0029213
DCL C (M,P) BIN FIXED(31); /* Product of first and second */
0029313
```
PL/I example

DCL KELEMENT_SIZE INIT(4) FIXED BIN(31); /* Size of an element of an array. This value is tied directly to the data type of the three arrays (ie. FIXED(31) is 4 bytes */

/* Indices */
DCL I FIXED BIN(31), J FIXED BIN(31), K FIXED BIN(31);

/* Others */
DCL RC FIXED BIN(31);
DCL RSN FIXED BIN(31);

/* Initialize the first two arrays such that each element equals the sum of the indices for that element (eg. A(4,10) = 14 */
CALL CSRRIP (A(1,1), M*N*KELEMENT_SIZE, CSR_FORWARD, KELEMENT_SIZE*N, 0, 20, RC, RSN);
CALL CSRRIP (B(1,1), N*P*KELEMENT_SIZE, CSR_FORWARD, KELEMENT_SIZE*P, 0, 20, RC, RSN);
DO I = 1 TO M;
  DO J = 1 TO N;
    A(I,J) = I + J;
  END;
END;
DO I = 1 TO N;
  DO J = 1 TO P;
    B(I,J) = I + J;
  END;
END;
CALL CSRRIP (A(1,1), M*N*KELEMENT_SIZE, RC, RSN);
CALL CSRRIP (B(1,1), N*P*KELEMENT_SIZE, RC, RSN);
/* Multiply the two arrays together */
CALL CSRRIP (A(1,1), M*N*KELEMENT_SIZE, CSR_FORWARD, KELEMENT_SIZE*N, 0, 20, RC, RSN);
CALL CSRRIP (B(1,1), N*P*KELEMENT_SIZE, CSR_FORWARD, KELEMENT_SIZE*(P-1), 50, 20, RC, RSN);
DO I = 1 TO M;
  DO J = 1 TO P;
    C(I,J) = 0;
  END;
END;
PL/I example

```
DO K = 1 TO N;
  C(I,J) = C(I,J) + A(I,K) * B(K,J);
END;
END;
END;
CALL CSRRRP (A(1,1), M*N*KELEMENT_SIZE, RC, RSN);
CALL CSRRRP (B(1,1), N*P*KELEMENT_SIZE, RC, RSN);
END BPGLI;
```

***********************************************************************
**
** JCL TO COMPIL AND LINKEDIT.
**
**
***********************************************************************

//PLIJOB JOB 00010007

//**
//** PL/I Compile and Linkedit
//**
//** Change all CRTPLN to CRTPLNy
//**
//**
//GO EXEC PLIXCL,PARM.PLI='MACRO'

//PLI.SYSLIB DD DSN=REFPAT.DECLARE.SET,DISP=SHR
//PLI.SYSIN DD DSN=REFPAT.SAMPLE.PROG(PLI),DISP=SHR
// LKED.SYSLMOD DD DSN=REFPAT.USER.LOAD,UNIT=3380,VOL=SER=RSMPAK,
// DISP=SHR
// LKED.SYSIN DD *
// INCLUDE IN(CSRIRP,CSRRRP)
// NAME BPGLI(R)
//*/
//*
/// SYS1.CSSLIB is source of CSR stubs
//**
//**
//LKED.IN DD DSN=SYS1.CSSLIB,DISP=SHR
//PLIJOB JOB 00010007

***********************************************************************
**
** JCL TO EXECUTE.
**
**
***********************************************************************

//PLIRUN JOB MSGLEVEL=(1,1),TIME=1440

//**
//** EXECUTE A PL/I TESTCASE - CHANGE NAME ON NEXT LINE
//**
//**
//GO EXEC PGM=CRTPPL3
//STEPLIB DD DSN=REFPAT.USER.LOAD,DISP=SHR,
// UNIT=3380,VOL=SER=VM2TSO
// DD DSN=CEE.SCEERUN,DISP=SHR
//SYSABEND DD SYSOUT=* SYSOUT=* SYSOUT=* SYSOUT=* SYSOUT=
```
PL/I example
Part 3. Global resource serialization latch manager services
Chapter 9. Using the latch manager services

To use global resource serialization latch manager services, you issue CALLs from high level language programs. Each service requires a set of parameters coded in a specific order on the CALL statement.

This topic describes the CALL statements that invoke latch manager services. Each description includes a syntax diagram, parameter descriptions, and return and reason code explanations with recommended actions. Return and reason codes are shown in hexadecimal and decimal, along with the associated equate symbol.

This topic contains the following subtopics:
- "ISGLCRT — Create a latch set" on page 110
- "ISGLOBT — Obtain a latch" on page 114
- "ISGLREL — Release a latch" on page 117
- "ISGLPRG — Purge a requestor from a latch set" on page 120
- "ISLPBA — Purge a group of requestors from a group of latch sets" on page 122

For information about the basic function of the latch manager, how to plan to use the latch manager, and how to use the latch manager callable services, see the serialization topic in z/OS MVS Programming: Authorized Assembler Services Guide.

Syntax and linkage conventions for latch manager callable services

The latch manager callable services have the following general calling syntax:

CALL routine_name(parameters)

Some specific calling formats for languages that can invoke the latch manager callable services are:

C     routine_name (parm1,parm2,...return_code)

COBOL
     CALL "routine_name" USING parm1,parm2,...return_code

FORTRAN
     CALL routine_name (parm1,parm2,...return_code)

PL/I
     CALL routine_name (parm1,parm2,...return_code)

REXX
     ADDRESS LU62 "routine_name parm1 parm2...return_code"

IBM provides files, called interface definition files (IDFs), that define variables and values for the parameters used with latch manager services. IBM provides IDFs for some of the listed languages. See the serialization topic in z/OS MVS Programming: Authorized Assembler Services Guide for information about the IDFs that are available on MVS.
ISGLCRT — Create a latch set

Call the Latch_Create service to create a set of latches. Your application should call Latch_Create during application initialization, and specify a number of latches that is sufficient to serialize all the resources that the application requires. Programs that run as part of the application can call the following related services:

ISGLOBT
- Requests exclusive or shared ownership of a latch.

ISGLREL
- Releases ownership of an owned latch or a pending request to obtain a latch.

ISGLPRG
- Purges all granted and pending requests for a particular requestor within a specific latch set.

In the following description of Latch_Create, constants defined in the latch manager IDFs are followed by their numeric equivalents; you may specify either when coding calls to Latch_Create.

Write the call as shown on the syntax diagram. You must code all parameters on the CALL statement in the order shown.

Assign values to the following parameters:
- number_of_latches
- latch_set_name
- create_option

Latch_Create returns values in the following parameters:
- latch_set_token
- return_code

### CALL statement

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL ISGLCRT</td>
<td>(number_of_latches, latch_set_name, create_option, latch_set_token, return_code)</td>
</tr>
</tbody>
</table>

The parameters are explained as follows:

**number_of_latches**
- Specifies a fullword integer that indicates the number of latches to be created.

**latch_set_name**
- Specifies a 48-byte area that contains the name of the latch set. The latch set name must be unique within the current address space. The latch set name can be any value up to 48 characters, but the first character must not be binary zeros or an EBCDIC blank. If the latch set name is less than 48 characters, it must be padded on the right with blanks.

IBM recommends that you use a standard naming convention for the latch set name. To avoid using a name that IBM uses, do not begin the latch set name...
with the character string SYS. It is a good idea to select a latch set name that is readable in output from the DISPLAY GRS command and interactive problem control system (IPCS). Avoid '@', '$', and '#' because those characters do not always display consistently.

`,create_option`

Specifies a fullword integer that must have one of the following values:

- ISGLCRT_PRIVATE (or a value of 0)
- ISGLCRT_PRIVATE + ISGLCRT_LOWSTGUSAGE (or a value of 2)
- ISGLCRT_PRIVATE + ISGLCRT_DEADLOCKDET1 (or a value of 64)
- ISGLCRT_PRIVATE + ISGLCRT_DEADLOCKDET2 (or a value of 128)
- ISGLCRT_PRIVATE + ISGLCRT_DEADLOCKDET1 + ISGLCRT_LOWSTGUSAGE (or a value of 66)
- ISGLCRT_PRIVATE + ISGLCRT_DEADLOCKDET2 + ISGLCRT_LOWSTGUSAGE (or a value of 130)

If the creating address space is constrained by private storage, use the ISGLCRT_LOWSTGUSAGE option. ISGLCRT_LOWSTGUSAGE reduces storage usage at the cost of performance. IBM suggests that this option is only used if there is a known or possible storage constraint issue. See “Specifying the Number of Latches in a Latch Set” in z/OS MVS Programming: Authorized Assembler Services Guide for a description of the amount of storage that can be consumed by a latch set.

If you want to have the latch obtain services detect some simple latch deadlock situations, consider using the ISGLCRT_DEADLOCKDET1 and ISGLCRT_DEADLOCKDET2 options. For performance reasons, latch deadlock detection is not exhaustive. It can detect some simple deadlock situations.

When ISGLCRT_PRIVATE + ISGLCRT_DEADLOCKDET1 is specified, it can detect the following deadlock situations:

- The work unit requests exclusive ownership of a latch that the work unit already owns exclusively.
- The work unit requests shared ownership of a latch that the work unit already owns exclusively.

When ISGLCRT_PRIVATE + ISGLCRT_DEADLOCKDET2 is specified, it can detect all the deadlock situations listed under ISGLCRT_PRIVATE + ISGLCRT_DEADLOCKDET1, and it can also detect if the work unit holding a SHARED latch requests exclusive use of the same latch.

Because ISGLCRT_DEADLOCKDET2 provides the best deadlock detection, IBM suggests that you use ISGLCRT_DEADLOCKDET1 in cases where it can be used and use ISGLCRT_DEADLOCKDET2 in all cases where there are not many SHARED latch holders.

**Note:**

1. The unit of work context of the requester is captured at latch obtain time. The system does not know if the application passes responsibility for releasing the latch to another unit of work. To prevent false detection, deadlock detection can not be used if latches are used in such a way that responsibility for releasing the latch is passed between the obtainer and the releaser.

2. Deadlock detection can be safely used by SRBs, if all the obtained latches are released by the SRB work unit before the unit of work completes. There is a possibility of false deadlock hits otherwise.
Deadlock detection is not performed if the latches are obtained conditionally using the ISGLOBT_ASYNC_ECB option in ISGLOBT.

\[ \text{latch_set_token} \]
Specifies an 8-byte area to contain the latch set token returned by the Latch_Create service. The latch set token uniquely identifies the latch set. Programs must specify this value on calls to the Latch_Obtain, Latch_Release, and Latch_Purge services.

\[ \text{return_code} \]
A fullword integer to contain the return code from the Latch_Create service.

**ABEND codes**
The caller might encounter abend code X'9C6' for certain errors. See z/OS MVS System Codes for explanations and responses.

**Return codes**
When the Latch_Create service returns control to your program, return_code contains a hexadecimal return code. The following table identifies return codes in hexadecimal and decimal (in parentheses), the equate symbol associated with each return code, the meaning of each return code, and a recommended action:

<table>
<thead>
<tr>
<th>Return code and Equate symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00 (0) ISGLCRT_SUCCESS        | **Meaning:** The Latch_Create service completed successfully.  
**Action:** None required. |
| 04 (4) ISGLCRT_DUPLICATE_NAME | **Meaning:** The specified latch_set_name already exists, and is associated with a latch set that was created by a program running in the current primary address space. The latch manager does not create a new latch set.  
**Action:** To create a new latch set, specify a unique name on the latch_set_name parameter, then call the Latch_Create service again. Otherwise, continue processing with the returned latch set token. |
| 10 (16) ISGLCRT_NO_STORAGE    | **Meaning:** Environmental error. Not enough storage was available to contain the requested number of latches. The latch manager does not create a new latch set.  
**Action:** Specify a smaller value on the number_of_latches parameter. |

**Examples of calls to latch manager services**
The following is an example of how to call all the latch manager services in C language:

```c
/*****************************/
/* C Example */
/*****************************/
#pragma linkage(setsup, OS)
#pragma linkage(setprob, OS)
#include <ISGLMC.H> /* Include C language IDF */
main()
{
    const int numberOfLatches = 16; /* in this example we create 16 latches */
    ISGLM_LSNM_type latchSetName
        = "EXAMPLE.ONE_LATCH_SET_NAME "; /* set up 48-byte latch set name */
```
ISGLCRT callable service

ISGLM_LSTK_type latchSetToken; /* latch set token - output from create and input to obtain, release, and purge */
int returnCode = 0; /* return code from services */
const int latchNumber = 6; /* in this example we obtain latch six */
ISGLM_LRID_type requestorID = "123"; /* requestor ID - output from obtain and input to purge */
int ECB = 0; /* ECB used for latch obtain service */
ISGLM_EADDR_type ECBaddress = &ECB; /* pointer to ECB */
ISGLM_LTK_type latchToken; /* latch token - output from obtain and input to release */
union {
    double alignment; /* force double word alignment */
    ISGLM_WA_type area; /* set up work area */
} work;

setsup(); /* set supervisor state PSW */

/**********************************************************/
/* create a latch set with 16 latches */
/**********************************************************/

isglcrt(numberOfLatches
    ,latchSetName
    ,ISGLCRT_PRIVATE
    ,&latchSetToken;
    ,&returnCode);

/**********************************************************/
/* obtain latch */
/**********************************************************/

isglobt(latchSetToken
    ,latchNumber
    ,requestorID
    ,ISGLOBT_SYNC /* suspend until granted */
    ,ISGLOBT_EXCLUSIVE /* access option (exclusive) */
    ,&ECBaddress /* required, but not used */
    ,&latchToken /* identifies request */
    ,&work.area
    ,&returnCode);

/**********************************************************/
/* release latch */
/**********************************************************/

isglrel(latchSetToken
    ,latchToken
    ,ISGLREL_UNCOND /* ABEND if latch not owned */
    ,&workarea
    ,&returnCode);

/**********************************************************/
/* purge requestor from latch set */
/**********************************************************/

isglprg(latchSetToken
    ,requestorID
    ,&returnCode);

setprob(); /* set problem state PSW */
}
**ISGLCRT callable service**

```
* SETSUP subroutine
**********************************************************************
SETSUP CSECT
SETSUP AMODE 31
SETSUP RMODE ANY
SAVE (14,12) save regs
SAC 0 ensure primary mode
LR 12,15 establish addressability
USING SETSUP,12
MODESET MODE=SUP set supervisor state
RETURN (14,12),RC=0 restore caller's regs and return
END SETSUP
**********************************************************************
* SETPROB subroutine
**********************************************************************
SETPROB CSECT
SETPROB AMODE 31
SETPROB RMODE ANY
SAVE (14,12) save regs
LR 12,15 establish addressability
USING SETPROB,12
MODESET MODE=PROB set problem state
RETURN (14,12),RC=0 restore caller's regs and return
END SETPROB
```

**ISGLOBT — Obtain a latch**

Call the Latch_Obtain service to request exclusive or shared ownership of a latch. When a requestor owns a particular latch, the requestor can use the resource associated with that latch. The following callable services are related to Latch_Obtain:

**ISGLCRT**

Creates a latch set that an application can use to serialize resources.

**ISGLREL**

Releases ownership of an owned latch or a pending request to obtain a latch.

**ISGLPRG**

Purges all granted and pending requests for a particular requestor within a specific latch set.

In the following description of Latch_Obtain:

- The term requestor describes a task or SRB routine that calls the Latch_Obtain service to request ownership of a latch.
- Constants defined in the latch manager IDFs are followed by their numeric equivalents; you may specify either when coding calls to Latch_Obtain. For example, "ISGLOBT_COND (value of 1)" indicates the constant ISGLOBT_COND and its associated value, 1.

Write the call as shown on the syntax diagram. You must code all parameters on the CALL statement in the order shown.

Assign values to the following parameters:

- latch_set_token
- latch_number
- requestor_ID
- obtain_option
- access_option
ISGLOBT callable service

- ECB_address

Latch_Obtain returns values in the following parameters:
- latch_set_token
- return_code

Latch_Obtain uses the following parameter for temporary storage:
- work_area

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL ISGLOBT</td>
<td>(latch_set_token, latch_number, requestor_ID, obtain_option, access_option, ECB_address, latch_token, work_area, return_code)</td>
</tr>
</tbody>
</table>

The parameters are explained as follows:

**latch_set_token**
Specifies an 8-byte area that contains the latch_set_token that the Latch_Create service returned earlier when it created the latch set.

**latch_number**
Specifies a fullword integer that contains the number of the latch to be obtained. The latch_number must be in the range from 0 to the total number of latches in the associated latch set minus one.

**requestor_ID**
Specifies an 8-byte area that contains a value that identifies the caller of the Latch_Obtain service. The requestor_ID can be any value except all binary zeros.

Recovery routines can purge all granted and pending requests for a particular requestor (identified by a requestor_ID) within a specific latch set. When specifying the requestor_ID on Latch_Obtain, consider which latches would be purged if the Latch_Purge service were to be called with the specified requestor_ID. For more information about the Latch_Purge service, see "ISGLPRG — Purge a requestor from a latch set" on page 120.

**obtain_option**
A fullword integer that specifies how the system is to handle the Latch_Obtain request if the latch manager cannot immediately grant ownership of the latch to the requestor:

**ISGLOBT_SYNC (value of 0)**
The system processes the request synchronously. The system suspends the requestor. When the latch manager eventually grants ownership of the latch to the requestor, the system returns control to the requestor.

**ISGLOBT_COND (value of 1)**
The system processes the request conditionally. The system returns control to the requestor with a return code of ISGLOBT_CONTENTION (value of 4). The latch manager does not queue the request to obtain the latch.
ISGLOBT callable service

**ISGLOBT_ASYNC_ECB (value of 2)**

The system processes the request asynchronously. The system returns control to the requestor with a return code of ISGLOBT_CONTENTION (value of 4). When the latch manager eventually grants ownership of the latch to the requestor, the system posts the ECB pointed to by the value specified on the ECB_address parameter.

When you specify this option, the ECB_address parameter must contain the address of an initialized ECB that is addressable from the home address space (HASN).

**access_option**

A fullword or character string that specifies the access required:

- ISGLOBT_EXCLUSIVE (value of 0) - Exclusive (write) access
- ISGLOBT_SHARED (value of 1) - Shared (read) access

**ECB_address**

Specifies a fullword that contains the address of an ECB. If you specify an obtain_option of ISGLOBT_SYNC (value of 0) or ISGLOBT_COND (value of 1) on the call to Latch_Obtain, the ECB_address field must be valid (though its contents are ignored). IBM recommends that an address of 0 be used when no ECB is to be processed.

If you specify an obtain_option of ISGLOBT_ASYNC_ECB (value of 2) and the system returns a return code of ISGLOBT_CONTENTION (value of 4) to the caller, the system posts the ECB pointed to by the value specified on the ECB_address parameter when the latch manager grants ownership of the latch to the requestor.

**latch_token**

Specifies an 8-byte area to contain the latch token returned by the Latch_Obtain service. You must provide this value as a parameter on a call to the Latch_Release service to release the latch.

**work_area**

Specifies a 256-byte work area that provides temporary storage for the Latch_Obtain service. The work area should begin on a doubleword boundary to optimize performance. The work area must be in the same storage key as the caller of Latch_Obtain.

**return_code**

Specifies a fullword integer that is to contain the return code from the Latch_Obtain service.

**ABEND codes**

The caller might encounter abend code X'9C6' for certain errors. See [z/OS MVS System Codes](http://www.ibm.com/support/knowledgecenter/SSS77U_2.2.0/com.ibm.zos.v2r1.mvs.mvsr1_se00/zosabend.html) for explanations and responses.

**Return codes**

When the Latch_Obtain service returns control to your program, return_code contains a hexadecimal return code. The following table identifies return codes in hexadecimal and decimal (in parentheses), the equate symbol associated with each return code, the meaning of each return code, and a recommended action:
**ISGLOBT callable service**

### Table 8. ISGLOBT Return Codes

<table>
<thead>
<tr>
<th>Return code and Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 (0) ISGLOBT_SUCCESS</td>
<td><strong>Meaning:</strong> The Latch_Obtain service completed successfully.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
<tr>
<td>04 (4) ISGLOBT_CONTENTION</td>
<td><strong>Meaning:</strong> A requestor called Latch_Obtain with an obtain_option of ISGLOBT_COND (value of 1) or ISGLOBT_ASYNC_ECB (value of 2). The latch is not immediately available.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> If the requestor specified an obtain_option of ISGLOBT_COND (value of 1), no response is required. If the requestor specified an obtain_option of ISGLOBT_ASYNC_ECB (value of 2), and the latch is still required, wait on the ECB to be posted when the latch manager grants ownership of the latch to the requestor.</td>
</tr>
</tbody>
</table>

#### Example

See "Examples of calls to latch manager services" on page 112 for an example of how to call Latch_Obtain in C language.

**ISGLREL — Release a latch**

Call the Latch_Release service to release ownership of an owned latch or a pending request to obtain a latch. Requestors should call Latch_Release when the use of a resource associated with a latch is no longer required. The following callable services are related to Latch_Release:

**ISGLCRT**

Creates a latch set that an application can use to serialize resources.

**ISGLOBT**

Requests exclusive or shared control of a latch.

**ISGLPRG**

Purges all granted and pending requests for a particular requestor within a specific latch set.

In the following description of Latch_Release:

- The term `requestor` describes a program that calls the Latch_Release service to release ownership of an owned latch or a pending request to obtain a latch.
- Constants defined in the latch manager IDFs are followed by their numeric equivalents; you may specify either when coding calls to Latch_Obtain. For example, "ISGLREL_COND (value of 1)" indicates the constant ISGLREL_COND and its associated value, 1.

Write the CALL as shown on the syntax diagram, coding all parameters in the specified order.

Assign values to the following parameters:

- `latch_set_token`
- `latch_token`
- `release_option`

Latch_Release returns a value in the following parameter:

- `return_code`
Latch_Release uses the following parameter for temporary storage:

- work_area

```
CALL statement  Parameters
CALL ISGLREL
      (latch_set_token
       ,latch_token
       ,release_option
       ,work_area
       ,return_code)
```

The parameters are explained as follows:

- **latch_set_token**
  Specifies an 8-byte area that contains the latch set token returned to the caller of the Latch_Create service. The latch set token identifies the latch set that contains the latch to be released.

- **latch_token**
  Specifies an 8-byte area that contains the latch token returned to the caller of the Latch_Obtain service. The latch token identifies the request to be released.

- **release_option**
  Specifies a fullword integer that tells the latch manager what to do when the requestor either no longer owns the latch to be released or still has a pending request to obtain the latch to be released:

  **ISGLREL_UNCOND (value of 0)**
  Abend the requestor:
  - If a requestor originally specified an obtain_option of ISGLOBT_SYNC (value of 0) when obtaining the latch, the latch manager does not release the latch. The system abends the caller of Latch_Release with abend X'9C6', reason code xxxx0009.
  - If a requestor originally specified an obtain_option of ISGLOBT_ASYNC_ECB (value of 2) when obtaining the latch, the latch manager does not release the latch. The system abends the caller of Latch_Release with abend X'9C6', reason code xxxx0007.
  - If the latch manager does not find a previous Latch_Obtain request for the specified latch, the system abends the caller of Latch_Release with abend X'9C6', reason code xxxx000A.

  **ISGLREL_COND (value of 1)**
  Return control to the requestor:
  - If a requestor originally specified an obtain_option of ISGLOBT_ASYNC_ECB (value of 2) when obtaining the latch, the latch manager releases the request for ownership of the latch. The system returns control to the caller of Latch_Release with a return code of ISGLREL_NOT_OWNED_ECB_REQUEST (value of 4).
  - If a requestor originally specified an obtain_option of ISGLOBT_SYNC (value of 0) when obtaining the latch, the latch manager does not release the request for ownership of the latch. The system returns control to the caller of Latch_Release with a return code of ISGLREL_STILL_SUSPENDED (value of 8).
  - If the latch manager does not find a previous Latch_Obtain request for the specified latch, the system returns control to the caller of
ISGLREL callable service

Latch_Release with a return code of
ISGLREL_INCORRECT_LATCH_TOKEN (value of 12).

,work_area
Specifies a 256-byte work area that provides temporary storage for the
Latch_Release service. The work area should begin on a doubleword boundary
to optimize performance. The work area must be in the same storage key as
the caller of Latch_Release.

,return_code
Specifies a fullword integer that is to contain the return code from the
Latch_Release service.

ABEND codes
The caller might encounter abend code X'9C6' for certain errors. See z/OS MVS
System Codes for explanations and responses.

Return codes
When the Latch_Release service returns control to your program, return_code
contains a hexadecimal return code. The following table identifies return codes in
hexadecimal and decimal (in parentheses), the equate symbol associated with each
return code, the meaning of each return code, and a recommended action:

Table 9. ISGLREL Return Codes

<table>
<thead>
<tr>
<th>Return code and Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 (0) ISGLREL_SUCCESS</td>
<td>Meaning: The Latch_Release service completed successfully. The caller released ownership of the specified latch request.</td>
</tr>
<tr>
<td></td>
<td>Action: None.</td>
</tr>
<tr>
<td>04 (4) ISGLREL_NOT_OWNED_ECB_REQUEST</td>
<td>Meaning: The requestor that originally called the Latch_Release service is still expecting the system to post an ECB (to indicate that the requestor has obtained the latch). The call to the Latch_Release service specified a release_option of ISGLREL_COND (value of 1). The latch manager does not post the ECB at the address specified on the original call to Latch_Obtain. The latch manager releases the latch.</td>
</tr>
<tr>
<td></td>
<td>Action: Validate the integrity of the resource associated with the latch (the requestor might have used the resource without waiting on the ECB). If the resource is undamaged, no action is necessary (a requestor routine may have been in the process of cancelling the request to obtain the latch).</td>
</tr>
</tbody>
</table>
Table 9. ISGLREL Return Codes (continued)

<table>
<thead>
<tr>
<th>Return code and Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 08 (8) ISGLREL_STILL_SUSPENDED | **Meaning:** Program error. The request specified a correct latch token, but the program that originally requested the latch is still suspended and waiting to obtain the latch. The latch requestor originally specified an obtain_option of ISGLOBT_SYNC on the call to the Latch_Obtain service. The call to the Latch_Release service specified a release_option of ISGLREL_COND (value of 1). The latch manager does not release the latch. The latch requestor remains suspended. **Action:**  
  - Wait for the latch requestor to obtain the latch and receive control back from the system; then call the Latch_Release service again, or
  - End the program that originally requested the latch. |
| 0C (12) ISGLREL_INCORRECT_LATCH_TOKEN | **Meaning:** The latch manager could not find a granted or pending request associated with the value on the latch token parameter. The latch manager does not release a latch. This return code does not indicate an error if a routine calls Latch_Release to ensure that a latch is released. For example, if an error occurs when a requestor calls the Latch_Obtain service, the requestor’s recovery routine might call Latch_Release to ensure that the requested latch is released. If the error prevented the requestor from obtaining the latch, the recovery routine receives this return code. **Action:** If the return code is not expected, validate that the latch token is the same latch token returned to the caller of Latch_Obtain. |

Example

See “Examples of calls to latch manager services” on page 112 for an example of how to call Latch_Release in C language.

**ISGLPRG — Purge a requestor from a latch set**

Call the Latch_Purge service to purge all granted and pending requests for a particular requestor within a specific latch set. Recovery routines should call Latch_Purge when one or more errors prevent requestors from releasing latches. The following callable services are related to Latch_Purge:

**ISGLCRT**

Creates a latch set that an application can use to serialize resources.

**ISGLOBT**

Requests exclusive or shared control of a latch.

**ISGLREL**

Releases control of an owned latch or a pending request to obtain a latch.
ISGLPRG callable service

In the following description of Latch_Purge, constants defined in the latch manager IDFs are followed by their numeric equivalents; you may specify either when coding calls to Latch_Purge.

Write the CALL as shown on the syntax diagram. You must code all parameters on the CALL statement in the order shown.

Assign values to the following parameters:
- latch_set_token
- requestor_ID

Latch_Purge returns a value in the return_code parameter.

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL ISGLPRG</td>
<td>(latch_set_token, requestor_ID, return_code)</td>
</tr>
</tbody>
</table>

The parameters are explained as follows:

**latch_set_token**
Specifies an 8-byte area that contains the latch_set_token previously returned by the Latch_Create service. The latch set token identifies the latch set from which latch requests are to be purged.

**requestor_ID**
Specifies an 8-byte area that contains the requestor_ID originally specified on one or more previous calls to the Latch_Obtain service. The Latch_Purge service is to release all Latch_Obtain requests that specify this requestor_ID.

**return_code**
A fullword integer that contains the return code from the Latch_Purge service.

**ABEND codes**
The caller might encounter abend code X'9C6' for certain errors. See z/OS MVS System Codes for explanations and responses.

**Return codes**
When the Latch_Purge service returns control to your program, return_code contains a hexadecimal return code. The following table identifies return codes in hexadecimal and decimal (in parentheses), the equate symbol associated with each return code, the meaning of each return code, and a recommended action:

<table>
<thead>
<tr>
<th>Return code and Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00 (0)</td>
<td>Meaning: The Latch_Purge service completed successfully.</td>
</tr>
<tr>
<td>ISGLPRG_SUCCESS</td>
<td>Action: None.</td>
</tr>
</tbody>
</table>
Table 10. ISGLPRG Return Codes (continued)

<table>
<thead>
<tr>
<th>Return code and Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 04 (4) ISGLPRG_DAMAGE_DETECTED | **Meaning:** Program error. While purging all requests for a particular requestor from a latch set, the latch manager found incorrect data in one or more latches. The latch manager tries to purge the latches that contain incorrect data, but the damage might prevent the latch manager from purging those latches. The latch manager purges the remaining latches (those with correct data) for the specified requestor.  
**Action:** Take a dump and check for a storage overlay. If your application can continue without the resources serialized by the damaged latches, no action is required. |

Example

See "Examples of calls to latch manager services" on page 112 for an example of how to call Latch_Purge in C language.

**ISLPBA — Purge a group of requestors from a group of latch sets**

Call the Latch_Purge_by_Address_Space service to purge all granted and pending requests for a group of requestors for a group of latch sets in the same address space. To effectively use this service, your latch_set_names and your requestor_IDs should be defined such that they have a common portion and a unique portion. Groups of latch sets can then be formed by masking off the unique portion of the latch_set_name, and groups of latch requests in a latch set can then be formed by masking off the unique portion of the requestor_ID. Masking off the unique portion of the requestor_ID allows a single purge request to handle multiple latch sets and multiple requests in a latch set. Recovery routines should call Latch_Purge_by_Address_Space when one or more errors prevent requestors from releasing latches.

The following callable services are related to Latch_Purge_by_Address_Space:

**ISGLCRT**
 Creates a latch set that an application can use to serialize resources.

**ISGLOBT**
 Requests exclusive or shared control of a latch.

**ISGLREL**
 Releases control of an owned latch or a pending request to obtain a latch.

**ISGLPRG**
 Purges all granted and pending requests for a particular requestor within a specific latch set.

In the following description of Latch_Purge_by_Address_Space, equate symbols defined in the ISGLMASM macro are followed by their numeric equivalents; you may specify either when coding calls to Latch_Purge_by_Address_Space.

Write the CALL as shown on the syntax diagram. You must code all parameters on the CALL statement in the order shown.

Assign values to the following parameters:
- `latch_set_token`
- `requestor_ID`
ISGLPBA callable service

- requestor_ID_mask
- latch_set_name
- latch_set_name_mask

Latch_Purge_by_Address_Space returns a value in the return_code parameter.

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
</table>
| CALL ISGLPBA   | (latch_set_token, 
|               | requester_ID,  |
|               | requester_ID_mask, |
|               | latch_set_name,   |
|               | latch_set_name_mask, |
|               | return_code)     |

The parameters are explained as follows:

**latch_set_token**
Specifies an 8-byte area that contains the latch_set_token previously returned by the Latch_Create service or a value of zero. If the value is not zero, the latch_set_token identifies the latch set from which latch requests are to be purged. If the latch_set_token is set to zero, a group of latch sets, determined by the latch_set_name and latch_set_name_mask, will have their latch requests purged.

**requestor_id**
Specifies an 8-byte area that contains a portion of the requestor_ID originally specified on one or more previous calls to the Latch_Obtain service. This operand will be compared to the result of logically ANDing each requestor_ID in the latch set with the requestor_ID_mask. Make sure that any corresponding bits that are zero in the requestor_ID_mask are also zero in this field, otherwise no ID matches will occur. Each requestor_ID that has a name match will have its Latch_Obtain requests released.

**requestor_id_mask**
Specifies an 8-byte area that contains the requestor_ID_mask that will be logically ANDed to each requestor_ID in the latch set and then compared to the requestor_ID operand. Each requestor_ID that has a name match will have its Latch_Obtain requests released.

**latch_set_name**
Specifies a 48-byte area that contains the portion of the latch_set_name that will be compared to the result of logically ANDing the latch_set_name_mask with each latch set name in the primary address space. Make sure that any corresponding bits that are zero in the latch_set_name_mask are also zero in this field, otherwise no name matches will occur. Each latch set that has a name match will have its Latch_Obtain requests released. If the latch_set_token operand is non-zero this operand is ignored.

**latch_set_name_mask**
Specifies a 48-byte area that contains the mask that will be logically ANDed to each of the latch set names in the primary address space and then compared to the latch_set_name operand. Each latch set that has a name match will have its Latch_Obtain requests released. If the latch_set_token operand is non-zero this operand is ignored.
ISGLPBA callable service

$return_code$
A fullword integer that contains the return code from the Latch_Purge_By_Address_Space service.

ABEND codes
The caller might encounter abend code X'9C6' for certain errors. See z/OS MVS System Codes for explanations and responses.

Return codes
When the Latch_Purge_by_Address_Space service returns control to your program, the return_code contains a hexadecimal return code. The following table identifies return codes in hexadecimal and decimal (in parentheses), the equate symbol associated with each return code, the meaning of each return code, and a recommended action:

<table>
<thead>
<tr>
<th>Return code and Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00 (0) ISGLPRG_SUCCESS        | Meaning: The Latch_Purge_by_Address_Space service completed successfully.  
Action: None. |
| 04 (4) ISGLPRG_DAMAGE_DETECTED | Meaning: Program error. While purging all requests for a particular requestor from a latch set, the latch manager found incorrect data in one or more latches. The latch manager tries to purge the latches that contain incorrect data, but the damage might prevent the latch manager from purging those latches. The latch manager purges the remaining latches (those with correct data) for the specified requestor.
Action: Take a dump and check for a storage overlay. If your application can continue without the resources serialized by the damaged latches, no action is required. |
Part 4. Resource recovery services (RRS)
Chapter 10. Using protected resources

Many computer resources are so critical to a company’s work that the integrity of these resources must be guaranteed. If changes to the data in the resources are corrupted by a hardware or software failure, human error, or a catastrophe, the computer must be able to restore the data. These critical resources are called protected resources or, sometimes, recoverable resources.

The system, when requested, can coordinate changes to one or more protected resources so that all changes are made or no changes are made. Resources that the system can protect are, for example:
- A hierarchical database
- A relational database
- A product-specific resource

Resource recovery is the protection of the resources. Resource recovery consists of the protocols and program interfaces that allow an application program to make consistent changes to multiple protected resources.

Resource recovery programs

Three programs work together to protect resources:
- Application program: The application program accesses protected resources and requests changes to the resources.
- Resource manager: A resource manager is an authorized program that controls and manages access to a resource. A resource manager provides interfaces that allow the application program to read and change a protected resource. The resource manager also takes actions that commit or back out changes to a resource it manages.
  Often an application changes more than one protected resource, so that more than one resource manager is involved.
  A resource manager may be an IBM product, part of an IBM product, or a product from another vendor. A resource manager can be:
  - A database manager, such as DB2®
  - A program, such as IMS/ESA® Transaction Manager, that accepts work from an end user or another system and manages that work

  Note: The resource manager in resource recovery is different from an RTM resource manager, which is related to the operating system’s recovery termination management (RTM) and runs during termination processing.
- Sync-point manager: The sync-point manager coordinates changes to protected resources, so that all changes are made or no changes are made. The z/OS sync-point manager is recoverable resource management services (RRMS). Three MVS components provide RRMS function; because resource recovery services (RRS) provides the sync-point services, most technical information uses RRS rather than RRMS.
  If your resources are distributed, so that they are on multiple systems, the communication resource manager on one system will coordinate the changes. Each communication resource manager works with RRS on its system.
RRS can enable resource recovery on a single system or, with APPC/MVS, on multiple systems.

The application program, resource manager, and sync-point manager use a two-phase commit protocol to protect resources.

**Two-phase commit protocol**

The two-phase commit protocol is a set of actions used to make sure that an application program makes all changes to a collection of resources or makes no changes to the collection. The protocol makes sure of the all-or-nothing changes even if the system, RRS, or the resource manager fails.

The phases of the protocol are:

- Phase 1: In the first phase, each resource manager must be prepared to either commit or backout the changes. They prepare for the commit and tell RRS either YES, the change can be made, or NO, the change cannot be made.
  
  First, RRS decides the results of the YES or NO responses from the resource managers. If the decision is YES to commit the changes, RRS hardens the decision, meaning that it stores the decision in an RRS log.
  
  Once a commit decision is hardened, the application changes are considered committed. If there is a failure after this point, the resource manager will make the changes during restart. Before this point, a failure causes the resource manager to back out the changes during restart.

- Phase 2: In the second phase, the resource managers commit or back out the changes.

**Resource recovery process**

For a look at the resource recovery process, think of a person who requests an automated teller machine (ATM) to transfer money from a savings account to a checking account. The application program receives the person’s input from the ATM. Each account is in a different database. Each database has its own resource manager. The sync-point manager is RRS. [Figure 11 on page 129](#) shows how the ATM application, resource managers, and RRS work together.
The actions required to process the ATM transaction are:

1. The ATM user requests transfer of money from a savings account to a checking account.
2. The ATM application program receives the ATM input.
   [Figure 12 on page 130] shows, for the same transaction, the sequence of the following actions, with time moving from left to right, in the two-phase commit protocol RRS uses to commit the changes. The top line in the figure shows the two phases of the protocol described in “Two-phase commit protocol” on page 128.
3. The ATM application requests the savings resource manager to subtract the money from the savings database. For this step, the application uses the resource manager's application programming interface (API).
4. The ATM application requests the checking resource manager to add the money to the checking database. The application uses this resource manager's API.
5. The ATM application issues a call to RRS to commit the database changes.
6. RRS asks the resource managers to prepare for the changes.
7. The resource managers indicate whether or not they can make the changes, by voting YES or NO. In [Figure 12 on page 130] both resource managers vote YES.
8. In response, RRS notifies the resource managers to commit the changes, that is, to make the changes permanently in the databases.
9. The resource managers complete the commit and return OK to RRS.
10. RRS gives a return code to the application program, indicating that all changes were made in the databases.
If the ATM user decides not to transfer the money and presses a NO selection, the application requests backout, instead of commit, in step 6. In this case, the changes are backed out and are not actually made in any database. See Figure 13.

Or if a resource manager cannot make the change to its database, the resource manager votes NO during prepare. If any resource manager votes NO, all of the changes are backed out. See Figure 14 on page 131.
Requesting resource protection and recovery

To request resource protection, your application program must use resource managers that work with RRS to protect resources. The code in your application should do the following:

1. Request one or more accesses to resources for reads, writes, or both.
2. If all of the changes are to be made, request commit by issuing a call to the Application_Commit_UR service.
3. If none of the changes are to be made, request backout by issuing a call to the Application_Backout_UR service.

For details about the calls, see “Application_Backout_UR (SRRBACK)” on page 132 and “Application_Commit_UR (SRRCMIT)” on page 136.

Using distributed resource recovery

The databases for a work request may be distributed, residing on more than one system. In this case, the application program initiating the work uses a distributed communications manager, such as APPC/MVS, to request changes by an application program on another system. The database resource managers, communication resource managers, and RRS components work together to make or not make all changes of both application programs. Figure 15 illustrates distributed resource recovery.
Call the Application_Backout_UR service to indicate that the changes for the unit of recovery (UR) are not to be made. A UR represents the application’s changes to resources since the last commit or backout or, for the first UR, since the beginning of the application. In response to the call, RRS requests that the resource managers return their resources to the values they had before the UR was processed.

An application might need to issue a call to the Application_Backout_UR service if:

- An APPC/MVS call returns a TAKE_BACKOUT return code. For example, a CI send_data call to a communications manager could return TAKE_BACKOUT.
- A resource manager call returns a return code that indicates that a resource manager directly backed out its resource. This situation can occur if the resource manager does not have the capability to return a TAKE_BACKOUT code.
- A communications resource manager call returns a return code that indicates that a backout must be done, such as a return code of COMRESOURCE_FAILURE_NO_RETRY from a CI call.

**Description**

**Environment**

The requirements for the caller are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>Problem state, any PSW key</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>24- or 31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller.</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard MVS linkage conventions are used.</td>
</tr>
</tbody>
</table>

**Programming requirements**

The two methods described here can be used to access the callable service.
• Linkedit the stub routine ATRSCSS with the program that uses the service. ATRSCSS resides in SYS1.CSSLIB.
• Code the MVS LOAD macro within a program that uses the service to obtain the entry point address of the service. Use that address to call the service.

Additional language-specific statements may be necessary so that compilers can provide the proper assembler interface. Other programming notations, such as variable declarations, are also language-dependent.

SYS1.CSSLIB contains stubs for all of MVS’s callable services including RRS. Other program products like DB2 and IMS™ also provide libraries that contain stubs for their versions of SRRBACK and SRRCMIT.

Because other program products like DB2 and IMS provide their own stubs for SRRBACK or SRRCMIT, you must make sure your program uses the correct stub. You need to take particular care when recompiling and linkediting any application that uses these services. When you linkedit, make sure that the data sets in the syslib concatenation are in the right order. For example, if you want a DB2 application to use the RRS callable service SRRBACK or SRRCMIT, you must ensure that SYS1.CSSLIB precedes the data sets with the stubs that DB2 provides for SRRBACK or SRRCMIT.

If you inadvertently cause your program to use SRRCMIT for RRS when it expects SRRCMIT for another program product like IMS, the application does not run correctly, and your program receives an error return code from the call to SRRCMIT.

For examples of the JCL link edit statements used with high-level languages, see Chapter 4, “Window services coding examples,” on page 43 or Chapter 8, “Reference pattern services coding examples,” on page 91.

**High level language (HLL) definitions:** The high level language (HLL) definitions for the callable service are:

<table>
<thead>
<tr>
<th>HLL Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATRSASM</td>
<td>390 Assembler declarations</td>
</tr>
<tr>
<td>ATRSC</td>
<td>C/390 declarations</td>
</tr>
<tr>
<td>ATRSCOB</td>
<td>COBOL 390 declarations</td>
</tr>
<tr>
<td>ATRSPAS</td>
<td>Pascal 390 declarations</td>
</tr>
<tr>
<td>ATRSPPLI</td>
<td>PL/I 390 declarations</td>
</tr>
</tbody>
</table>

Assembler: If you are an Assembler language caller running in AMODE 24, either use a BASSM instruction in place of the CALL or specify a LINKINST=BASSM parameter on the CALL macro. For example:

```
CALL SRRBACK(RETCODE),LINKINST=BASSM
```

COBOL: The return/reason code names and abend code names in ATRSCOB are truncated at 30 characters.

PL/I: The return/reason code names and abend code names in ATRSPPLI are truncated at 31 characters.

**Restrictions:** The state of the UR must be **in-reset** or **in-flight**. A successful call creates a new UR that is **in-reset**.
The UR cannot be in local transaction mode.

**Input register information:** Before issuing the call, the caller does not have to place any information into any register unless using it in register notation for the parameter, or using it as a base register.

**Output register information:** When control returns to the caller, the GPRs contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Used as work registers by the system</td>
</tr>
<tr>
<td>2-13</td>
<td>Unchanged</td>
</tr>
<tr>
<td>14</td>
<td>Used as a work register by the system</td>
</tr>
<tr>
<td>15</td>
<td>Return code</td>
</tr>
</tbody>
</table>

When control returns to the caller, the ARs contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Used as work registers by the system</td>
</tr>
<tr>
<td>2-13</td>
<td>Unchanged</td>
</tr>
<tr>
<td>14-15</td>
<td>Used as work registers by the system</td>
</tr>
</tbody>
</table>

Some callers depend on register contents remaining the same before and after issuing a call. If the system changes the contents of registers on which the caller depends, the caller must save them before calling the service, and restore them after the system returns control.

**Performance implications:** None.

**Syntax:** Write the call as shown in the syntax diagram. You must code the parameters in the CALL statement as shown.

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL SRRBACK</td>
<td>(return_code)</td>
</tr>
</tbody>
</table>

**Parameters:** The parameters are explained as follows:

*return_code*
- Returned parameter
  - Character Set: N/A
  - Length: 4 bytes
  - Contains the return code from the Application_Backout_UR service.

**ABEND codes:** The call might result in an abend X'5C4' with a reason code of X'00150000' through X'00150010'. See [z/OS MVS System Codes](https://www.ibm.com) for the explanations and actions.

If your application ends abnormally during sync-point processing, the condition is called an asynchronous abend, and you might need to see the programmer at your
Issuing SETRRS CANCEL for non-resource manager programs that use the
synch-point service results in an abend X'058'. When RRS restarts, transactions that
were in progress are resolved.

Return codes:  When the service returns control to your program, GPR 15 and
return_code contain a hexadecimal return code, shown in the following table. If you
need help with a return code, see the programmer at your installation responsible
for managing RRS. Under information about working with application programs,
z/OS MVS Programming: Resource Recovery contains additional details about these
return codes.

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Decimal Return Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0                       | 0                   | Code: RR_OK
                          | Meaning: Successful completion. The resource managers returned
                          | their resources to the values they had before the UR was
                          | processed.
                          | Action: None. |
| 12D                     | 301                 | Code: RR_BACKED_OUT_OUTCOME_PENDING
                          | Meaning: Environmental error. The backout was not completed,
                          | for one of the following reasons:
                          | • RRS requested that the resource managers back out the changes
to the resources. However, the state of one or more of the
resources is not known.
                          | • RRS is not active.
                          | • The resource manager fails with an incomplete protected
interest in the UR, or RRS fails before the UR is complete.
                          | Action: The action by an application depends on the system
                          | environment. Some possible actions are:
                          | • Display a warning message to the end user.
                          | • Write an exception entry into an output log.
                          | • Abnormally end the application because the resource manager
will not allow any further changes to the resource until the
situation is resolved. |
| 12E                     | 302                 | Code: RR_BACKED_OUT_OUTCOME_MIXED
                          | Meaning: Environmental error. RRS requested that the resource
managers back out the changes to the resources. However, one or
more resources were changed.
                          | Action: Same as the action for return code 12D (301). |

Example:  In the pseudocode example, the application issues a call to request that
RRS back out a UR.
Application_Commit_UR (SRRCMIT)

Call the Application_Commit_UR service to indicate that the changes for the unit of recovery (UR) are to be made permanent. A UR represents the application’s changes to resources since the last commit or backout or, for the first UR, since the beginning of the application. In response to the call, RRS requests that the resource managers make the changes permanent.

Certain resource managers, such as a communications manager, can issue a TAKE_COMMIT return code to an application that has requested changes to resources. In response to the TAKE_COMMIT code from the resource manager, the application should request the changes to the resources:

- If all of the change requests are accepted, call the Application_Commit_UR service again.
- If any of the change requests are not accepted, call the Application_Backout_UR service to back out the changes.

Description

Environment

The requirements for the caller are:

<table>
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The two methods described here can be used to access the callable service.

- Linkedit the stub routine ATRSCSS with the program that uses the service. ATRSCSS resides in SYS1.CSSLIB.
- Code the MVS LOAD macro within a program that uses the service to obtain the entry point address of the service. Use that address to call the service.

Additional language-specific statements may be necessary so that compilers can provide the proper assembler interface. Other programming notations, such as variable declarations, are also language-dependent.

SYS1.CSSLIB contains stubs for all of MVS’s callable services including RRS. Other program products like DB2 and IMS also provide libraries that contain stubs for their versions of SRRBACK and SRRCMIT.
Because other program products like DB2 and IMS provide their own stubs for SRRBACK or SRRCMIT, you must make sure your program uses the correct stub. You need to take particular care when recompiling and linkediting any application that uses these services. When you linkedit, make sure that the data sets in the syslib concatenation are in the right order. For example, if you want a DB2 application to use the RRS callable service SRRBACK or SRRCMIT, you must ensure that SYS1.CSSLIB precedes the data sets with the stubs that DB2 provides for SRRBACK or SRRCMIT.

If you inadvertently cause your program to use SRRCMIT for RRS when it expects SRRCMIT for another program product like IMS, the application does not run correctly, and your program receives an error return code from the call to SRRCMIT.

For examples of the JCL link edit statements for high-level languages, see Chapter 4, “Window services coding examples,” on page 45 or Chapter 8, “Reference pattern services coding examples,” on page 91.

**High level language (HLL) definitions:** The high level language (HLL) definitions for the callable service are:

<table>
<thead>
<tr>
<th>HLL Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATRSASM</td>
<td>390 Assembler declarations</td>
</tr>
<tr>
<td>ATRSC</td>
<td>C/390 declarations</td>
</tr>
<tr>
<td>ATRSCOB</td>
<td>COBOL 390 declarations</td>
</tr>
<tr>
<td>ATRSPAS</td>
<td>Pascal 390 declarations</td>
</tr>
<tr>
<td>ATRSPPLI</td>
<td>PL/I 390 declarations</td>
</tr>
</tbody>
</table>

Assembler: If you are an Assembler language caller running in AMODE 24, either use a BASSM instruction in place of the CALL or specify a LINKINST=BASSM parameter on the CALL macro. For example:

```
CALL SRRCMIT(RETCODE),LINKINST=BASSM
```

COBOL: The return/reason code names and abend code names in ATRSCOB are truncated at 30 characters.

PL/I: The return/reason code names and abend code names in ATRSPPLI are truncated at 31 characters.

**Restrictions**
The state of the UR that represents the changes must be **in-reset** or **in-flight**.

The UR cannot be in local transaction mode.

**Input register information**
Before issuing the call, the caller does not have to place any information into any register unless using it in register notation for the parameter, or using it as a base register.

**Output register information**
When control returns to the caller, the GPRs contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Used as work registers by the system</td>
</tr>
</tbody>
</table>
Application_Commit_UR

2-13  Unchanged
14  Used as a work register by the system
15  Return code

When control returns to the caller, the ARs contain:

Register

Contents
0-1  Used as work registers by the system
2-13  Unchanged
14-15  Used as work registers by the system

Some callers depend on register contents remaining the same before and after
issuing a call. If the system changes the contents of registers on which the caller
depends, the caller must save them before calling the service, and restore them
after the system returns control.

Performance implications
None.

Syntax
Write the call as shown in the syntax diagram. You must code the parameter in the
CALL statement as shown.

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL SRRCMIT</td>
<td>(return_code)</td>
</tr>
</tbody>
</table>

Parameters
The parameters are explained as follows:

return_code
  Returned parameter
  • Type: Integer
  • Length: 4 bytes

  Contains the return code from the Application_Commit_UR service.

ABEND codes
The call might result in an abend X'5C4' with a reason code of X'00160000' through
X'00160012'. See [z/OS MVS System Codes] for the explanations and actions.

If your application ends abnormally during sync-point processing, the condition is
called an asynchronous abend, and you might need to see the programmer at your
installation responsible for managing RRS. Under information about working with
application programs, [z/OS MVS Programming: Resource Recovery] contains
additional details about asynchronous abends.

Issuing SETRRS CANCEL for non-resource manager programs that use the
synch-point service results in an abend X'058'. When RRS restarts, transactions that
were in progress are resolved.
Return codes
When the service returns control to your program, GPR 15 and return_code contain a hexadecimal return code, shown in the following table. If you need help with a return code, see the programmer at your installation responsible for managing RRS. Under information about working with application programs, z/OS MVS Programming: Resource Recovery contains additional details about these return codes.

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Decimal Return Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Code: RR_OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meaning: Successful completion. The changes to all protected resources have been made permanent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Action: None.</td>
</tr>
<tr>
<td>65</td>
<td>101</td>
<td>Code: RR_COMMITTED_OUTCOME_PENDING</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meaning: Environmental error. The commit was not completed:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• RRS requested that the resource managers make the changes to the resources permanent. However, the state of one or more of the resources is not known.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Action: The action by an application depends on the system environment. Some possible actions are:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Display a warning message to the end user.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Write an exception entry into an output log.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Abnormally end the application because the resource manager will not allow any further changes to the resource until the situation is resolved.</td>
</tr>
<tr>
<td>66</td>
<td>102</td>
<td>Code: RR_COMMITTED_OUTCOME_MIXED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meaning: Environmental error: RRS requested that the resource managers make the changes to the resources permanent. One or more resources were changed, but one or more were not changed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Action: Same as the action for return code 65 (101).</td>
</tr>
<tr>
<td>C8</td>
<td>200</td>
<td>Code: RR_PROGRAM_STATE_CHECK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meaning: Environmental error. The commit failed. The resource managers did not make the changes to the resources because one of the following occurred:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A resource on the same system as the application is not in the proper state for a commit.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A protected conversation is not in the required state: send, send pending, defer receive, defer allocate, sync_point, sync_point send, sync_point deallocate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A protected conversation is in send state. The communications manager started sending the basic conversation logical record, but did not finish sending it.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Action: Initiate an action by a resource manager to get its resource to a committable state, then call Application_Commit_UR again. For example, if the application has allocated a protected conversation through APPC/MVS, and the conversation is in receive state, the application gets this return code. It then must use APPC/MVS services to change the conversation to send state before issuing the commit request again.</td>
</tr>
</tbody>
</table>
### Application_Commit_UR

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Decimal Return Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>12C</td>
<td>300</td>
<td>Code: RR_BACKED_OUT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meaning: Environmental error. The commit failed. The resource managers backed out the changes, returning the resources to the values they had before the UR was processed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Action: Same as the action for return code 65 (101).</td>
</tr>
<tr>
<td>12D</td>
<td>301</td>
<td>Code: RR_BACKED_OUT_OUTCOME_PENDING</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meaning: Environmental error. The commit failed for one of the following reasons:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• RRS requested that the resource managers back out the changes to the resources. However, the state of one or more of the resources is not known.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• RRS is not active.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Action: Same as the action for return code 65 (101).</td>
</tr>
<tr>
<td>12E</td>
<td>302</td>
<td>Code: RR_BACKED_OUT_OUTCOME_MIXED</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Meaning: Environmental error. The commit failed. RRS requested that the resource managers back out the changes to the resources. One or more resources were backed out, but one or more were changed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Action: Same as the action for return code 65 (101).</td>
</tr>
</tbody>
</table>

### Example

In the pseudocode example, the application issues a call to request that RRS commit a UR.

```
...  
CALL SRRCMIT(RETCODE)  
...  
```

### Additional callable services

Additional callable services that an authorized resource manager can use to request resource recovery services can be found in [z/OS MVS Programming: Resource Recovery](https://www.ibm.com).
Part 5. CEA TSO/E address space services
Chapter 11. Introduction to CEA TSO/E address space services

The z/OS CEA TSO/E address space manager provides services to programmatically start and manage TSO/E address spaces and provides a communications mechanism for use between the caller and the programs running in these managed address spaces.

CEA TSO/E address space services allow callers to:
- Start a new TSO/E address space.
- End a TSO/E address space started by CEA.
- Send an attention interrupt to a TSO/E address space started by CEA.
- Obtain information about a TSO/E address space started by CEA.
- Obtain information about all the TSO/E address spaces that CEA started for an application.
- Ping a TSO/E address space that was started by CEA to prevent the address space from ending because it has been idle too long.

CEA TSO/E address space manager components

The CEA TSO/E address space manager ships with the common event adapter (CEA) component of z/OS. The CEA component provides the framework and manages the resources for the TSO/E address spaces started using the CEA TSO/E address space manager. Table 12 describes the components included in the CEA TSO/E address space manager.

Table 12. CEA TSO/E address space manager components

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEA address space</td>
<td>The CEA TSO/E address space manager is integrated into the CEA address space infrastructure. The function is started automatically when CEA is started.</td>
</tr>
<tr>
<td></td>
<td><strong>Attention:</strong> If the CEA address space ends, all the TSO/E sessions created by CEA will also end. Callers will not be notified that the CEA address space has ended. Instead, when a caller attempts to invoke the CEA TSO/E address space services or use the z/OS UNIX message queue, the request will fail.</td>
</tr>
<tr>
<td>Session table</td>
<td>When the CEA TSO/E address space manager starts a new TSO/E address space, the attributes of the address space and the resources obtained are stored in an internal session table. The entry exists for the life of the session and is removed when the TSO/E address space ends.</td>
</tr>
<tr>
<td></td>
<td>To display the contents of the session table, use the MODIFY CEA,DIAG,SESTABLE command. For more details about the command, see the topic about displaying the CEA TSO/E address space information in the z/OS MVS System Commands.</td>
</tr>
</tbody>
</table>
Table 12. CEA TSO/E address space manager components (continued)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>z/OS UNIX message queue</td>
<td>The CEA TSO/E address space manager creates and manages a z/OS UNIX message queue, which is used to facilitate communication between the caller and the TSO/E address space. For more information about the z/OS UNIX message queue, see “Communicating with programs running in the TSO/E address spaces” on page 146.</td>
</tr>
<tr>
<td>CEATsoRequest API</td>
<td>The CEA TSO/E address space manager provides the CEATsoRequest API, which is a 64-bit C-language based API that callers can use to request TSO/E address space services. For more information about the API, see Chapter 12, “Using CEA TSO/E address space services,” on page 151.</td>
</tr>
</tbody>
</table>

System prerequisites for the CEA TSO/E address space services

Table 13 describes the system prerequisites for using the CEA TSO/E address space services.

Table 13. System prerequisites

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Description</th>
</tr>
</thead>
</table>
| CEA must be active.                  | The CEA TSO/E address space manager runs in the CEA address space, which is started automatically during z/OS initialization. If your installation has stopped CEA, restart it. Otherwise, the services are not enabled.  

To determine whether the CEA address space is active, enter the following z/OS system console command:

D A,CEA

| The TRUSTED attribute must be assigned to the CEA started task. | To allow the CEA TSO/E address space manager to access or create any resource it needs, the CEA started task requires the TRUSTED(YES) attribute to be set on the RDEFINE STARTED CEA.** definition.  

If the TRUSTED attribute is not assigned to the CEA started task, the CEA TSO/E address space manager services might not be operational. For example, the services will not be able to create or access z/OS UNIX message queues. 

For more information about the RACF® TRUSTED attribute, see the topic on associating started procedures and jobs with user IDs in z/OS Security Server RACF System Programmer’s Guide and the topic on using started procedures in z/OS Security Server RACF Security Administrator’s Guide. |
| The CEA address space must be started in full function mode.   | Because the CEATsoRequest API requires z/OS UNIX System Services, CEA must be started in full function mode. For information about starting CEA in full function mode, see the topic about customizing CEA in z/OS Planning for Installation. |
| Callers must be authorized to SAF resource profile CEA.CEATSO.TSOREQUEST. | To access the CEATsoRequest API, callers must be authorized by their security product to SAF resource profile CEA.CEATSO.TSOREQUEST. |
Table 13. System prerequisites (continued)

<table>
<thead>
<tr>
<th>Prerequisite</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Users must be authorized to the appropriate resources.</td>
<td>The user ID of the user for whom the caller is requesting TSO/E address space services must be authorized to use TSO/E, OMVS, and any other resources the address space requires.</td>
</tr>
</tbody>
</table>

Working with TSO/E address spaces started by CEA

The CEA TSO/E address space manager can create up to 10 concurrent address spaces for a single user, and can create a maximum of 50 concurrent TSO/E address spaces. You can use the same processes that you use to work with other TSO/E address spaces when working with the TSO/E address spaces that are created by the CEA TSO/E address space manager.

For example, you can issue the `DT S` z/OS console command to display information about TSO/E address spaces, or you can issue the `C u=userid,A=asid` console command to cancel a TSO/E address space. For the display command, the TSO/E address spaces will appear in the list, indistinguishable from the other TSO/E address spaces. Note that TSO/E sessions started by CEA do not add to the count for the total maximum sessions for VTAM®.

You can also display information about these TSO/E address spaces using SDSF, a REXX EXEC, or a CLIST. Note that the application identifier that was specified when the TSO/E session was started is displayed where you would typically expect to see a terminal ID.

For example, if the CEA TSO/E address space manager starts a TSO/E session for the z/OSMF ISPF task, which has an application identifier equal to IZUIS, and you issue the REXX EXEC depicted in Figure 16, you will obtain the results depicted in Figure 17 on page 146:

```rexx
/* REXX */
trace all
myapp = sysvar('systermid')
say myapp
exit 0
```

*Figure 16. Sample REXX EXEC*
Communicating with programs running in the TSO/E address spaces

A z/OS UNIX message queue is the mechanism the CEA TSO/E address space manager uses for allowing communications between the caller and TSO/E, ISPF, and other programs running in the TSO/E address space. To communicate with the TSO/E address space, callers must read data from and write data to the message queue.

The CEA TSO/E address space manager creates a z/OS UNIX message queue for each TSO/E address space when the TSO/E address space is started, and anchors the message queue in the session table for the duration of the session. The CEA TSO/E address space manager deletes the message queue when the TSO/E address space ends.

Messages that typically are written to a 3270-type terminal are translated to UTF-8, converted to a JSON format, and written to the z/OS UNIX message queue along with identifying header information and a message type identifier. For a list of the message type identifiers, see Table 14.

Table 14. Message type identifiers

<table>
<thead>
<tr>
<th>Message Type ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Control data for the client.</td>
</tr>
<tr>
<td>2</td>
<td>TSO/E data for the client.</td>
</tr>
<tr>
<td>3</td>
<td>ISPF data for the client.</td>
</tr>
<tr>
<td>4 thru 32768</td>
<td>Reserved for IBM.</td>
</tr>
<tr>
<td>32769</td>
<td>Control TSO/E data from the client.</td>
</tr>
<tr>
<td>32770</td>
<td>TSO/E data from the client.</td>
</tr>
<tr>
<td>32771</td>
<td>ISPF data from the client.</td>
</tr>
</tbody>
</table>

Figure 17. Example illustrating that the REXX SYSTERMID is the same as the z/OSMF ISPF application identifier
Table 14. Message type identifiers (continued)

<table>
<thead>
<tr>
<th>Message Type ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>32772 thru 65535</td>
<td>Reserved for IBM.</td>
</tr>
<tr>
<td>65536 and above</td>
<td>Available for use by applications.</td>
</tr>
</tbody>
</table>

For information about the JSON format used for TSO/E messages, see "JSON format for TSO/E messages." For the JSON format used for ISPF messages, see the topic about JSON data structures and variables used to communicate between ISPF and a client in [z/OS ISPF Services Guide].

**JSON format for TSO/E messages**

TSO/E messages are written to the z/OS UNIX message queue using message type identifiers 2 and 32770 and are formatted as follows:

```
{"message-type":{"VERSION": "JSON-version","data-type": "data-value"}}
```

where:

- **message-type**
  
  Keyword that identifies the type of TSO/E message. Table 15 lists and describes the message types that can be used for message type identifiers 2 and 32770.

**Table 15. Message types**

<table>
<thead>
<tr>
<th>Message Type</th>
<th>Description</th>
<th>Message Type ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSO MESSAGE</td>
<td>Indicates that the system has created data or a message to be displayed on the client. The caller should read the message and display it accordingly.</td>
<td>2</td>
</tr>
<tr>
<td>TSO PROMPT</td>
<td>Indicates that the system requires a response from the client.</td>
<td>2</td>
</tr>
<tr>
<td>TSO RESPONSE</td>
<td>Indicates that a response was created by the client in response to a prompt. Callers should use this keyword when writing a response to the message queue.</td>
<td>32770</td>
</tr>
</tbody>
</table>

- **JSON-version**
  
  A four-digit number that identifies the JSON version used to format the message.

- **data-type**
  
  Keyword that describes the type of data included in the data-value variable. Table 16 lists and describes the data types that can be used for each TSO/E message type.

**Table 16. Data types**

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Description</th>
<th>Message Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA</td>
<td>Indicates that the data included in the data-value variable is either a message from the system or a response from the client. For this data type, the data-value variable is a character string that can contain up to 32,767 bytes.</td>
<td>TSO MESSAGE and TSO RESPONSE</td>
</tr>
</tbody>
</table>
Table 16. Data types (continued)

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Description</th>
<th>Message Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIDDEN</td>
<td>Indicates whether the client should hide or mask the response. For this data type, the <em>data-value</em> variable is a Boolean that can have the value of either TRUE or FALSE. When TRUE, this tells the client to hide or mask the response as it is entered. Otherwise, the response will display as it is entered.</td>
<td>TSO PROMPT</td>
</tr>
<tr>
<td>ACTION</td>
<td>Indicates that the caller would like to interrupt or end a process that is in progress. For this data type, specify ATTN as the value for the <em>data-value</em> variable. Callers should use the CEAisoRequest API to issue the CEAisoAttn request type before using a message to issue an attention interrupt. Use this data type only if the CEAisoAttn request fails.</td>
<td>TSO RESPONSE</td>
</tr>
</tbody>
</table>

Sample TSO/E messages written to the *z/OS UNIX message queue*

Figure 18 provides an example that illustrates how TSO/E messages appear on the *z/OS UNIX message queue.*

**Note:** The message type identifiers are not part of the JSON structure. They are included for illustration purposes only.

```json
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"IKJ56455I IBMUSER LOGON IN PROGRESS AT 03:46:24 ON OCTOBER 12, 2011"}}
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"IKJ56951I NO BROADCAST MESSAGES"}}
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"READY "}}
2 {"TSO PROMPT":{"VERSION":"0100","HIDDEN":"FALSE"}}
32770 {"TSO RESPONSE":{"VERSION":"0100","DATA":"TIME"}}
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"IKJ56650I TIME-03:46:50 AM. CPU-00:00:00 SERVICE-775140 SESSION-00:00:26 OCTOBER 12,2011"}}
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"READY "}}
2 {"TSO PROMPT":{"VERSION":"0100","HIDDEN":"FALSE"}}
32770 {"TSO RESPONSE":{"VERSION":"0100","DATA":"ALLOC DA"}}
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"IKJ56700A ENTER DATA SET NAME OR * - "}}
2 {"TSO PROMPT":{"VERSION":"0100","HIDDEN":"FALSE"}}
32770 {"TSO RESPONSE":{"VERSION":"0100","DATA":"sys1.broadcast"}}
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"IKJ56225I DATA SET IS ALLOCATED TO ANOTHER JOB OR USER"}}
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"IKJ56225I DATA SET IS ALLOCATED TO ANOTHER JOB OR USER"}}
2 {"TSO MESSAGE":{"VERSION":"0100","DATA":"READY "}}
2 {"TSO PROMPT":{"VERSION":"0100","HIDDEN":"FALSE"}}
32770 {"TSO RESPONSE":{"VERSION":"0100","DATA":"LOGOFF"}}
```

**Figure 18. Sample TSO/E messages written to the queue**

Reconnecting to CEA TSO/E address spaces

When a user requests to end a TSO/E session created by CEA, if the caller has not set the abnormal logoff flag (CEATSO_ABLOGOFF) or the no reconnect flag (CEATSO_NORECONN), the CEA TSO/E address space manager can intercept that request and place the session in a dormant state instead of ending it.
A **dormant TSO/E session** is a session that has been deactivated for communication through its message queue but remains available at a TSO/E READY prompt for a period of time so that the user can reconnect to it. Reconnecting to a dormant session is faster and uses fewer resources than constructing a new session because the session resources are retained and reused when the user reconnects to the session.

To enable the CEA reconnect feature, which is disabled by default, specify non-zero values for the RECONSESSIONS and RECONTIME statements in the TSOASMGR parmlib statement in the CEAPRMxx parmlib member. The RECONSESSIONS statement indicates how many dormant sessions can be created for each user, and the RECONTIME statement indicates the amount of time a dormant session remains a candidate for reconnection.

The CEA TSO/E address space manager can create a maximum of three dormant sessions per user and can keep a dormant session available for reconnection for a maximum of 23 hours, 59 minutes, and 59 seconds. The settings you specify for the TSOASMGR parmlib statement affect all of the TSO/E sessions that are managed by the CEA TSO/E address space manager. For more information about the TSOASMGR parmlib statement, see the topic about the CEAPRMxx parmlib member in [z/OS MVS Initialization and Tuning Reference](#).

When the CEA reconnect feature is enabled, to reconnect to a dormant session, the user must do the following:

- Request to start a new TSO/E session before the specified RECONTIME expires. After the RECONTIME expires, the session remains in a dormant state until CEA ends it; however, the session is no longer a candidate for reconnection.
- Use the same security credentials and logon parameters that were used for the dormant session.

If no dormant sessions are available that satisfy these requirements, the CEA TSO/E address space manager will create a new address space for the user.

Dormant TSO/E sessions do not interfere with the maximum number of sessions allowed. That is, if a user tries to create a new session and the number of active and dormant sessions equal the maximum allowed, the CEA TSO/E address space manager will end a dormant session and create a new session for the user.

**Idle time versus RECONTIME**

Each dormant TSO/E session has an idle application time, which is not adjustable, and a reconnect time (RECONTIME). The idle time cannot exceed 15 minutes. Otherwise, the CEA TSO/E address space manager will end the session regardless of reconnect time. To prevent your dormant sessions from ending because of idle time, issue a ping request at least once every 15 minutes, which informs CEA that all of the sessions for your application are still active. For more information, see "CeaTsoPing - Sending a ping on behalf of an application" on page 160.

**TSO/E LOGON RECONNECT operand versus CEA reconnect**

The TSO/E LOGON command is not supported for CEA-managed TSO/E sessions, and the capability provided by the TSO/E LOGON RECONNECT operand is different from the CEA reconnect feature. For more information about the TSO/E LOGON RECONNECT operand, see the topic about LOGON command operands in [z/OS TSO/E Command Reference](#).
Chapter 12. Using CEA TSO/E address space services

To use CEA TSO/E address space services, you issue CALLs from high-level language programs that invoke the CEATsoRequest API. The API is a 64-bit C-language based interface that the CEA TSO/E address space manager uses to receive requests from callers and to determine what action to take to process the request.

The CEATsoRequest API supports the following request types:

- **CeaTsoStart.** Start a TSO/E address space.
- **CeaTsoAttn.** Send an attention interrupt to a TSO/E address space started by CEA.
- **CeaTsoEnd.** End a TSO/E address space started by CEA.
- **CeaTsoPing.** Ping a TSO/E address space that was started by CEA to prevent the address space from ending because it has been idle too long.
- **CeaTsoQuery.** Obtain information about a specific TSO/E address space started by CEA.
- **CeaTsoQueryApp.** Obtain information about all the TSO/E address spaces that CEA started for an application.

For more details about the request types, see “Understanding the request types” on page 157.

### Invoking the CEATsoRequest API

The format to use to call the CEATsoRequest API follows:

```c
#include <ceaytsor.h>
#include <ceaxrdef.h>

int32_t CEATsoRequest(CEATsoRequestStruct_t* RequestStruct,
                      CEATsoQueryStruct_t* QueryStruct,
                      CEATsoError_t* ErrorStruct)
```

The call format is the same for each request type. The only difference is the fields that are required for each structure. For a description of each parameter and all the possible fields that can be included in each structure, see “Parameters” on page 152. For a list of the fields that are required for each request type, see “Understanding the request types” on page 157.

The CEATsoRequest API is used as a dynamically loaded library. The file ceasapit.x, which exists in /usr/lib, contains the sidedeck needed to link your program to the DLL. The contents of the file are depicted in Figure 19.

```c
IMPORT CODE64,'ceasapit.dll','CEATsoRequest'
```

**Figure 19. Contents included in the ceasapit.x file**

To compile your programs, the following header files are required: ceaytsor.h and ceaxrdef.h. The header files are stored in partitioned data set SYS1.SIEAHDRV. The contents of the header files are provided in “CEAYTSOR header file” on page 170 and “CEAXRDEF header file” on page 174.
Parameters

RequestStruct

Pointer to the CEATsoRequestStruct structure. The layout of the CEATsoRequestStruct structure follows:

```c
struct CEATsoRequestStruct_s {
    char ceatso_eyecatcher[8];
    uint32_t ceatso_version;
    uint32_t ceatso_requesttype;
    char ceatso_userid[8];
    uint32_t ceatso_asid;
    char ceatso_logonproc[8];
    char ceatso_command[80];
    uint16_t ceatso_numqueryreq;
    uint16_t ceatso_numqueryrslt;
    uint32_t ceatso_duration;
    uint32_t ceatso_msgqueueid;
    uint16_t ceatso_charset;
    uint16_t ceatso_codepage;
    uint16_t ceatso_screenrows;
    uint16_t ceatso_screencols;
    char ceatso_account[40];
    char ceatso_group[8];
    char ceatso_region[7];
    char ceatso_instance[1];
    char ceatso_apptag[8];
    char ceatso_stoken[8];
    uint32_t ceatso_ascbaddr;
    uint16_t ceatso_flags;
    uint16_t ceatso_index;
    char rsvd1[8];
};
```

typedef struct CEATsoRequestStruct_s CEATsoRequestStruct_t;

The fields in the CEATsoRequestStruct structure are explained as follows:

- **ceatso_eyecatcher**
  Eye catcher. Specify 'CEAYTSOR'.

- **ceatso_version**
  Structure version number.

- **ceatso_requesttype**
  Type of request. Specify one of the following values:
  - CeaTsoStart
  - CeaTsoAttn
  - CeaTsoEnd
  - CeaTsoPing
  - CeaTsoQuery
  - CeaTsoQueryApp
  For more details about each request type, see "Understanding the request types" on page 157.

- **ceatso_userid**
  User ID of the authenticated user for which the TSO/E address space was created.

- **ceatso_asid**
  The address space ID (ASID) for the TSO/E address space.
**ceatso_logonproc**
Name of the TSO/E logon procedure to use to log onto the TSO/E address space.

**ceatso_command**
Unused.

**ceatso_numqueryreq**
Maximum number of sessions to query.

**ceatso_numqueryrslt**
Number of sessions found that satisfy the query.

**ceatso_duration**
Unused.

**ceatso_msgqueueid**
The ID of the z/OS UNIX message queue that is used for communications between the caller and the TSO/E session.

**ceatso_charset**
Character set to use for the caller’s TSO/E address space. This value is used by the applications running in the TSO/E address space to convert messages and responses from UTF-8 to EBCDIC. The default character set, which is 697 decimal, will be used if zero is specified as the value.

**ceatso_codepage**
Codepage to use for the caller’s TSO/E address space. This value is used by the applications running in the TSO/E address space to convert messages and responses from UTF-8 to EBCDIC. The default codepage, which is 1047 decimal, will be used if zero is specified as the value.

**ceatso_screenrows**
Number of rows to be displayed on the screen. The default number of rows, which is 24, will be used if zero is specified as the value.

**ceatso_screencols**
Number of columns to be displayed on the screen. The default number of columns, which is 80, will be used if zero is specified as the value.

**ceatso_account**
TSO/E account number.

**ceatso_group**
TSO/E group name.

**ceatso_region**
Region size used for the TSO/E address space.

**ceatso_instance**
Number of active TSO/E address spaces that were started by CEA for the corresponding user ID. In the session table, this value is stored with the oldest TSO/E session entry created for the user.

**ceatso_apptag**
Identifies the application that is responsible for creating the TSO/E address space.

**ceatso_stoken**
A token that uniquely identifies the TSO/E address space.
ceatso_ascbaddr
Address of the address space control block that was created for the TSO/E address space.

ceatso_flags
When ending a TSO/E session, you can set the following flags:

- **CEATSO_ABLOGOFF (0x8000)**. If this flag is set, the CANCEL command will be issued to end the TSO/E session regardless of whether the CEA reconnect feature is enabled. Otherwise, the LOGOFF command will be issued or the TSO/E session will be placed in a dormant state as a candidate for reconnection.

- **CEATSO_NORECONN (0x4000)**. If this flag is set, the CEA TSO/E address space manager will end the TSO/E session even if the CEA reconnect feature is enabled. That is, if the client allows users to set this flag, users can force the CEA TSO/E address space manager to end a TSO/E session even if your installation has enabled the reconnect feature. For more information about the reconnect feature, see “Reconnecting to CEA TSO/E address spaces” on page 148.

When starting a TSO/E session, the CEA TSO/E address space manager sets the CEATSO_RECONNECTD (0x2000) flag if the user was connected to a dormant TSO/E session instead of a new session.

ceatso_index
The index value, STOKEN, and ASID together identify the TSO/E address space to the CEA TSO/E address space services.

rsdv1  Reserved for future use.

QueryStruct
Pointer to the CEATsoQueryStruct structure. This structure is used to return query results for the CeaTsoQuery and CeaTsoQueryApp request types. The layout of the CEATsoQueryStruct structure follows:

```c
struct CEATsoQueryStruct_s{
    char   ceatsoq_eyecatcher[8];
    uint32_t ceatsoq_version;
    uint32_t ceatsoq_requesttype;
    char   ceatsoq_userid[8];
    uint32_t ceatsoq_asid;
    char   ceatsoq_logonproc[8];
    char   ceatsoq_command[80];
    uint16_t ceatsoq_numqueryreq;
    uint16_t ceatsoq_numqueryrslt;
    uint32_t ceatsoq_duration;
    uint32_t ceatsoq_msgqueueid;
    uint16_t ceatsoq_charset;
    uint16_t ceatsoq_codepage;
    uint16_t ceatsoq_screencols;
    char   ceatsoq_screencols;
    char   ceatsoq_group[8];
    char   ceatsoq_region[7];
    char   ceatsoq_instance[1];
    char   ceatsoq_apptag[8];
    char   ceatsoq_ascbaddr;
    uint32_t ceatsoq_ascbaddr;
    uint16_t ceatsoq_flags;
    uint16_t ceatsoq_index;
    char   rsvd1[8];
};
```

typedef struct CEATsoQueryStruct_s  CEATsoQueryStruct_t;
The fields in the CEATsoQueryStruct structure are explained as follows:

**ceatso眼catcher**
Eye catcher. The value is ‘CEAYTSOQ’.

**ceatso_version**
Structure version number.

**ceatso_requesttype**
Type of request. The CeaTsoQueryStruct returns results for the
CeaTsoQuery and CeaTsoQueryApp request types. For more details
about each request type, see “Understanding the request types” on
page 157.

**ceatso_userid**
User ID of the authenticated user for which the TSO/E address space
was created.

**ceatso_asid**
The address space ID (ASID) for the TSO/E address space.

**ceatso_logonproc**
Name of the TSO/E logon procedure to use to log onto the TSO/E
address space.

**ceatso_command**
Unused.

**ceatso_numqueryreq**
Maximum number of sessions to query.

**ceatso_numqueryrslt**
Number of sessions found that satisfy the query.

**ceatso_duration**
Unused.

**ceatso_msgqueueid**
The ID of the z/OS UNIX message queue that is used for
communications between the caller and the TSO/E session.

**ceatso_charset**
Character set to use for the caller’s TSO/E address space. This value is
used by the applications running in the TSO/E address space to
convert messages and responses from UTF-8 to EBCDIC. The default
character set, which is 697 decimal, will be used if zero is specified as the
value.

**ceatso_codepage**
Codepage to use for the caller’s TSO/E address space. This value is
used by the applications running in the TSO/E address space to
convert messages and responses from UTF-8 to EBCDIC. The default
codepage, which is 1047 decimal, will be used if zero is specified as the
value.

**ceatso_screenrows**
Number of rows to be displayed on the screen. The default number of
rows, which is 24, will be used if zero is specified as the value.

**ceatso_screencols**
Number of columns to be displayed on the screen. The default number of
columns, which is 80, will be used if zero is specified as the value.
ceatso_account
TSO/E account number.

ceatso_group
TSO/E group name.

ceatso_region
Region size used for the TSO/E address space.

ceatso_instance
Number of active TSO/E address spaces that were started by CEA for the corresponding user ID. In the session table, this value is stored with the oldest TSO/E session entry created for the user.

ceatso_apptag
Identifies the application that is responsible for creating the TSO/E address space.

ceatso_stoken
A token that uniquely identifies the TSO/E address space.

ceatso_ascbaddr
Address of the address space control block that was created for the TSO/E address space.

ceatso_flags
When ending a TSO/E session, you can set the following flags:

- **CEATSO_ABLOGOFF (0x8000)**. If this flag is set, the CANCEL command will be issued to end the TSO/E session regardless of whether the CEA reconnect feature is enabled. Otherwise, the LOGOFF command will be issued or the TSO/E session will be placed in a dormant state as a candidate for reconnection.

- **CEATSO_NORECONN (0x4000)**. If this flag is set, the CEA TSO/E address space manager will end the TSO/E session even if the CEA reconnect feature is enabled. That is, if the client allows users to set this flag, users can force the CEA TSO/E address space manager to end a TSO/E session even if your installation has enabled the reconnect feature. For more information about the reconnect feature, see "Reconnecting to CEA TSO/E address spaces" on page 148.

When starting a TSO/E session, the CEA TSO/E address space manager sets the CEATSO_RECONNECTD (0x2000) flag if the user was connected to a dormant TSO/E session instead of a new session.

ceatso_index
The index value, STOKEN, and ASID together identify the TSO/E address space to the CEA TSO/E address space services.

resv1 Reserved for future use.

ErrorStruct
Pointer to the CEATsoErrorStruct structure. This structure contains information about the results of the request. The layout of the CEATsoErrorStruct structure follows:

```c
struct CEATsoError_s {
    char    eyeCatcher[8];
    uint32_t version;
    int32_t  returnCode;
    uint32_t reasonCode;
}
```
CEATsoDiag_t diag;
}
typedef struct CEATsoError_s CEATsoError_t;

The fields in the CEATsoErrorStruct structure are explained as follows:

eyeCatcher
   Eye catcher. Specify 'CEAIERRO'.

version
   Structure version number.

returnCode
   Return code. For more information about return codes, see "Return codes" on page 163.

reasonCode
   Reason code. For more information about reason codes, see "Reason codes" on page 163.

diag
   Diagnostic codes, which are mapped by a CEATsoDiag_t structure. This structure can contain up to four diagnostic codes that provide more details about the failure. For more information about diagnostic codes, see "Diagnostic codes" on page 167.

Requirements for callers

To send requests to the API, the environment of the caller must satisfy the following requirements:

- **Minimum authorization**: Problem state
- **Dispatchable unit mode**: Task
- **Cross memory mode**: PASN HASN SASN
- **AMODE**: 64-bit
- **ASC mode**: Primary
- **Interrupt status**: Enabled for I/O and external interrupts
- **Locks**: No locks held
- **Linkage**: Uses standard C linkage conventions
- **Library path (LIBPATH)**: Must be set to include /usr/lib

Understanding the request types

This section describes the request types that are provided by the CEATsoRequest API. For a description of the API, including the call format and parameters, see "Invoking the CEATsoRequest API" on page 151.

CeaTsoStart - Starting a new TSO/E session

Use the CeaTsoStart request type to start a new TSO/E address space or to reconnect to a dormant TSO/E session. When you start a new TSO/E address space, a z/OS UNIX message queue is also created to enable communication between the caller and the TSO/E address space. When you reconnect to a TSO/E session, the existing message queue is reused.

The TSO/E address space is started or reconnected to using the security environment of the caller. If there is task-level security, it is used for the address space. Otherwise, the address space security environment is used. The user tokens (UTOKENs) from both environments are saved and are used to verify subsequent requests.
Table 17 lists the input callers must provide for each structure used for this request type and the output that will be provided. No other fields in the structures are used. The value for the unused fields is indeterminate. For more details about the fields listed for each structure, see "Parameters" on page 152.

Table 17. Input and output for each structure used for the CeaTsoStart request type

<table>
<thead>
<tr>
<th>Structure</th>
<th>Required Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeaTsoRequestStruct</td>
<td>• eyecatcher • ceatso_version • ceatso_requesttype • ceatso_logonproc • ceatso_charset • ceatso_screencols • ceatso_screencols • ceatso_account • ceatso_group • ceatso_region • ceatso_apptag</td>
<td>If the return code is CEASUCCESS, the following fields are returned: • ceatso_userid • ceatso_asid • ceatso_msgqueueid • ceatso_stoken • ceatso_index • ceatso_flags. The value is tsor_reconnected if the CEA TSO/E address space manager connected the user to a dormant TSO/E session.</td>
</tr>
<tr>
<td>CeaTsoQueryStruct</td>
<td>Not used for this request type.</td>
<td>Not used for this request type.</td>
</tr>
<tr>
<td>CeaTsoErrorStruct</td>
<td>• eyeCatcher • version</td>
<td>• returnCode • reasonCode • diag</td>
</tr>
</tbody>
</table>

CeaTsoAttn - Sending an attention interrupt to a TSO/E session

Use the CeaTsoAttn request type to send an attention interrupt to a TSO/E address space started by CEA. An attention interrupt allows you to interrupt or end a process that is taking place. This request type is useful if the client is stuck at a prompt or if you submitted a request to which the system is not responding.

To perform this request, the CEA TSO/E address space manager extracts the caller’s security UTOKEN from the caller’s environment and uses it when needed.

Table 18 lists the input callers must provide for each structure used for this request type and the output that will be provided. No other fields in the structures are used. The value for the unused fields is indeterminate. For more details about the fields listed for each structure, see "Parameters" on page 152.

Table 18. Input and output for each structure used for the CeaTsoAttn request type

<table>
<thead>
<tr>
<th>Structure</th>
<th>Required Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeaTsoRequestStruct</td>
<td>• eyecatcher • ceatso_version • ceatso_requesttype • ceatso_asid • ceatso_apptag • ceatso_stoken • ceatso_index</td>
<td>None</td>
</tr>
</tbody>
</table>
Table 18. Input and output for each structure used for the CeaTsoAttn request type (continued)

<table>
<thead>
<tr>
<th>Structure</th>
<th>Required Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeaTsoQueryStruct</td>
<td>Not used for this request type.</td>
<td>Not used for this request type.</td>
</tr>
<tr>
<td>CeaTsoErrorStruct</td>
<td>• eyecatcher&lt;br&gt;• version</td>
<td>• returnCode&lt;br&gt;• reasonCode&lt;br&gt;• diag</td>
</tr>
</tbody>
</table>

CeaTsoEnd - Ending a TSO/E session

Use the CeaTsoEnd request type to end a TSO/E address space started by CEA or to place the session into a dormant state. When you end a TSO/E address space, all of the associated resources are returned to the system, including the z/OS UNIX message queue that was used for communicating with the session.

If the CEA reconnect feature is enabled and the caller has not set the CEATSO_ABLOGOFF flag (0x8000) or the CEATSO_NORECONN flag (0x4000), the CEA TSO/E address space manager will intercept the CeaTsoEnd request and place the TSO/E session in a dormant state instead of ending it. In this case, some of the session resources are retained and reused when the user reconnects to the session. For more information about the reconnect feature, see “Reconnecting to CEA TSO/E address spaces” on page 148.

To perform the CeaTsoEnd request, the CEA TSO/E address space manager extracts the caller’s security UTOKEN from the caller’s environment and uses it when needed.

Table 19 lists the input callers must provide for each structure used for this request type and the output that will be provided. No other fields in the structures are used. The value for the unused fields is indeterminate. For more details about the fields listed for each structure, see “Parameters” on page 152.

Table 19. Input and output for each structure used for the CeaTsoEnd request type

<table>
<thead>
<tr>
<th>Structure</th>
<th>Required Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeaTsoRequestStruct</td>
<td>• eyecatcher&lt;br&gt;• ceatso_version&lt;br&gt;• ceatso_requesttype&lt;br&gt;• ceatso_asid&lt;br&gt;• ceatso_apptag&lt;br&gt;• ceatso_stoken&lt;br&gt;• ceatso_index&lt;br&gt;Optional input: &lt;br&gt;• ceatso_flags</td>
<td>None</td>
</tr>
<tr>
<td>CeaTsoQueryStruct</td>
<td>Not used for this request type.</td>
<td>Not used for this request type.</td>
</tr>
<tr>
<td>CeaTsoErrorStruct</td>
<td>• eyecatcher&lt;br&gt;• version</td>
<td>• returnCode&lt;br&gt;• reasonCode&lt;br&gt;• diag</td>
</tr>
</tbody>
</table>
CeaTsoPing - Sending a ping on behalf of an application

Each TSO/E session has an idle application time that the CEA TSO/E address space manager uses to determine if the application that is associated with the session is active. If the idle application time is 15 minutes, the application is considered to be inactive. In which case, the CEA TSO/E address space manager ends all the CEA-managed TSO/E sessions for that application that have the same application identifier.

To prevent TSO/E sessions from ending because of idle application time, callers can use the CeaTsoPing request type to issue a ping request at least once every 15 minutes. Doing so informs CEA that the application is still active, and causes the CEA TSO/E address space manager to reset the idle application time for all the CEA-managed TSO/E sessions that have the same application identifier.

To perform this request, the CEA TSO/E address space manager extracts the caller’s security UTOKEN from the caller’s environment and uses it when needed.

Table 20 lists the input callers must provide for each structure used for this request type and the output that will be provided. No other fields in the structures are used. The value for the unused fields is indeterminate. For more details about the fields listed for each structure, see “Parameters” on page 152.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Required Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeaTsoRequestStruct</td>
<td>• eyecatcher</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>• ceatso_version</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_requests_type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_asid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_apptag</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_stoken</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_index</td>
<td></td>
</tr>
<tr>
<td>CeaTsoQueryStruct</td>
<td>Not used for this request type.</td>
<td>Not used for this request type.</td>
</tr>
<tr>
<td>CeaTsoErrorStruct</td>
<td>• eyeCatcher</td>
<td>• returnCode</td>
</tr>
<tr>
<td></td>
<td>• version</td>
<td>• reasonCode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• diag</td>
</tr>
</tbody>
</table>

CeaTsoQuery - Querying the TSO/E address spaces

Use the CeaTsoQuery request type to obtain information from the CEA TSO/E address space manager about a TSO/E address space started by CEA.

To perform this request, the CEA TSO/E address space manager extracts the caller’s security UTOKEN from the caller’s environment and uses it when needed.

Table 21 on page 161 lists the input callers must provide for each structure used for this request type and the output that will be provided. No other fields in the structures are used. The value for the unused fields is indeterminate. For more details about the fields listed for each structure, see “Parameters” on page 152.
Table 21. Input and output for each structure used for the CeaTsoQuery request type

<table>
<thead>
<tr>
<th>Structure</th>
<th>Required Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeaTsoRequestStruct</td>
<td>• eyecatcher</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>• ceatso_version</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_requesttype</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_asid</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_apptag</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_stoken</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• ceatso_index</td>
<td></td>
</tr>
<tr>
<td>CeaTsoQueryStruct</td>
<td>• eyecatcher</td>
<td>If the return code is CEASUCCESS, the following fields are returned:</td>
</tr>
<tr>
<td></td>
<td>• ceatso_version</td>
<td>• ceatso_userid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_asid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_logonproc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_msgqueueid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_charset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_codepage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_screencols</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_region</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_apptag</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_stoken</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• ceatso_index</td>
</tr>
<tr>
<td>CeaTsoErrorStruct</td>
<td>• eyeCatcher</td>
<td>• returnCode</td>
</tr>
<tr>
<td></td>
<td>• version</td>
<td>• reasonCode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• diag</td>
</tr>
</tbody>
</table>

**CeaTsoQueryApp - Querying TSO/E sessions by application**

Use the CeaTsoQueryApp request type to obtain information from the CEA TSO/E address space manager about all the TSO/E address spaces that CEA started that are associated with a specific application identifier.

To perform this request, the CEA TSO/E address space manager extracts the caller’s security UTOKEN from the caller’s environment and uses it when needed.

Table 22 on page 162 lists the input callers must provide for each structure used for this request type and the output that will be provided. No other fields in the structures are used. The value for the unused fields is indeterminate. For more details about the fields listed for each structure, see "Parameters" on page 152.

**Attention:** It is the caller’s responsibility to free the storage associated with the query structures that are returned.
### Table 22. Input and output for each structure used for the CeaTsoQueryApp request type

<table>
<thead>
<tr>
<th>Structure</th>
<th>Required Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>CeaTsoRequestStruct</td>
<td>• eyecatcher&lt;br&gt;• ceatso_version&lt;br&gt;• ceatso_requesttype&lt;br&gt;• ceatso_asid&lt;br&gt;• ceatso_numqueryreq&lt;br&gt;• ceatso_apptag&lt;br&gt;• ceatso_stoken&lt;br&gt;• ceatso_index</td>
<td>If the return code is CEASUCCESS, the following field is returned:&lt;br&gt;• ceatso_numqueryrslt</td>
</tr>
<tr>
<td>CeaTsoQueryStruct</td>
<td>None</td>
<td>If the return code is CEASUCCESS, an array of query structures are allocated and the following fields are returned for each:&lt;br&gt;• eyecatcher&lt;br&gt;• ceatso_version&lt;br&gt;• ceatso_userid&lt;br&gt;• ceatso_asid&lt;br&gt;• ceatso_logonproc&lt;br&gt;• ceatso_msgqueueid&lt;br&gt;• ceatso_charset&lt;br&gt;• ceatso_codepage&lt;br&gt;• ceatso_screenerows&lt;br&gt;• ceatso_screencols&lt;br&gt;• ceatso_account&lt;br&gt;• ceatso_group&lt;br&gt;• ceatso_region&lt;br&gt;• ceatso_apptag&lt;br&gt;• ceatso_stoken&lt;br&gt;• ceatso_index</td>
</tr>
<tr>
<td>CeaTsoErrorStruct</td>
<td>• eyeCatcher&lt;br&gt;• version</td>
<td>• returnCode&lt;br&gt;• reasonCode&lt;br&gt;• diag</td>
</tr>
</tbody>
</table>

---

### Return, reason, and diagnostic codes

When the CEARequest API returns control to your program, the CEAErrorStruct structure contains the return, reason, and diagnostic codes that you can use to identify more information about any errors that occurred.

The codes the API returns are described in the following sections:

- [“Return codes” on page 163](#)
- [“Reason codes” on page 163](#)
- [“Diagnostic codes” on page 167](#)
Return codes

Table 23 lists and describes the return codes that are typically returned after the CEATsoRequest API processes a request.

Table 23. Return codes

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Equate Symbol, Meaning, and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFFFFFFF</td>
<td>Equate symbol: CEAFailure</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> One or more errors occurred during CEATSOREQUEST processing.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> Check the reason and diagnostic codes to obtain additional information, and correct any errors.</td>
</tr>
<tr>
<td>00000000</td>
<td>Equate symbol: CEASUCCESS</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> No errors occurred during CEATSOREQUEST processing. The meaning of a CEASUCCESS return code for each request type follows:</td>
</tr>
<tr>
<td></td>
<td>• CeaTsoStart. A new TSO/E address space was started, or the user was connected to a dormant TSO/E session. The caller can now read from and write to the z/OS UNIX message queue.</td>
</tr>
<tr>
<td></td>
<td>• CeaTsoAttn. The attention interrupt request was sent to the specified TSO/E address space.</td>
</tr>
<tr>
<td></td>
<td>• CeaTsoEnd. The specified TSO/E address space was ended or placed into a dormant state. If the session was ended, all associated resources were returned to the system. Otherwise, the resources were retained so that they can be reused when the user reconnects to the session.</td>
</tr>
<tr>
<td></td>
<td>• CeaTsoPing. The ping request was performed, and the timestamp for the specified TSO/E session was updated.</td>
</tr>
<tr>
<td></td>
<td>• CeaTsoQuery. The query completed with no errors.</td>
</tr>
<tr>
<td></td>
<td>• CeaTsoQueryApp. The query by application completed with no errors. An array of query structures were allocated and populated with information about the sessions.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
<tr>
<td>00000004</td>
<td>Equate symbol: CEAWARNING</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> One or more warnings occurred during CEATSOREQUEST processing.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> Check the reason and diagnostic codes to obtain additional information, and correct any errors.</td>
</tr>
</tbody>
</table>

Reason codes

Table 24 on page 164 lists and describes the reason codes that are typically returned after the CEATsoRequest API processes a request. Additional reason codes might also be returned from services that obtained an unexpected error. Those reason codes are not listed in the table.
<table>
<thead>
<tr>
<th>Hexadecimal Reason Code</th>
<th>Equate Symbol, Meaning, and Action</th>
</tr>
</thead>
</table>
| 1000                   | **Equate symbol**: CEATSOMSGQSERVICEFAILED  
**Meaning**: Error occurred during CEATSOREQUEST processing: z/OS UNIX message queue processing failed.  
**Action**: Ensure that the CEA started task is TRUSTED. For more information about the RACF TRUSTED attribute, see the topic on associating started procedures and jobs with user IDs in z/OS Security Server RACF System Programmer’s Guide and the topic on using started procedures in z/OS Security Server RACF Security Administrator’s Guide. |
| 1001                   | **Equate symbol**: CEATSONOUSERIDFOUND  
**Meaning**: Error occurred during CEATSOREQUEST processing: An input user ID value was expected, but not received.  
**Action**: Specify a user ID. |
| 1002                   | **Equate symbol**: CEATSOMATCHMISSING  
**Meaning**: Error occurred during CEATSOREQUEST processing: A user ID was expected, but not found in the session table.  
**Action**: Ensure that the user ID, STOKEN, and index specified are valid. |
| 1003                   | **Equate symbol**: CEATSOSTOKENMISSING  
**Meaning**: Error occurred during CEATSOREQUEST processing: An input STOKEN value was expected, but not received.  
**Action**: Specify a STOKEN. |
| 1004                   | **Equate symbol**: CEATSOINDEXOUTOFRANGE  
**Meaning**: Error occurred during CEATSOREQUEST processing: Input table index is too big or too small for the session table.  
**Action**: Specify a valid index. The index for the TSO/E address space should be between 1 and 50. |
| 1005                   | **Equate symbol**: CEATSOStartFAILED  
**Meaning**: Error occurred during CEATSOREQUEST processing: CEA could not create a TSO/E address space.  
**Action**: Ensure that sufficient system resources are available to create the TSO/E address space, and verify that the user is authorized to create address spaces. |
| 1006                   | **Equate symbol**: CEATSOATTNFAILED  
**Meaning**: Error occurred during CEATSOREQUEST processing: CEA could not issue a TSO/E attention interrupt.  
**Action**: Check the diagnostic codes to obtain additional information, and correct any errors. |
<table>
<thead>
<tr>
<th>Hexadecimal Reason Code</th>
<th>Equate Symbol, Meaning, and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1007</td>
<td>Equate symbol: CEATSOENDFAILED</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: CEA could not end a TSO/E address space.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> Check the diagnostic codes to obtain additional information, and correct any errors.</td>
</tr>
<tr>
<td>1008</td>
<td>Equate symbol: CEATSOQUERYFAILED</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: An attempt to query the session table failed.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> Ensure that the input values you specified are valid. If the input values are valid, check the diagnostic codes to obtain additional information. Correct any errors.</td>
</tr>
<tr>
<td>1009</td>
<td>Equate symbol: CEATSOQUERYAPPFAILED</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: An attempt to query the session table for the TSO/E sessions that are associated with a specific application failed.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> Ensure that the application identifier you specified is valid. If the application identifier is valid, check the diagnostic codes to obtain additional information. Correct any errors.</td>
</tr>
<tr>
<td>100A</td>
<td>Equate symbol: CEATSOPINGFAILED</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: Ping processing failed. Typically, this error occurs when the ping request is not issued from the security environment where the TSO/E address space was started or the user is not authorized to the application identified when the TSO/E address space was created.</td>
</tr>
<tr>
<td></td>
<td>Note that the TSO/E address space is started or reconnected to using the security environment of the caller. If there is task-level security, it is used for the address space. Otherwise, the address space security environment is used. The user tokens (UTOKENs) from both environments are saved and are used to verify subsequent requests.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> Issue the ping request from the security environment that was used when the TSO/E address space was started, and ensure that the user is authorized to the application specified when the address space was created.</td>
</tr>
<tr>
<td>100B</td>
<td>Equate symbol: CEATSOENDSENDLOGOFFFAILED</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: The CANCEL command was issued to end the TSO/E address space because the LOGOFF command failed.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
<tr>
<td>Hexadecimal Reason Code</td>
<td>Equate Symbol, Meaning, and Action</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>100C</td>
<td><strong>Equate symbol:</strong> CEATSOBadAmode</td>
</tr>
<tr>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: The call was invoked in the wrong AMODE. AMODE 64 is required.</td>
<td></td>
</tr>
<tr>
<td><strong>Action:</strong> Invoke the API in AMODE 64.</td>
<td></td>
</tr>
<tr>
<td>100D</td>
<td><strong>Equate symbol:</strong> CEATSODisabled</td>
</tr>
<tr>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: The dispatchable unit is not enabled.</td>
<td></td>
</tr>
<tr>
<td><strong>Action:</strong> Ensure that the dispatchable unit is enabled.</td>
<td></td>
</tr>
<tr>
<td>100E</td>
<td><strong>Equate symbol:</strong> CEATSONotTaskMode</td>
</tr>
<tr>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: The CEATsoRequest API was not invoked under task mode. The dispatchable unit mode must be task.</td>
<td></td>
</tr>
<tr>
<td><strong>Action:</strong> Ensure that the dispatchable unit is a task.</td>
<td></td>
</tr>
<tr>
<td>100F</td>
<td><strong>Equate symbol:</strong> CEATSOFRRSet</td>
</tr>
<tr>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: The CEATsoRequest API was invoked under a functional recovery routine (FRR). No FRRs are allowed.</td>
<td></td>
</tr>
<tr>
<td><strong>Action:</strong> Ensure that no FRRs are invoked in your environment.</td>
<td></td>
</tr>
<tr>
<td>1010</td>
<td><strong>Equate symbol:</strong> CEATSOLocked</td>
</tr>
<tr>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: The caller is holding a system lock. No system locks are allowed.</td>
<td></td>
</tr>
<tr>
<td><strong>Action:</strong> Release the lock.</td>
<td></td>
</tr>
<tr>
<td>1011</td>
<td><strong>Equate symbol:</strong> CEATSOXMMMode</td>
</tr>
<tr>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: The CEATsoRequest API was invoked while running cross memory mode, which is not allowed. The API must be invoked in primary mode.</td>
<td></td>
</tr>
<tr>
<td><strong>Action:</strong> Invoke the API in primary mode.</td>
<td></td>
</tr>
<tr>
<td>1013</td>
<td><strong>Equate symbol:</strong> CEATsoReqStructFieldBad</td>
</tr>
<tr>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: Input provided for a field in the CEATsoRequestStruct structure is not valid.</td>
<td></td>
</tr>
<tr>
<td><strong>Action:</strong> To identify the field that is not valid, see the diagnostic codes.</td>
<td></td>
</tr>
<tr>
<td>1014</td>
<td><strong>Equate symbol:</strong> CEATsoBadQueryEyecatcher</td>
</tr>
<tr>
<td><strong>Meaning:</strong> Error occurred during CEATSOREQUEST processing: The eye catcher specified for the query structure is not valid. The expected value is CEAYTSO.</td>
<td></td>
</tr>
<tr>
<td><strong>Action:</strong> Specify CEAYTSO as the value for the eye catcher field.</td>
<td></td>
</tr>
</tbody>
</table>
Table 24. Reason codes (continued)

<table>
<thead>
<tr>
<th>Hexadecimal Reason Code</th>
<th>Equate Symbol, Meaning, and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1015</td>
<td>Equate symbol: CEATsoBadQueryVersion</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning</strong>: Error occurred during CEATsoREQUEST processing: The version specified for the query structure is not valid.</td>
</tr>
<tr>
<td></td>
<td><strong>Action</strong>: Specify a valid version number. The version numbers allowed are specified in the ceaytsor.h header file.</td>
</tr>
</tbody>
</table>

**Diagnostic codes**

Table 25 lists and describes the diagnostic codes that are typically returned after the CEATsoRequest API processes a request. Additional diagnostic codes might also be returned from services that obtained an unexpected error. Those diagnostic codes are not listed in the table.

Table 25. Diagnostic code

<table>
<thead>
<tr>
<th>Hexadecimal Diagnostic Code</th>
<th>Equate Symbol and Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>04</td>
<td>Equate symbol: kCEATsoBadRacRouteExtr</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning</strong>: The TSO/E address space was not started because an error occurred while trying to authenticate the caller. The CEA TSO/E address space service could not complete one of the following actions:</td>
</tr>
<tr>
<td></td>
<td>• Extract the security identity of the caller.</td>
</tr>
<tr>
<td></td>
<td>• Log the caller into TSO/E.</td>
</tr>
<tr>
<td></td>
<td>• Authorize the caller to a required resource.</td>
</tr>
<tr>
<td></td>
<td>The following fields are returned in the CEATsoErrorStruct structure:</td>
</tr>
<tr>
<td></td>
<td>• diag2 contains the SAF return code from RACRoute returned in R15.</td>
</tr>
<tr>
<td></td>
<td>• diag3 contains the RACF or installation return code from the SAF parameter list.</td>
</tr>
<tr>
<td></td>
<td>• diag4 contains the RACF or installation exit reason code from the SAF parameter list.</td>
</tr>
<tr>
<td></td>
<td>Note that a value is not always returned in diag2, diag3, and diag4.</td>
</tr>
<tr>
<td>05</td>
<td>Equate symbol: kCEATsoBadRacRouteCreate</td>
</tr>
<tr>
<td></td>
<td><strong>Meaning</strong>: An error was encountered when requesting verification of the newly created security identity.</td>
</tr>
<tr>
<td></td>
<td>The following fields are returned in the CEATsoErrorStruct structure:</td>
</tr>
<tr>
<td></td>
<td>• diag2 contains the SAF return code from RACRoute returned in R15.</td>
</tr>
<tr>
<td></td>
<td>• diag3 contains the RACF or installation return code from the SAF parameter list.</td>
</tr>
<tr>
<td></td>
<td>• diag4 contains the RACF or installation exit reason code from the SAF parameter list.</td>
</tr>
<tr>
<td>Hexadecimal Diagnostic Code</td>
<td>Equate Symbol and Meaning</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>0A</td>
<td>Equate symbol: kCEATsoBadAddSession</td>
</tr>
<tr>
<td></td>
<td>Meaning: Unable to create a new TSO/E address space.</td>
</tr>
<tr>
<td></td>
<td>The return code received from the TSO/E session is provided in the diag2 field of the CEATsoErrorStruct structure.</td>
</tr>
<tr>
<td>0B</td>
<td>Equate symbol: kCEATsoBadQuerySession</td>
</tr>
<tr>
<td></td>
<td>Meaning: Unable to query the attributes of TSO/E sessions that are associated with a specific application.</td>
</tr>
<tr>
<td></td>
<td>The return code received from the method is provided in the diag2 field of the CEATsoErrorStruct structure.</td>
</tr>
<tr>
<td>0C</td>
<td>Equate symbol: kCEATsoBadASCBStoken</td>
</tr>
<tr>
<td></td>
<td>Meaning: Unable to issue an attention interrupt or query the session table for information about the TSO/E address space because the STOKEN could not be found.</td>
</tr>
<tr>
<td>0D</td>
<td>Equate symbol: kCEATsoBadSessIndex</td>
</tr>
<tr>
<td></td>
<td>Meaning: The value provided in the ceatso_index field in the CeaTsoRequestStruct is zero, which is not valid. The index must be greater than or equal to one.</td>
</tr>
<tr>
<td>0F</td>
<td>Equate symbol: kCEATsoBadLOGONMGCRE</td>
</tr>
<tr>
<td></td>
<td>Meaning: The MGCRE service used to issue the start command to start a TSO/E address space failed.</td>
</tr>
<tr>
<td></td>
<td>The register where MGCRE returned its return code is provided in the diag2 field of the CEATsoErrorStruct structure. In this case, the value in the diag2 field is R15 (register 15).</td>
</tr>
<tr>
<td>10</td>
<td>Equate symbol: SESS_SESSIONNOLONGERINTABLE</td>
</tr>
<tr>
<td></td>
<td>Meaning: The TSO/E session no longer exists in the session table.</td>
</tr>
<tr>
<td>11</td>
<td>Equate symbol: kCEATsoBadSessENQreq</td>
</tr>
<tr>
<td></td>
<td>Meaning: Unable to acquire the ENQ on the session table.</td>
</tr>
<tr>
<td></td>
<td>The return code received from the method is provided in the diag2 field of the CEATsoErrorStruct structure.</td>
</tr>
<tr>
<td>13</td>
<td>Equate symbol: kCEATsoBadSessUpdateLastRef</td>
</tr>
<tr>
<td></td>
<td>Meaning: The ping request failed because the CEA TSO/E address space manager was unable to update the last reference timestamp for that session.</td>
</tr>
<tr>
<td></td>
<td>The return code received from the method is provided in the diag2 field of the CEATsoErrorStruct structure.</td>
</tr>
<tr>
<td>14</td>
<td>Equate symbol: kCEATsoBadQuerySessionForApptag</td>
</tr>
<tr>
<td></td>
<td>Meaning: Unable to query the sessions table for the specified application identifier because an error occurred.</td>
</tr>
<tr>
<td></td>
<td>The return code received from the method is provided in the diag2 field of the CEATsoErrorStruct structure.</td>
</tr>
</tbody>
</table>
Table 25. Diagnostic code (continued)

<table>
<thead>
<tr>
<th>Hexadecimal Diagnostic Code</th>
<th>Equate Symbol and Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td><code>Equate symbol: kCEATsoBadNumEntries</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The number of entries found that match the query exceeds the maximum number of sessions that can be queried or exceeds the number of entries the query structure can accommodate. The number of entries found is provided in the diag2 field of the CEATsoErrorStruct structure.</td>
</tr>
<tr>
<td>18</td>
<td><code>Equate symbol: kCEATsoBadResmgrAdd</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> Unable to set the end of memory resource manager; an ABEND dump was taken.</td>
</tr>
<tr>
<td>19</td>
<td><code>Equate symbol: kCEATsoBadQueryAllSessions</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> Unable to perform a query of all TSO/E sessions in the session table. You must search for a specific TSO/E session, or search for TSO/E sessions that are associated with a specific application identifier. The return code received from the method is provided in the diag2 field of the CEATsoErrorStruct structure.</td>
</tr>
<tr>
<td>1A</td>
<td><code>Equate symbol: kCEATsoBadApptag</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The value contained in the application identifier field is not valid.</td>
</tr>
<tr>
<td>1B</td>
<td><code>Equate symbol: kCEATsoBaduserid</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The value contained in the user ID field is not valid.</td>
</tr>
<tr>
<td>1C</td>
<td><code>Equate symbol: kCEATsoBadlogonproc</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The value contained in the logon procedure field is not valid.</td>
</tr>
<tr>
<td>1F</td>
<td><code>Equate symbol: kCEATsoBadscreenrows</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The number of screen rows specified is out of range. The minimum number of screen rows is 24, and the maximum is 204.</td>
</tr>
<tr>
<td>20</td>
<td><code>Equate symbol: kCEATsoBadscreencols</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The number of screen columns specified is out of range. The minimum number of screen columns is 80, and the maximum is 160.</td>
</tr>
<tr>
<td>21</td>
<td><code>Equate symbol: kCEATsoBadaccount</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The value contained in the account field is not valid.</td>
</tr>
<tr>
<td>22</td>
<td><code>Equate symbol: kCEATsoBadgroup</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The value contained in the TSO/E group name field is not valid.</td>
</tr>
<tr>
<td>23</td>
<td><code>Equate symbol: kCEATsoBadregion</code></td>
</tr>
<tr>
<td></td>
<td><strong>Meaning:</strong> The value contained in the TSO/E region size field is not valid.</td>
</tr>
</tbody>
</table>
### CEAYTSOR header file

For the C programmer, include file ceaytsor.h defines the structures, functions, and macros used for the CEATsoRequest API. The header file is stored in partitioned data set SYS1.SIEAHDRV, and contains the following information.

```c
#ifndef __ceaytsor__
#define __ceaytsor__

/****** START OF SPECIFICATIONS **************************************
* 
* DESCRIPTIVE NAME: CEA TsoRequest structures
* 
* ACRONYM: CEAYTSOR
* 
* STRUCT NAME: None
* 
* LABEL PREFIX: None
* 
* COMPONENT ID: Common Event Adpater (CEA)
* 
****** END OF SPECIFICATIONS ***************************************/

/****PROPRIETARY_STATEMENT****************************************************************/
/* */
/* */
/* LICENSED MATERIALS - PROPERTY OF IBM */
/* COPYRIGHT IBM CORP. 2011, 2012 */
/* */
/* STATUS= HBB7770 */
/* */
/****END_OF_PROPRIETARY_STATEMENT***************************************************************************/
/* */
/*01* EXTERNAL CLASSIFICATION: PI */
/*01* END OF EXTERNAL CLASSIFICATION: */
/* */
/***************************************************************************/

/* $Id: ieac1as2.ide, ieapr, osnp_v1r13.5 1.9 12/01/24 17:16:48 $ */

/***************************************************************************/

FUNCTION:
* 
* This header file defines the structures, functions
* and macros used for CEATsoRequest() API.
* 
* This support requires the setting of _XOPEN_SOURCE_EXTENDED

---

**Table 25. Diagnostic code (continued)**

<table>
<thead>
<tr>
<th>Hexadecimal Diagnostic Code</th>
<th>Equate Symbol and Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>26</td>
<td>kCEATsoBadCharsetCodepage</td>
</tr>
<tr>
<td><strong>Meaning:</strong> The value contained in the codepage field is not valid because no match was found in the Coded Character Set Identifiers (CCSID) table.</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>kCEATsoBadregionsize</td>
</tr>
<tr>
<td><strong>Meaning:</strong> The value contained in the region size field is not valid because it exceeds the maximum allowable region size of 2,096,128.</td>
<td></td>
</tr>
</tbody>
</table>
### Constants

#### Constants

- `CEATSOREQUEST_CURRENTVERSION` 1
- `CEATSOQUERY_CURRENTVERSION` 1
- `CEATSOERROR_CURRENTVERSION` 1
- `CEATSO_DIAG_CURRENTVERSION` 1
- `CEATSO_REQUEST_EYECATCHER` "CEAYTSOR"
- `CEATSO_QUERY_EYECATCHER` "CEAYTSOQ"
- `CEATSO_ERROR_EYECATCHER` "CEAIERRO"

#### Constants

- `CEATSO_REQUESTTYPE`:
  - 1: `CeaTsoStart`
  - 2: `CeaTsoEnd`
  - 3: `CeaTsoQuery`
  - 4: `CeaTsoAttn`
  - 5: `CeaTsoPing`
  - 6: `CeaTsoQueryApp`

#### Constants

- `CEATSO_FLAGS`:
  - `CEATSO_ABLOGOFF` 0x8000 // Use Cancel to end the TSO session
  - `CEATSO_NOREUSE` 0x4000 // Do not reconnect an existing session

### CEATsoRequestStruct_t

**Version**: `CEATSOQUERY_CURRENTVERSION` 1

**Request**: Uses `CeaTso*` constants

```c
struct CEATsoRequestStruct_s {
  char ceatso_eyecatcher[8]; /* eye catcher: CEAYTSOR */
  uint32_t ceatso_version; /* version number */
  uint32_t ceatso_requesttype; /* which type request */
  char ceatso_userid[8]; /* tso id */
  uint32_t ceatso_asid; /* tso asid */
  char ceatso_logonproc[8]; /* logon proc name */
  char ceatso_command[80]; /* unused */
  uint16_t ceatso_numqueryreq; /* caller num max query */
  uint16_t ceatso_numqueryrslt; /* actual num query */
  uint32_t ceatso_duration; /* unused */
  uint32_t ceatso_msgqueueid; /* msg queue id */
  uint16_t ceatso_charset; /* callers character set */
  uint16_t ceatso_codepage; /* callers code page */
  uint16_t ceatso_screenrows; /* screen rows */
  uint16_t ceatso_screencols; /* screen cols */
  char ceatso_account[40]; /* tso account number */
  char ceatso_group[8]; /* tso group name */
  char ceatso_region[7]; /* tso region size */
  char ceatso_instance[1]; /* tso instance number */
  char ceatso_apptag[8]; /* identity of caller */
};
```
typedef struct CEATsoRequestStruct_s CEATsoRequestStruct_t;

typedef struct CEATsoQueryStruct_s CEATsoQueryStruct_t;

struct CEATsoQueryStruct_s { /* query results */
  char  ceatsoq_eyecatcher[8]; /* eye catcher: CEAYTSOQ */
  uint32_t  ceatsoq_version; /* version number */
  uint32_t  ceatsoq_requesttype; /* which type request */
  char  ceatsoq_userid[8]; /* tso id */
  uint32_t  ceatsoq_asid; /* tso asid */
  char  ceatsoq_logonproc[8]; /* logon proc name */
  char  ceatsoq_command[80]; /* tso command */
  uint16_t  ceatsoq_numqueryreq; /* caller num max query */
  uint16_t  ceatsoq_numqueryrslt; /* actual num query */
  uint32_t  ceatsoq_duration; /* duration */
  uint32_t  ceatsoq_msgqueueid; /* msg queue id */
  uint16_t  ceatsoq_charset; /* callers character set */
  uint16_t  ceatsoq_codepage; /* callers code page */
  uint16_t  ceatsoq_scrnrows; /* screen rows */
  uint16_t  ceatsoq_scrncols; /* screen cols */
  char  ceatsoq_account[40]; /* tso account number */
  char  ceatsoq_group[8]; /* tso group name */
  char  ceatsoq_region[7]; /* tso region size */
  char  ceatsoq_instance[1]; /* tso instance number */
  char  ceatsoq_apptag[8]; /* identity of caller */
  uint32_t  ceatsoq_stoken[8]; /* tso asid stoken */
  uint32_t  ceatsoq_ascbaddr; /* tso ascb address */
  uint16_t  ceatsoq_flags; /* tso request flags */
  uint16_t  ceatsoq_index; /* tso session index */
  char  rsvd1[8]; /* reserved space */
};

typedef struct CEATsoQueryStruct_s CEATsoQueryStruct_t;

struct CEATsoDiag_s {
  uint8_t  version; /* version of CEADiag_t */
  uint8_t  flags; /* diagnostic flags */
  uint32_t  offset; /* offset point to additional information */
  uint32_t  rsvd; /* reserved for future use */
  uint32_t  diag1; /* used to hold return codes */
  uint32_t  diag2; /* from system REXX scripts */
  uint32_t  diag3; /* or other things outside of */
  uint32_t  diag4; /* CEA control */
  uint32_t  rsvd2; /* reserved for future use */
  char  messageArea[128]; /* contains any output messages relating to error codes */
};

typedef struct CEATsoDiag_s CEATsoDiag_t;
typedef struct CEATsoDiag_s CEATsoDiag_t;

 /******************************************************************************
 CEAError_t

 eyeCatcher - "CEAIERRO"
 version - version of CEAError_t
 returnCode - function return code - duplicate of function return value
 reasonCode - further explanation of a return code.
 diag - further explanation of a reason code.
 ******************************************************************************/

 struct CEATsoError_s {
  char eyeCatcher[8];
  uint32_t version;
  int32_t returnCode;
  uint32_t reasonCode;
  CEATsoDiag_t diag;
};
typedef struct CEATsoError_s CEATsoError_t;

 /******************************************************************************
 Function prototype CEATsoRequest
 ******************************************************************************/
 #ifdef __cplusplus
 extern "C" {
 #endif
 int32_t CEATsoRequest(CEATsoRequestStruct_t*,
 CEATsoQueryStruct_t*,
 CEATsoError_t*);

 #ifdef __cplusplus
 }
 #endif

 /******************************************************************************
 Diag Values

 These are the possible values that can be returned in the Diag1
 field in the CEAError_t Diag structure returned from the
 CEATsoRequest API

 Note: Some duplication of codes exist but codes are unique per API
 Request Type
 ******************************************************************************/
 #define kCEATsoBadRacRouteExtr 0X0004 //0004
 #define kCEATsoBadRacRouteCreate 0X0005 //0005
 #define kCEATsoBadAddSession 0X000A //0010
 #define kCEATsoBadQuerySession 0X000B //0011
 #define kCEATsoBadASCBStoken 0X000C //0012
 #define kCEATsoBadSessIndex 0X000D //0013
 #define kCEATsoBadRemoveSessEntry 0X000E //0014
 #define kCEATsoBadLogonMCRE 0X000F //0015
 #define kCEATsoSessionNotFound 0X0010 //0016
 #define kCEATsoBadSessENQreq 0X0011 //0017
 #define kCEATsoBadSessDEQreq 0X0012 //0018
 #define kCEATsoBadSessUpdateLR 0X0013 //0019

 Chapter 12. Using CEA TSO/E address space services  173
CEAXRDEF header file

For the C programmer, include file ceaxrdef.h defines the return codes and reason codes that are associated with the CEA TSO/E address space manager services. The header file is stored in partitioned data set SYS1.SIEAHDRV, and contains the following information.

```c
#ifndef __ceaxrdef__
#define __ceaxrdef__

/****** START OF SPECIFICATIONS *******************************
* DESCRIPTIVE NAME: CEA reason code definitions
* ACRONYM: CEAXRDEF
* STRUCT NAME: None
* LABEL PREFIX: None
* COMPONENT ID: Common Event Adpater (CEA)
* **************************************************************/

/* $Id: ieac1as2.ide, ieapr, osnp_v1r13.5 1.9 12/01/24 17:16:48 $ */

/***** PROPRITARY_STATEMENT****************************
*/

/****** END_OF_PROPRITARY_STATEMENT*****************/
*/

/*01* EXTERNAL CLASSIFICATION: PI */
/*01* END OF EXTERNAL CLASSIFICATION: */
/* */

#endif /* _ceaxrdef__ */
```
**********************************************************************
* ceaxrdef.h header file
* -----------
* This header file defines the reason codes associated with
* the Common Event Adapter (a.k.a. CEAS) client code.
* *
* *
* CHANGE-ACTIVITY:
* *
***END OF SPECIFICATIONS*********************************************/

// Completion Codes
#define CEASUCCESS 0
#define CEAFailure -1
#define CEAWARNING 4

// Reason Codes
#define CEUNAVAIL 0x100 //256
#define CEADUPLIATENAME 0x101 //257
#define CEANOCONNAUTH 0x102 //258
#define CEANDACCESS 0x103 //259
#define CEABADPID 0x104 //260
#define CEABADHANDLE 0x105 //261
#define CEADUPESUB 0x106 //262
#define CEADUPHANDLER 0x107 //263
#define CEANOSUBSCRIBE 0x108 //264
#define CEANOMATCH 0x109 //265
#define CEALABEL 0x10A //266
#define CEADUPDATA 0x10B //267
#define CEADATATRUNC 0x10C //268 //returned on warning
#define CEEVENTSMISSED 0x10D //269 //returned on warning
#define CEANOSUBAUTH 0x10E //270
#define CEADPROTOCOL 0x10F //271
#define CEACOMMFailure 0x110 //272
#define CEASYSTMFailure 0x111 //273
#define CEAINVALIDCLIENT 0x112 //274
#define CEASOFTWAREFAILURE 0x113 //275
#define CEABADHANDLEPTR 0x114 //276
#define CEASECURITYFAILURE 0x115 //277
#define CEAINVALIDCOMMAND 0x116 //278
#define CEABADCLIENTCONNECTED 0x117 //279
#define CEANDYETIMPLEMENTED 0x118 //280
#define CEABADREGVERSION 0x119 //281
#define CEANFFFAILURE 0x11A //282
#define CEADYNEXFAILURE 0x11B //283
#define CEAEVENTSMISSTRUNC 0x11C //284
#define CEASSSHUTDOWN 0x11D //285
#define CEANENFEXITRTN 0x11E //286
#define CEASYSPOFORCEUNSUBSCRIBE 0x11F //287
#define CEASYSPOFORDERCONNECT 0x120 //288
#define CEAFORCEMINMODE 0x121 //289
#define CEASSNOTACTIVE 0x122 //290
#define CEAMAXWTOSUBSCRIBED 0x123 //291
#define CEAMAXWTOSUBSCRIBED 0x124 //292
#define CEAMAXSUBSCRIBE 0x125 //293
#define CEAMAXPGMSUBSCRIBED 0x126 //294
#define CEANONAME 0x200 //512
#define CEAINVALIDFORM 0x201 //513
#define CEABADCONVERSION 0x202 //514
#define CEANOTRECOGNIZED 0x203 //515
#define CEANOTYPE 0x204 //516
#define CEABADENGNAME 0x205 //517
#define CEABADRETVERSION 0x206 //518
#define CEABADEVENTVERSION 0x207 //519
#define CEAINVALIDFORM 0x208 //520
#define CEAINVALIDMODE 0x0209 //521
#define CEAHANDLERNOTFOUND 0x020A //522
#define CEAHANDLERNOTREENT 0x020B //523
#define CEAINVALIDHANDEL 0x020C //524
#define CEACHNENTERDEFINED 0x020D //525
#define CEACHEMENTDEFINED 0x020E //526
#define CEABADCHANNELNAME 0x020F //527
#define CEAINVALIDMSGID 0x0210 //528
#define CEABADADDRESS 0X0211 //529
#define CEAINVALIDHANDLER 0x0212 //530
#define CEAINVALIDHANDLER 0x0213 //531
#define CEAEXTENTREACHED 0x0214 //532
#define CEABADQMASK 0x0215 //533
#define CEABADBITCOMPARE 0x0216 //534
#define CEAMAXTHRUPUTREACHED 0x0217 //535
#define CEABADQMASK 0x0218 //536
#define CEAPROPERTYSTRUCTBADPTR 0x0302 //770
#define CEAPROPERTYSTRUCTBADPTR 0x0303 //771
#define CEAPROPERTYSTRUCTBADVERSION 0x0304 //772
#define CEAPROPERTYBADRESOURCE 0x0305 //773
#define CEAPROPERTYNOMATCH 0x0306 //774
#define CEAPROPERTYMATCH 0x0307 //775
#define CEAPROPERTYMATCH 0x0308 //776
#define CEAPROPERTYMATCH 0x0309 //777
#define CEAPROPERTYMATCH 0x030A //778
#define CEAPROPERTYMATCH 0x030B //779
#define CEAPROPERTYMATCH 0x030C //780
#define CEAPROPERTYMATCH 0x030D //781
#define CEAPROPERTYMATCH 0x030E //782
#define CEAPROPERTYMATCH 0x030F //783
#define CEAPROPERTYMATCH 0x0310 //784
#define CEAPROPERTYMATCH 0x0311 //785
#define CEAPROPERTYMATCH 0x0312 //786
#define CEAPROPERTYMATCH 0x0313 //787
#define CEAPROPERTYMATCH 0x0314 //788
#define CEAPROPERTYMATCH 0x0315 //789
#define CEAPROPERTYMATCH 0x0316 //790
#define CEAPROPERTYMATCH 0x0317 //791
#define CEAPROPERTYMATCH 0x0318 //792
#define CEAPROPERTYMATCH 0x0319 //793
#define CEAPROPERTYMATCH 0x031A //794
#define CEAPROPERTYMATCH 0x031B //795
#define CEAPROPERTYMATCH 0x031C //796
#define CEAPROPERTYMATCH 0x031D //797
#define CEAPROPERTYMATCH 0x031E //798
#define CEAPROPERTYMATCH 0x031F //799
#define CEAPROPERTYMATCH 0x0320 //800
#define CEAPROPERTYMATCH 0x0321 //801
#define CEAPROPERTYMATCH 0x0322 //802
#define CEAPROPERTYMATCH 0x0323 //803
#define CEAPROPERTYMATCH 0x0324 //804
#define CEAPROPERTYMATCH 0x0325 //805
#define CEAPROPERTYMATCH 0x0326 //806
#define CEAPROPERTYMATCH 0x0327 //807
#define CEAPROPERTYMATCH 0x0328 //808
#define CEAPROPERTYMATCH 0x0329 //809
#define CEAPROPERTYMATCH 0x032A //810
#define CEAPROPERTYMATCH 0x032B //811
#define CEAPROPERTYMATCH 0x032C //812
#define CEAPROPERTYMATCH 0x032D //813
#define CEAPROPERTYMATCH 0x032E //814
#define CEAPROPERTYMATCH 0x032F //815
#define CEAPROPERTYMATCH 0x0330 //816
Programming example

The following example shows how to invoke the CEATsoRequest API from a C program. For a sample compile job that you can use to compile this sample program, see "Sample compile job" on page 196.

```c
#define _XOPEN_SOURCE
#define _POSIX1_SOURCE 2
#define SESS_SESSIONNOLONGERINTABLE 16
#define SESS_MATCHMISSING 11
#define SESS_INDEXOUTOFRANGE 13
#define kMaximumSessions 50

#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <errno.h>
#include <env.h>
#include <iconv.h>
#include <sys/msg.h>
#include <sys/types.h>
#include <time.h>
#include "ceaytsor.h"
#include "ceaxrdef.h"

void init_expected_values( void );
void init_ceatso_struct( void );
void print_request_struct( void );
void print_query_struct( void );
void print_error_struct( void );
int send_message( void );
int check_message( int, int );
int verify_messages( int, int );
int verify_attn_messages( int, int );
void save_required_members( void );
void init_required_members( void );
void set_required_members( void );

#define NUMVARS 56
struct message_queue_s {
    long int message_type;
};
```
typedef struct message_queue_s message_queue_t;

int error_counter; /* Total errors */

CEATsoRequestStruct_t ceatso_request;
CEATsoQueryStruct_t ceatso_query;
CEATsoError_t ceatso_error;

char userid[8];
uint32_t asid;
char apptag[8];
uint32_t ascbaddr;
int index_value; /* Save index value */
char stoken[8]; /* Stoken buffer */
char *stoken_ptr; /* Stoken pointer */
char *ptr;

message_queue_t message_queue;
int message_id;
size_t message_size;
char message_text[200];
int wait_seconds; /* Msg receive time */
int sleep_time;

char *tso_cmd_ptr;
char tso_cmd[80] =
         "{"TSO RESPONSE":{"VERSION":"0100","DATA":"ALLOC DA"}}";

int32_t expected_rc;
uint32_t expected_rsn;
uint32_t expected_diag1;
uint32_t expected_diag2;
uint32_t expected_diag3;
uint32_t expected_diag4;
uint32_t reason_mask;

int CeaTsoSamp1( void );

int main() {
int rc; /* Return code */

CeaTsoSamp1(); /* Invoke the sample code */

return 0;
}

/***************************************************************************/
/**
/** Routine to initialize the expected return code, reason code and diag
codes. */
/*****************************************************************************/
void init_expected_values( void ) {

expected_rc = CEASUCCESS;
expected_rsn = 0;
expected_diag1 = 0;
expected_diag2 = 0;
expected_diag3 = 0;
expected_diag4 = 0;

return;
}
void init_ceatso_struct( void ) {

    /* Initialize CEA TSO Request structure for CEATsoRequest() */
    memset(&ceatso_request, '\0', sizeof(CEATsoRequestStruct_t));
    strcpy(ceatso_request.ceatso_eyecatcher, CEATSOREQUEST_EYECATCHER);
    ceatso_request.ceatso_version = CEATSOREQUEST_CURRENTVERSION;
    ceatso_request.ceatso_requesttype = 0;

    /* ceatso_request.ceatso_asid = 0; */
    strcpy(ceatso_request.ceatso_userid, "IBMUSER ");
    strcpy(ceatso_request.ceatso_logonproc, "OMVS0803");
    memset(&ceatso_request.ceatso_command, ' ', 80);

    /*
    ceatso_request.ceatso_numqueryreq = 12;
    ceatso_request.ceatso_numqueryrslt = 12;
    ceatso_request.ceatso_duration = 0;
    ceatso_request.ceatso_msgqueueid = 0;
    */
    ceatso_request.ceatso_charset = 697;
    ceatso_request.ceatso_codepage = 1047;
    ceatso_request.ceatso_screenrows = 24;
    ceatso_request.ceatso_screencols = 80;
    memset(ceatso_request.ceatso_account, '0', 40);
    memset(ceatso_request.ceatso_group, ' ', 8);
    strcpy(ceatso_request.ceatso_region, "2000000");

    /*
    memset(ceatso_request.ceatso_instance, ' ', 1);
    */
    strcpy(ceatso_request.ceatso_apptag, "IZUIS ");
    ceatso_request.ceatso_flags = CEATSO_ABLOGOFF;

    /*
    memset(ceatso_request.ceatso_stoken, 0xFF, 8);
    */
    ceatso_request.ceatso_ascbaddr = 0;
}
ceatso_request.ceatso_index = 0;
*/

/* Initialize the CEA TSO Query structure for CEATsoRequest() */
memset(&ceatso_query, '\0', sizeof(CEATsoQueryStruct_t));
strcpy(ceatso_query.ceatsoq_eyecatcher, CEATSOQUERY_EYECATCHER);
memset(&ceatso_request.ceatso_command, ' ', 40);

/* Initialize the CEA TSO Error structure for CEATsoRequest() */
memset(&ceatso_error, 0x00, sizeof(CEATsoError_t));
strcpy(ceatso_error.eyeCatcher, CEAINCT_EYE_CEAIERRO);
ceatso_error.version = CEAIERRO_CURRENTVERSION;
return;
}

/* ***************************************************/
/** **
/** Routine to print out the CEATsoRequest structure **
/** used by CEATsoRequest( ) API. **
/** ***************************************************/
void print_request_struct( void ) {
    int i;

    printf("CEATsoRequest structure\n\n");
    printf("sizeof(CEATsoRequestStruct_t) = %d\n", sizeof(CEATsoRequestStruct_t));
    printf("CeaTsoRequest Eyecatcher = ");
    ptr = ceatso_request.ceatso_eyecatcher;
    for ( i = 1; i <= 8; i++ )
        printf("%C", *ptr++);
    printf("\n");
    printf("CeaTsoRequest Version = %d\n", ceatso_request.ceatso_version);
    printf("\n");
    printf("CeaTsoRequest Requesttype = %d\n", ceatso_request.ceatso_requesttype);
    printf("\n");
    printf("CeaTsoRequest Userid = ");
    ptr = ceatso_request.ceatso_userid;
    for ( i = 1; i <= 8; i++ )
        printf("%C", *ptr++);
    printf("\n");
    printf("CeaTsoRequest Asid = %X\n", ceatso_request.ceatso_asid);
    printf("\n");
    printf("CeaTsoRequest LogonProc = ");
    ptr = ceatso_request.ceatso_logonproc;
    for ( i = 1; i <= 8; i++ )
        printf("%C", *ptr++);
}
printf("\n");
ptr = ceatso_request.ceatso_command;
for (i = 1; i <= 40; i++)
    printf("%C", *ptr++);
printf("\n");
printf("CeaTsoRequest Numqueryreq = %d
",
ceatso_request.ceatso_numqueryreq);
printf("CeaTsoRequest Numqueryrslt = %d
",
ceatso_request.ceatso_numqueryrslt);
printf("CeaTsoRequest Duration = %d
",
ceatso_request.ceatso_duration);
printf("CeaTsoRequest Msgqueueid = %d
",
ceatso_request.ceatso_msgqueueid);
printf("CeaTsoRequest Charset = %d
",
ceatso_request.ceatso_charset);
printf("CeaTsoRequest Codepage = %d
",
ceatso_request.ceatso_codepage);
printf("CeaTsoRequest Screenrows = %d
",
ceatso_request.ceatso_screenrows);
printf("CeaTsoRequest Screencols = %d
",
ceatso_request.ceatso_screencols);
printf("CeaTsoRequest Account = *");
ptr = ceatso_request.ceatso_account + 32;
for (i = 1; i < 8; i++)
    printf("%C", *ptr++);
printf("\n");
printf("CeaTsoRequest Group = *");
ptr = ceatso_request.ceatso_group;
for (i = 1; i <= 8; i++)
    printf("%C", *ptr++);
printf("\n");
printf("CeaTsoRequest Region = *");
ptr = ceatso_request.ceatso_region;
for (i = 1; i <= 7; i++)
    printf("%C", *ptr++);
printf("\n");
ptr = ceatso_request.ceatso_instance;
printf("CeaTsoRequest Instance = %C\n", *ptr);
printf("CeaTsoRequest Apptag = *");
ptr = ceatso_request.ceatso_apptag;
for (i = 1; i <= 8; i++)
    printf("%C", *ptr++);
printf("\n");
printf("CeaTsoRequest Stoken = *");
stoken_ptr = ceatso_request.ceatso_stoken;
for (i = 1; i <= 8; i++)
    printf("%X *, *stoken_ptr++;
printf("\n");

printf("CeaTsoRequest ASCBaddr = %8X", 
    ceatso_request.ceatso_ascbaddr);

printf("CeaTsoRequest Flags = %d", 
    ceatso_request.ceatso_flags);

printf("CeaTsoRequest Index = %d", 
    ceatso_request.ceatso_index);

printf("\n");
return;
}

/**
/** Routine to print out the CEATsoQuery structure 
/** used by CEATsoRequest( ) API. 
/**
***************************************************************************/

void print_query_struct( void ) {
    int i;

    printf("\n\n\nCEATsoQuery structure\n\n");
    printf("sizeof(CEATsoQueryStruct_t) = %d\n", 
        sizeof(CEATsoQueryStruct_t));
    printf("CeaTsoQuery Eyecatcher = ");
    ptr = ceatso_query.ceatsoq_eyecatcher;
    for (i = 1; i <= 8; i++)
        printf("%C", *ptr++);
    printf("\n");
    printf("CeaTsoQuery Version = %d", 
        ceatso_query.ceatsoq_version);
    printf("CeaTsoQuery Requesttype = %d", 
        ceatso_query.ceatsoq_requesttype);
    printf("CeaTsoQuery Userid = ");
    ptr = ceatso_query.ceatsoq_userid;
    for (i = 1; i <= 8; i++)
        printf("%C", *ptr++);
    printf("\n");
    printf("CeaTsoQuery Asid = %X", 
        ceatso_query.ceatsoq_asid);
    printf("CeaTsoQuery LogonProc = ");
    ptr = ceatso_query.ceatsoq_logonproc;
    for (i = 1; i <= 8; i++)
        printf("%C", *ptr++);
    printf("\n");
    printf("CeaTsoQuery Command = ");
    ptr = ceatso_query.ceatsoq_command;
for (i = 1; i <= 40; i++)
    printf("%C", *ptr++);
printf("\n");

printf("CeaTsoQuery Numqueryreq = %d\n",
    ceatso_query.ceatsoq_numqueryreq);
printf("CeaTsoQuery Numqueryrslt = %d\n",
    ceatso_query.ceatsoq_numqueryrslt);
printf("CeaTsoQuery Duration = %d\n",
    ceatso_query.ceatsoq_duration);
printf("CeaTsoQuery Msgqueueid = %d\n",
    ceatso_query.ceatsoq_msgqueueid);
printf("CeaTsoQuery Charset = %d\n",
    ceatso_query.ceatsoq_charset);
printf("CeaTsoQuery Codepage = %d\n",
    ceatso_query.ceatsoq_codepage);
printf("CeaTsoQuery Screenrows = %d\n",
    ceatso_query.ceatsoq_screenrows);
printf("CeaTsoQuery Screencols = %d\n",
    ceatso_query.ceatsoq_screencols);

printf("CeaTsoQuery Account = *\n");
ptr = ceatso_query.ceatsoq_account + 32;
for (i = 1; i < 8; i++)
    printf("%C", *ptr++);
printf("\n");

printf("CeaTsoQuery Group = *\n");
ptr = ceatso_query.ceatsoq_group;
for (i = 1; i <= 8; i++)
    printf("%C", *ptr++);
printf("\n");

printf("CeaTsoQuery Region = *\n");
ptr = ceatso_query.ceatsoq_region;
for (i = 1; i <= 7; i++)
    printf("%C", *ptr++);
printf("\n");

ptr = ceatso_query.ceatsoq_instance;
printf("CeaTsoQuery Instance = %C\n", *ptr);

printf("CeaTsoQuery Apptag = *\n");
ptr = ceatso_query.ceatsoq_apptag;
for (i = 1; i <= 8; i++)
    printf("%C", *ptr++);
printf("\n");

printf("CeaTsoQuery Stoken = *\n");
stoken_ptr = ceatso_query.ceatsoq_stoken;
for (i = 1; i < 9; i++)
    printf("%X", *stoken_ptr++);
printf("\n");

printf("CeaTsoQuery ASCBaddr = %8X\n",
    ceatso_query.ceatsoq_ascbaddr);
CEATsoQuery

CEATsoQuery Flags = %d

CEATsoQuery Index = %d


return;

}
int verify_messages(int message_id, int wait_seconds) {
    int rc;
    char *string1;
    char *string2;
    char *string3;
    char *string4;
    char *string5;
    char *string6;

    if (ceatso_request.ceatso_requesttype == CeaTsoStart) {
        rc = check_message(message_id, wait_seconds);
        string1 = "LOGON IN PROGRESS";
        if (rc != 0 || strstr(message_text, string1) == NULL) {
            printf(" Failed to receive %s message.


", string1);
            return 99;
        }
        rc = check_message(message_id, wait_seconds);
        string2 = "NO BROADCAST MESSAGES";
        if (rc != 0 || strstr(message_text, string2) == NULL) {
            printf(" Failed to receive %s.


", string2);
            return 99;
        }
        rc = check_message(message_id, wait_seconds);
        string3 = "READY ";
        if (rc != 0 || strstr(message_text, string3) == NULL) {
            printf(" Failed to receive %s prompt.


", string3);
            return 99;
        }
        rc = check_message(message_id, wait_seconds);
        string4 = "HIDDEN";
        string5 = "FALSE";
        if (rc != 0应有的"HIDDEN"且"FALSE"点了，应该在最后为字符串赋值。)
            printf(" Failed to receive %s : %s message.


", string4, string5);
            return 99;
    }
    if (ceatso_request.ceatso_requesttype == CeaTsoAttn) {
        rc = check_message(message_id, wait_seconds);
        string6 = "ENTER DATA SET NAME OR * -";
        if (rc != 0应有的"ENTER DATA SET NAME OR * -"点了，应该在最后为字符串赋值。)
            printf(" Failed to receive %s message.


", string6);
            return 99;
        rc = check_message(message_id, wait_seconds);
        string4 = "HIDDEN";
        string5 = "FALSE";
        if (rc != 0应有的"HIDDEN"和"FALSE"点了，应该在最后为字符串赋值。)
            printf(" Failed to receive %s : %s message.


", string4, string5);
            return 99;
    }
    return 0;
}
int verify_attn_messages(int message_id, int wait_seconds) {
    int rc;
    char *string1;
    char *string2;
    char *string3;

    rc = check_message(message_id, wait_seconds);
    string1 = "READY ";
    if (rc != 0 || strstr(message_text, string1) == NULL) {
        printf(" Failed to receive %s prompt after Attn.\n\n", string1);
        return 99;
    }

    rc = check_message(message_id, wait_seconds);
    string2 = "HIDDEN";
    string3 = "FALSE";
    if (rc != 0 || strstr(message_text, string2) == NULL ||
        strstr(message_text, string3) == NULL) {
        printf(" Failed to receive %s : %s message.\n", string2, string3);
        return 99;
    }

    return 0;
}

int check_message(int message_id, int wait_seconds) {
    int rc;
    size_t iconv_rc;
    ssize_t msg_rc;
    iconv_t cd;
    char *input_ptr;
    char *output_ptr;
    size_t input_msgsize;
    size_t output_msgsize;
    time_t wait_time;
    time_t start_time;
    time_t receive_time;

    message_size = sizeof(message_queue_t) - sizeof(long int);
    memset(&message_text, '\0', message_size);
    time(&start_time);
    /* -6 should include 2 and 3 */
message_queue.message_type = (long int)-6;

sleep_time = 2;
msg_rc = 0;

/* Must include IPC_NOWAIT flag, otherwise could hang */
/* the program execution when no msg sending back. */
do {
    msg_rc = msgrcv(message_id, &message_queue, message_size,
                     message_queue.message_type, MSG_NOERROR | IPC_NOWAIT);
    sleep( sleep_time);
    wait_time = time(&receive_time) - start_time;
} while ( wait_time <= wait_seconds && msg_rc <= 0 );

if ( msg_rc == -1 ) {
    printf("Receive message failed with\n");
    printf(" msg_rc = %d", msg_rc);
    printf(" Wait time = %d seconds\n", wait_time);
    printf(" Errno = %X", errno);
    printf(" Errno_Jr = %X\n", __errno2());
    return 99;
}
else
    printf(" Received Message in %d seconds.\n", wait_time);

if ( (rc = setenv("_ICONV_UCS2", "D", 1)) != 0) {
    printf(" setenv( ) failed with ");
    printf(" rc = %d", rc);
    printf(" Errno = %X", errno);
    printf(" Errno_Jr = %X\n", __errno2());
    return rc;
}

if ( (cd = iconv_open("IBM-1047", "UTF-8")) == (iconv_t)-1 ) {
    printf(" iconv_open( ) failed with ");
    printf(" Errno = %X", errno);
    printf(" Errno_Jr = %X\n", __errno2());
    return 99;
}

input_ptr = message_queue.message_text;
output_ptr = message_text;
input_msgsize = msg_rc;
output_msgsize = msg_rc;

if ((iconv_rc = iconv(cd, &input_ptr, &input_msgsize, &output_ptr,
                     &output_msgsize)) == (size_t)-1) {
    printf(" iconv( ) failed with ");
    printf(" rc = %d", iconv_rc);
    printf(" Errno = %X", errno);
    printf(" Errno_Jr = %X\n", __errno2());
    return 99;
}

if ( (rc = iconv_close( cd )) == -1 ) {
    printf(" iconv_close( ) failed with ");
    printf(" rc = %d", rc);
    printf(" Errno = %X", errno);
    printf(" Errno_Jr = %X\n", __errno2());
    return rc;
}

printf(" Reveived Message Type: %2d\n",
       message_queue.message_type);
printf(" Reveived Message Length: \%d\n", strlen(message_text));
printf(" Received Message Text: \n");
printf(" \%s\n", message_text);
printf("\n");
return 0;
}

/**************************************************************************
**
** Send TSO command and check the proper message received
**
/**************************************************************************

int send_message( void ) {
        int rc;
        size_t iconv_rc;
        iconv_t cd;
        size_t input_msgsize;
        size_t output_msgsize;
        char *input_ptr;
        char *output_ptr;

        message_size = sizeof(message_queue_t) - sizeof(long int);
        memset(&message_queue.message_text, '\0', message_size);
        memset(&message_text, '\0', message_size);
        strcpy(message_text, tso_cmd);

        if ( (cd = iconv_open("UTF-8", "IBM-1047")) == (iconv_t)-1 ) {
                printf(" iconv_open( ) failed with ");
                printf(" Errno = %X ", errno);
                printf(" Errno_Jr = %X\n", __errno2());
                return 99;
        }

        input_ptr = message_text;
        output_ptr = message_queue.message_text;

        input_msgsize = strlen(message_text);
        output_msgsize = input_msgsize;

        if ((iconv_rc = iconv(cd, &input_ptr, &input_msgsize, &output_ptr,
                     &output_msgsize)) == (size_t)-1 ) {
                printf(" iconv( ) failed with ");
                printf(" Errno = %X ", errno);
                printf(" Errno_Jr = %X\n", __errno2());
                return 99;
        }

        if ( (rc = iconv_close( cd )) == -1 ) {
                printf(" iconv_close( ) failed with ");
                printf(" Errno = %X ", errno);
                printf(" Errno_Jr = %X\n", __errno2());
                return rc;
        }

        message_queue.message_type = (long int)7;
        message_size = strlen(message_queue.message_text);
        rc = msgsnd(message_id, &message_queue, message_size, 0);
        return rc;
}
void save_required_members( void ) { 
  int i;

  /* Not required input for End 
  if ( ceatso_request.ceatso_requesttype == CeaTsoEnd ) {
    strcpy(userid, ceatso_request.ceatso_userid);
    strcpy(apptag, ceatso_request.ceatso_apptag);
  }

  if ( ceatso_request.ceatso_requesttype == CeaTsoAttn )
    asid = ceatso_request.ceatso_asid;
  */

  asid = ceatso_request.ceatso_asid;

  stoken_ptr = stoken;
  ptr = ceatso_request.ceatso_stoken;
  for ( i = 1; i <= 9; i++)
    *stoken_ptr++ = *ptr++;

  ascbaddr = ceatso_request.ceatso_ascbaddr;
  index_value = ceatso_request.ceatso_index;

  /*
   * printf("\nSave the following value:\n");
   */

  /* Not required input for End 
  if ( ceatso_request.ceatso_requesttype == CeaTsoEnd ) {
    printf(" userid = ");
    ptr = userid;
    for ( i = 1; i <= 8; i++)
      printf("%C", *ptr);
    printf("\n");

    printf(" apptag = ");
    ptr = apptag;
    for ( i = 1; i <= 8; i++)
      printf("%C", *ptr);
    printf("\n");
  }
*/

  /*
   * printf(" asid = %X\n", asid);
   */

  ptr = ceatso_request.ceatso_stoken;
  printf(" stoken = ");
  for ( i = 1; i < 9; i++)
    printf("%X ", *ptr++);
  printf("\n");

  printf(" ascbaddr = %X\n", ascbaddr);
printf(" index_value = %X\n", index_value);
printf("\n");
*/
return;
}

/************************************************************
/** Initialize some required members of request structure **/
/** for ATTN and END process **/
/**
/************************************************************
void init_required_members( void ) {
  int i;

  memset(ceatso_request.ceatso_eyecatcher, 'F', 8);
  memset(ceatso_request.ceatso_userid, 'F', 8);
  memset(ceatso_request.ceatso_apptag, 'F', 8);
  memset(ceatso_request.ceatso_stoken, 0xFF, 8);
  memset(ceatso_request.ceatso_ascbaddr, 0);
  memset(ceatso_request.ceatso_index, 0);

  /* Initialize the CEA TSO Error structure for CEATsoRequest() */
  memset(&ceatso_error, 0x00, sizeof(CEATsoError_t));
  return;
}

/************************************************************
/** Set some required members of request structure back to the original value for ATTN and END process **/
/**
/************************************************************
void set_required_members( void ) {
  int i;

  strcpy(ceatso_request.ceatso_eyecatcher, CEATSOREQUEST_EYECATCHER);
  strcpy(ceatso_request.ceatso_userid, userid);
  strcpy(ceatso_request.ceatso_apptag, apptag);

  /*
  if ( ceatso_request.ceatso_requesttype == CeaTsoAttn )
    ceatso_request.ceatso_asid = 0;
  */
  memset(ceatso_request.ceatso_userid, 'F', 8);
  memset(ceatso_request.ceatso_apptag, 'F', 8);
  memset(ceatso_request.ceatso_userid, 'F', 8);
  memset(ceatso_request.ceatso_userid, 'F', 8);
  return;
}
if ( ceatso_request.ceatso_requesttype == CeaTsoAttn )
    ceatso_request.ceatso_asid = asid;

stoken_ptr = stoken;
ptr = ceatso_request.ceatso_stoken;
for ( i = 1; i < 9; i++ )
    *ptr++ = *stoken_ptr++;

ceatso_request.ceatso_ascbaddr = ascbaddr;

ceatso_request.ceatso_index = index_value;

/* Initialize the CEA TSO Error structure for CEATsoRequest() */
memset(&ceatso_error, 0x00, sizeof(CEATsoError_t));
strcpy(ceatso_error.eyeCatcher, CEAINCT_EYE_CEAIERRO);
ceatso_error.version = CEAIERRO_CURRENTVERSION;
return;
}

/*******************************************************************/
/** */
/** CeaTsoSamp1: Sample code to invoke CEATsoRequest() to start */
/** a CEA TSO Session send it an Attn interrupt the end the TSO */
/** session. */
/** */
/** Results are returned in the error structure */
/** */
/*******************************************************************/
int CeaTsoSamp1( ) {
    int i;
    int rc;

    printf("=================================================================
");
    printf("== Start CeaTsoRequest( ) Example ==
");
    printf("=================================================================
");
    printf("\n\nCEATsoRequest( ) Start session.\n\n");
    init_ceatso_struct();
    init_expected_values();
    ceatso_request.ceatso_requesttype = CeaTsoStart;

    CEATsoRequest(&ceatso_request, &ceatso_query, &ceatso_error);

    if ( ceatso_error.returnCode == expected_rc &&
        ceatso_error.reasonCode == expected_rsn &&
        ceatso_error.diag.diag1 == expected_diag1 &&
        ceatso_error.diag.diag2 == expected_diag2 &&
        ceatso_error.diag.diag3 == expected_diag3 &&
        ceatso_error.diag.diag4 == expected_diag4 )
        printf(" Verifying logon messages.\n\n");
    else {
        error_counter = error_counter + 1;
        printf("CEATsoRequest( ) Start session failed.\n\n");
        printf("CEATsoRequest( ) Start session failed.\n\n");
        printf("CEATsoRequest( ) Start session failed.\n\n");
        printf("\n\nVariation %d failed.\n\n", variation_id);
        printf("\n\n");
        return error_counter;
    }
wait_seconds = 8;
message_id = ceatso_request.ceatso_msgqueueid;
rc = verify_messages( message_id, wait_seconds );

if ( rc == 0 )
  printf("CEATsoRequest( ) Start session successful.\n\n");
else {
  error_counter = error_counter + 1;
  printf("CEATsoRequest( ) Start failed to receive the message ");
  printf("with rc = %d,\n\n", rc);
  printf("Variation %d failed.\n\n", variation_id);
  printf("\n\n");
  return error_counter;
}

save_required_members( );

ceatso_request.ceatso_requesttype = CeaTsoAttn;
rc = send_message( );

if ( rc == 0 ) {
  printf("\n\nSend TSO Command Successful.\n\n");  printf(" Send Message Type: %d\n",
         message_queue.message_type);
  printf(" Send Message Length: %d\n",
         strlen(message_queue.message_text));
  printf("\n\n");
} else {
  printf("\nSend message failed with ");
  printf(" rc = %d ", rc);
  printf(" Errno = %X ", errno);
  printf(" Errno Jr = %X\n", __errno2());
  error_counter = error_counter + 1;
  printf("Variation %d failed.\n\n", variation_id);
  printf("\n\n");
  return error_counter;
}

rc = verify_messages(message_id, wait_seconds);

if ( rc == 0 )
  printf("\n\nCEATsoRequest( ) Attn starts.\n\n");
else {
  error_counter = error_counter + 1;
  printf("Variation %d failed.\n\n", variation_id);
  printf("\n\n");
  return error_counter;
}

ceatso_request.ceatso_requesttype = CeaTsoAttn;
set_required_members( );
init_expected_values( );
strcpy(ceatso_request.ceatso_eyecatcher, CEATSOREQUEST_EYECATCHER);

CEATsoRequest(&ceatso_request, &ceatso_query, &ceatso_error);

if ( ceatso_error.returnCode == expected_rc &&
     ceatso_error.reasonCode == expected_rsn )

ceatso_error.diag.diag1 == expected_diag1 &&
ceatso_error.diag.diag2 == expected_diag2 &&
ceatso_error.diag.diag3 == expected_diag3 &&
ceatso_error.diag.diag4 == expected_diag4 )
printf(" Verifying messages after Attn.\n\n");
else {
    error_counter = error_counter + 1;
    printf("CEATsoRequest( ) Attn failed.\n\n");
    print_error_struct( );
    print_request_struct( );
    printf("\nVariation %d failed.\n\n\n", variation_id);
    return error_counter;
}
rc = verify_attn_messages(message_id, wait_seconds);
if ( rc == 0 )
    printf("\nCEATsoRequest( ) Attn successful.\n\n");
else {
    error_counter = error_counter + 1;
    printf("CEATsoRequest( ) Attn failed.\n\n");
    print_error_struct( );
    print_request_struct( );
    printf("\nVariation %d failed.\n\n\n", variation_id);
    return error_counter;
}
printf("\n\nCEATsoRequest( ) End starts.\n");
set_required_members( );
init_expected_values( );
ceatso_request.ceatso_requesttype = CeaTsoEnd;
CEATsoRequest(&ceatso_request, &ceatso_query, &ceatso_error);
if ( ceatso_error.returnCode == expected_rc &&
ceatso_error.reasonCode == expected_rsn &&
ceatso_error.diag.diag1 == expected_diag1 &&
ceatso_error.diag.diag2 == expected_diag2 &&
ceatso_error.diag.diag3 == expected_diag3 &&
ceatso_error.diag.diag4 == expected_diag4 )
    printf("\n\n\nCEATsoRequest( ) End session successful.\n\n");
else {
    error_counter = error_counter + 1;
    printf("\n\nCEATsoRequest( ) End session failed.\n\n");
    print_request_struct( );
    printf("\nVariation %d failed.\n\n\n", variation_id);
    return error_counter;
}
if ( ceatso_error.returnCode == CEASUCCESS )
    printf("\n\n\nVariation %d succeeded.\n\n\n\n");
else {
    error_counter = error_counter + 1;
    printf("\n\n\nVariation %d failed.\n\n\n\n");
}
printf("====================================================
");
printf("== Finished Start CeaTsoRequest( ) Example \n");
printf("====================================================
");
Sample compile job

For C programmers, you can use the following sample compile job to compile the sample program. For more details about the sample program, see “Programming example” on page 179.

```c
/* rexx */
/* c89/cc/c++ */
/* dbx needs -g or -wc,debug */
/* list(./) */
/* export _C89_STEPS='-1' enable all steps, inc prelinker */
/* export _C89_TMPS='-'3' prelinker will write composite .p file*/

`c89 -oceasamt -v -g -wc,LP64,SHOW,SO,AGGR,XREF,NOOFF,NOOPT,EXP,LIST(./
SSCOMM,DLL,STA,'LANGYL(EXTENDED)',WARN64
-W1,LP64,map,xref
    ceasamt.c ceasapit.x

',

'ls -galRe ceasamt.* ceasamt'
```

return error_counter;
}
Part 6. zEnterprise Data Compression (zEDC)
Chapter 13. Overview and planning of zEnterprise Data Compression (zEDC)

In today’s z/OS environment, many installations want to compress certain types of data to occupy less space while its not in use, and then restore the data when necessary. Using zEnterprise Data Compression (zEDC) to compress data might help to reduce CPU cost and elapsed time of data compression compared to traditional software-based compression services, such as CSRCESRV and CSRCMPSC. zEDC can also lower the cost of applications using host-based compression that are currently running on z/OS.

zEDC supports the DEFLATE compression data format, which compresses data using the following algorithms, defined by RFC 1951:

- **LZ77**
  - Replaces repeated string with length, back pointer pairs.
  - Points back up to 32K.

- **Huffman coding**
  - Variable length encoding of characters.
  - Minimize bit length of stream of characters by assigning shorter codes to frequent characters.
  - Data and length, back pointer pairs are Huffman encoded.

Requirements for zEnterprise Data Compression

zEDC requires the following:
- z/OS V2R1 operating system.
- IBM zEnterprise EC12 (with GA2 level microcode) or IBM zEnterprise zBC12.
- zEDC Express feature. This System z compression accelerator can improve the speed of data compression and is sharable across up to 15 partitions and up to 8 cards per CPC.
- zEDC Express software feature must be enabled in an IFAPRDxx parmlib member.

Planning for zEnterprise Data Compression

zEDC is established by launching either an unauthorized or authorized interface:
- Unauthorized interface for zEDC:
  - zlib for zEDC:
    - zlib is an OpenSource data compression library supporting the DEFLATE compressed data format.
    - The zlib compression library provides in-memory compression and decompression functions, including integrity checks of the uncompressed data. For additional information about zlib, see [http://zlib.net/]
- System z authorized interfaces for zEDC:
  - Requires supervisor state and supports task and SRB mode.
- Allows application buffers to be directly read by and written to by compression accelerator hardware, allowing the application to avoid a data move, but also adding complexity to managing I/O buffers.
- Operates on independent requests:
  - A deflate request produces a full DEFLATE block.
  - An inflate request consumes a full DELFATE block.
- Provides software inflate capability to maintain data access when System z compression accelerator hardware is not available.

- Additional method with the option to use zEDC:
  - SMF compression. Use the COMPRESS and PERMFIX keywords in the SMFPRMxx parmlib member to compress data before writing to a log stream. For additional information, see z/OS MVS System Management Facilities (SMF) and z/OS MVS Initialization and Tuning Reference.

Table 26. Comparison table between unauthorized and System z authorized interfaces for zEDC

<table>
<thead>
<tr>
<th>Options</th>
<th>Unauthorized interfaces for zEDC</th>
<th>System z authorized interfaces for zEDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>C</td>
<td>Any language that can call OS callable services</td>
</tr>
<tr>
<td>Data streaming</td>
<td>zlib-style data streams supported. Data can be broken up across requests as needed, but has to be within the minimum input buffer limit.</td>
<td>Each request is independent and handled as a single DEFLATE block. Inflate requests must receive single complete DEFLATE block.</td>
</tr>
<tr>
<td>Buffer management</td>
<td>Data move to device driver managed buffer.</td>
<td>Application buffer directly used by System z hardware.</td>
</tr>
<tr>
<td>Co-existence support</td>
<td>Both inflate and deflate are completed in software when hardware is not available.</td>
<td>Inflate completed in software when hardware is not available.</td>
</tr>
<tr>
<td>Authorization</td>
<td>Controlled by SAF-protected FACILITY class resource FPZ.ACCELERATOR.COMPRESSION.</td>
<td>Supervisor state.</td>
</tr>
</tbody>
</table>
Chapter 14. Application interfaces for zEnterprise Data Compression

This topic describes the following interfaces, considerations, and samples for zEnterprise Data Compression (zEDC):

- Invoking unauthorized interface for zEDC:
  - “zlib for zEnterprise Data Compression”
- Invoking System z authorized interfaces for zEDC:
  - “System z authorized compression services” on page 208
    - “FPZ4RZV — Rendezvous compression service” on page 208
    - “FPZ4PRB — Probe device availability compression service” on page 211
    - “FPZ4RMR — Memory registration compression service” on page 212
    - “FPZ4DMR — Deregister memory compression service” on page 214
    - “FPZ4ABC — Submit compression request” on page 215
    - “FPZ4URZ — Unrendezvous compression request” on page 219

Invoking unauthorized interfaces for zEnterprise Data Compression

zlib for zEnterprise Data Compression

The zlib data compression library provides in-memory compression and decompression functions, including integrity checks of the uncompressed data. A modified version of the zlib compression library is used by zEDC. The IBM-provided zlib compatible C library provides a set of wrapper functions that use zEDC compression when appropriate and when zEDC is not appropriate, software-based compression services are used.

The zlib wrapper functions use the following criteria to determine if zEDC can be used for compression:

- The system requirements for zEDC have been met. See “Requirements for zEnterprise Data Compression” on page 200 for the details.
- For a deflate stream, the parameters specified on deflateInit2() are supported by zEDC. For an inflate stream, all the parameters specified on inflateInit2() are supported. See “Standard zlib functions” on page 204 for the details.
- Because there are overhead costs when communicating with the hardware, on the first call to deflate or inflate a data stream, the provided input is checked to ensure that it is sufficiently large enough to make it worthwhile to use zEDC. If the data stream is large enough, zEDC is used. If the data stream is small, it might cost more to compress the data stream with zEDC so software-based compression services are used. Note: This check is only performed on the first call to deflate or inflate a data stream.

If any of the above criteria is not met, the zlib wrapper function calls the standard zlib functions to process the data stream in software.

Once zEDC is used as the compression mechanism (for example, after the first call to inflate or deflate the data stream is completed), you cannot change the compression method to software-based compression services. At the same time, if software-based compression services are used as the compression mechanism (for...
example, after the first call to inflate or deflate the data stream is completed, you cannot change the compression method to zEDC.

**Note:** Once a data stream starts using zEDC for compression, if a function is called that cannot be supported by zEDC or the zEDC hardware becomes unavailable, the unsupported function returns an error return code.

**Standard zlib functions**

The following table contains the standard zlib functions and whether they are supported using zEDC:

<table>
<thead>
<tr>
<th>zlib function</th>
<th>zEDC-supported</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>zlibVersion</td>
<td>Supported.</td>
<td>Returns '1.2.7-zEDC'</td>
</tr>
<tr>
<td>deflateInit</td>
<td>Supported.</td>
<td></td>
</tr>
<tr>
<td>deflate</td>
<td>All flush modes are supported.</td>
<td>If the input buffer size is smaller than the minimum threshold for zEDC on the first call to deflate (compress) a data stream, the data stream is compressed using traditional software-based compression.</td>
</tr>
<tr>
<td>deflateEnd</td>
<td>Supported.</td>
<td></td>
</tr>
<tr>
<td>inflateInit</td>
<td>Supported.</td>
<td></td>
</tr>
<tr>
<td>inflate</td>
<td>Supported if the flush mode is one of the following: • z_no_flush • z_sync_flush • z_finish</td>
<td>If either the input buffer size is smaller than a minimum threshold for zEDC or the flush mode is z_block or z_trees on the first call to inflate (decompress) a data stream, the data stream is decompressed using traditional software-based decompression. On subsequent calls to inflate a data stream, if the flush mode is z_block or z_trees and the stream is using zEDC decompression, Z_STREAM_ERROR is returned</td>
</tr>
<tr>
<td>inflateEnd</td>
<td>Supported.</td>
<td></td>
</tr>
<tr>
<td>deflateInit2</td>
<td>Support is based on the input parameters.</td>
<td>Input parameters: level This option is ignored for zEDC and does not affect the software or zEDC compression decision. This option is supported for zlib software compression. method Must be Z_DEFLATED. windowBits Must be -15 for raw deflate, 15 for zlib header and trailer, or 31 for gzip header and trailer. For all other windowBits values, the data stream uses traditional software-based compression. memLevel This option is ignored for zEDC and does not affect the software or zEDC compression decision. This option is supported for zlib software compression. strategy Use Z_DEFAULT_STRATEGY or Z_FIXED for zEDC. All other options use traditional software-based compression.</td>
</tr>
<tr>
<td>deflateSetDictionary</td>
<td>Supported.</td>
<td>This option is supported for zEDC when called before the first deflate call for the data stream and is not supported after the first call to deflate.</td>
</tr>
<tr>
<td>deflateCopy</td>
<td>Supported.</td>
<td></td>
</tr>
<tr>
<td>zlib function</td>
<td>zEDC-supported</td>
<td>Details</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>deflateReset</td>
<td>Supported.</td>
<td></td>
</tr>
</tbody>
</table>
| deflateParams | Support is based on the input parameters. | Input parameters:  
  **Level** This option is ignored for zEDC.  
  **Strategy** Use Z_DEFAULT_STRATEGY or Z_FIXED for zEDC. All other options use traditional software-based compression. |
| deflateTune   | Supported.     | This option only applies to traditional software-based compression. zEDC accepts the call, but none of the parameters apply to zEDC. |
| deflateBound  | Supported.     |         |
| deflatePending| Supported.     |         |
| deflatePrime  | Not supported for zEDC. | Returns Z_STREAM_ERROR if the stream is using zEDC. |
| deflateSetHeader | Supported. | |
| inflateInit2  | Supported.     |         |
| inflateSetDictionary | Supported if called immediately after a call to inflate the data stream that returns Z_NEED_DICT. | Otherwise, Z_STREAM_ERROR is returned if the data stream is attempting to use zEDC decompression. |
| InflateSync   | Supported.     |         |
| inflateCopy   | Supported.     |         |
| inflateReset  | Supported.     |         |
| inflateReset2 | Supported.     |         |
| inflatePrime  | Not supported for zEDC. | Returns Z_STREAM_ERROR if the stream is using zEDC decompression. |
| inflateMark   | Not supported for zEDC. | Returns Z_STREAM_ERROR if the stream is using zEDC decompression. |
| inflateGetHeader | Supported. | |
| inflateBackInit | Not supported for zEDC. | InflateBackInit forces stream to software-based compression. |
| inflateBack   | Not supported for zEDC. | |
| zlibCompileFlags | Supported. | |
| compress      | Supported.     |         |
| compress2     | Supported.     | Level is ignored if using zEDC. |
| compressBound | Supported.     |         |
| uncompress     | Supported.     |         |
| gz* routines   | Not supported for zEDC. | Uses software-based compression for inflate and deflate functions. |
| checksum functions | Not supported for zEDC. | Checksum functions calculate the checksum values using software-based compression services. |

**IBM-provided zlib compatible C library**

The IBM-provided zlib compatible C library provides the following query functions in addition to the standard zlib functions:
deflateHwAvail(buflen)
Determine if the compression accelerator is available for a deflate
operation. The input parameter buflen is an integer that represents the
input buffer size of the first deflate request. The function returns an integer
with a value of 1 if the compression accelerator will be used for the deflate
operation or a value of 0 if software will be used instead.

inflateHwAvail(buflen)
Determines if the compression accelerator is available for an inflate
operation. The input parameter buflen is an integer that represents the
input buffer size of the first inflate request. The function returns an integer
with a value of 1 if the compression accelerator will be used for this inflate
operation or a value of 0 if software will be used instead.

hwCheck(strm)
Determines if a zlib stream is using the compression accelerator or
software compression. The input parameter strm is a pointer to a zlib
z_stream structure to check. The function returns an integer with a value of
0 if the stream has gone to the compression accelerator, a value of 1 if the
stream is pending to go to the compression accelerator, but still could fall
back to software compression, a value of 2 if the stream has gone to
software compression, or Z_STREAM_ERROR if the stream has not been
initialized correctly.

Running zlib
To compress data with zEDC, your installation must meet the system requirements.
See "Requirements for zEnterprise Data Compression" on page 200 for the system
requirements for zEDC.

To use the IBM-provided zlib compatible C library for data compression or data
expansion services, follow these steps:
1. Link or re-link applications to use the IBM-provided zlib.
The IBM-provided zlib is an archive file in the z/OS UNIX System Services file
system and can be statically linked into your applications. The paths for the
zlib archive file and the zlib header files are:

   Path for the zlib archive file:
   /usr/lpp/hzc/lib/libzz.a

   Path for the zlib header files:
   /usr/lpp/hzc/include/

Note: When a new IBM service is provided for zlib, all applications that
statically link zlib must re-link in order to use the updated IBM-provided zlib
and take advantage of the new function.

2. Provide System Authorization Facility (SAF) Access:
   • Access to zEDC Express is protected by the SAF FACILITY resource class:
     FPZ.ACCELERATOR.COMPRESSION.
   • Give READ access to FPZ.ACCELERATOR.COMPRESSION to the identity of
     the address space that the zlib task will run in.

3. Use the z/OS UNIX environmental variable,
   _HZC_COMPRESSION_METHOD, to control if zEDC is used for data
   compression.

   Note: If the value of software is set, software-based compression services are
   used. All other values result in the default behavior of attempting to use zEDC
   for data compression.
4. Ensure that adequately sized input buffers are available. If the input buffer size falls below the minimum threshold, data compression occurs using zlib software compression and not zEDC. This threshold can be controlled at a system level using the PARMLIB member IQPPRMxx.

5. Allocate the correct amount of storage for I/O buffers. The zEDC requests generated by zlib use predefined I/O buffer pools. The size of these I/O buffer pools can be set using PARMLIB member IQPPRMxx.

When zlib is statically linked into an application that runs on software or hardware that is not compatible with zEDC, zlib uses the following compression and decompression:

<table>
<thead>
<tr>
<th>Hardware level</th>
<th>z/OS level</th>
<th>zEDC Express</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>zEC12 (with GA2 level microcode)</td>
<td>z/OS V2R1</td>
<td>Active</td>
<td>zEDC is used for both data compression and decompression.</td>
</tr>
<tr>
<td>zEC12 (with GA2 level microcode)</td>
<td>z/OS V2R1</td>
<td>Not Active</td>
<td>Requirements are not met for zEDC. When zEDC Express is not available, traditional software zlib is used for compression and decompression.</td>
</tr>
<tr>
<td>Pre-zEC12 (with GA2 level microcode)</td>
<td>z/OS V2R1 or pre-z/OS V2R1</td>
<td>N/A</td>
<td>Requirements are not met for zEDC. When zEDC Express is not available, traditional software zlib is used for compression and decompression.</td>
</tr>
</tbody>
</table>

zEDC error handling:
- If a System z compression accelerator is unavailable, data compression requests transfer to another System z compression accelerator configured to the same partition. These request transfers are transparent to the application.
- If all System z compression accelerators are unavailable, an error message is sent to the application.

**Invoking System z authorized interfaces for zEnterprise Data Compression**

This topic describes how to invoke System z authorized interfaces for zEnterprise Data Compression by:

- “System z authorized compression services” on page 208
  - “FPZ4RZV — Rendezvous compression service” on page 208
  - “FPZ4PRB — Probe device availability compression service” on page 211
  - “FPZ4RMR — Memory registration compression service” on page 212
  - “FPZ4DMR — Deregister memory compression service” on page 214
  - “FPZ4ABC — Submit compression request” on page 215
  - “FPZ4URZ — Unrendezvous compression request” on page 219

To compress data with zEDC, your installation must meet the system requirements. See “Requirements for zEnterprise Data Compression” on page 200 for the system requirements for zEDC.

All z/OS exploitation of zEDC handles mixed hardware and software levels. Compatibility APAR OA41245 provides software decompression for installations running with z/OS V1R13 or V1R12. The same software decompression is also
provided for installations running z/OS V2R1 on pre-IBM zEnterprise EC12 (with GA2 level microcode). This allows access to compressed data on all combinations of environments.

**Table 29. Compression and decompression with System z authorized interfaces for zEDC**

<table>
<thead>
<tr>
<th>Hardware level</th>
<th>z/OS level</th>
<th>zEDC Express</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>zEC12 (with GA2 level microcode)</td>
<td>z/OS V2R1</td>
<td>Active</td>
<td>zEDC is used for both data compression and decompression.</td>
</tr>
<tr>
<td>zEC12 (with GA2 level microcode)</td>
<td>z/OS V2R1</td>
<td>Not Active</td>
<td>Requirements are not met for zEDC. Software-based decompression services for zEDC Express compressed data are used because zEDC Express compression is not available.</td>
</tr>
<tr>
<td>Pre-zEC12 (with GA2 level microcode)</td>
<td>z/OS V2R1</td>
<td>N/A</td>
<td>Requirements are not met for zEDC. Software-based decompression services for zEDC Express compressed data are used because zEDC Express compression is not available.</td>
</tr>
<tr>
<td>Pre-zEC12 (with GA2 level microcode)</td>
<td>Pre-z/OS V2R1</td>
<td>N/A</td>
<td>Requirements are not met for zEDC. Software-based decompression services for zEDC Express compressed data are used because zEDC Express compression is not available. <strong>Note:</strong> APAR OA41245 is required to use the software-based decompression services.</td>
</tr>
</tbody>
</table>

**System z authorized compression services**

The following compression services are available when using System z authorized interfaces for zEDC:

- "FPZ4RZV — Rendezvous compression service"
- "FPZ4PRB — Probe device availability compression service" on page 211
- "FPZ4RMR — Memory registration compression service" on page 212
- "FPZ4DMR — Deregister memory compression service" on page 214
- "FPZ4ABC — Submit compression request” on page 215
- "FPZ4URZ — Unrendezvous compression request” on page 219

**FPZ4RZV — Rendezvous compression service**

**Description:** The FPZ4RZV service performs the required setup and initialization of the compression services for an exploiter. The scope is the address space of the application and it is valid for the life of the Cross Memory Resource Owner Task (CMRO).

**Notes:**
1. A maximum of 32 rendezvous tokens are supported per each address space. This allows multiple applications to exploit the compression driver so each can maintain their own rendezvous scope.
2. All 64-bit storage is obtained with the MEMLIMIT=NO option.

**Table 30. Environment for the FPZ4RZV service**

<table>
<thead>
<tr>
<th>Environmental factor</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>Supervisor State with Key 0</td>
</tr>
</tbody>
</table>
Table 30. Environment for the FPZ4RZV service (continued)

<table>
<thead>
<tr>
<th>Environmental factor</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>64-bit</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
</tbody>
</table>

Table 31. Parameters for the FPZ4RZV service

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Input/Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ApplicationId</td>
<td>Fixed(32)</td>
<td>Input</td>
<td>The application type to use. 0x01 is the application type for zEDC.</td>
</tr>
<tr>
<td>FPZ4RZV_options</td>
<td>Bit(64)</td>
<td>Input</td>
<td>Options for the FPZ4RZV service:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SoftwareInflate (X'80000000 00000000')</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Allows compression requests to fall back to software inflation when no compression devices are available.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>EnableABCScatter (X'40000000 00000000')</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Allows compression requests to use the FPZ4ABC compression service to submit work with scatter/gather lists.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FailOnNoDevices (X'20000000 00000000')</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If specified, compression requests fail when no compression devices are available. If FailOnNoDevices is not specified, a valid rendezvous token is returned even if no compression devices are currently available. This returned rendezvous token is used for all other services.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PlusOne (X'08000000 00000000')</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If specified, compression requests will only use zEDC Express Adapters with the March 31, 2014 Firmware MCL release, or later.</td>
</tr>
<tr>
<td>userid</td>
<td>Char(8)</td>
<td>Input</td>
<td>An eight character EBCDIC string identifying the user.</td>
</tr>
<tr>
<td>rmr_entries</td>
<td>Fixed(32)</td>
<td>Input</td>
<td>The estimated number of FPZ4RMR compression service calls to be performed that helps to size the tables used until the maximum number of registrations is reached. This is an optional parameter. rmr_entries can be anywhere between 1 and 64K. The default is 128. Define rmr_entries as integer data of length 32.</td>
</tr>
<tr>
<td>Rendezvous token</td>
<td>Char(16)</td>
<td>Output</td>
<td>This is the token that must be passed to all FPZ services.</td>
</tr>
<tr>
<td>Return code</td>
<td>Fixed(31)</td>
<td>Output</td>
<td>The return code for the service.</td>
</tr>
<tr>
<td>Reason code</td>
<td>Fixed(32)</td>
<td>Output</td>
<td>The reason code for the service.</td>
</tr>
</tbody>
</table>
### Table 32. Return and Reason Codes for the FPZ4RZV service

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00                      | 0000        | **Meaning:** The call completed successfully.  
**Action:** None. |
| 04                      | 0000        | **Meaning:** No zEDC devices are available. zEDC support is active so it is possible that zEDC devices might become available in the future.  
**Action:** If zEDC devices are available to this system, perform diagnostics to determine the reason for the failure. |
| 04                      | 0102        | **Meaning:** No zEDC devices are available because the system requirements for zEDC were not met. See “Requirements for zEnterprise Data Compression” on page 200 for the details. A ‘thin’ rendezvous was created.  
**Action:** None. |
| 08                      | 0000        | **Meaning:** No zEDC devices are available because the system requirements for zEDC were not met. This is the result of RvzFailOnNoDev being ON or SoftwareInflate being OFF when on downlevel hardware or software. See “Requirements for zEnterprise Data Compression” on page 200 for the details. No rendezvous token is returned.  
**Action:** None. |
| 0C                      | 0201        | **Meaning:** Invalid parameter combination.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0207        | **Meaning:** The calling environment is invalid.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0210        | **Meaning:** rmr_entries specified an invalid value.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0226        | **Meaning:** Invalid application specified.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 10                      | 0301        | **Meaning:** An internal error caused recovery to be entered.  
**Action:** Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center. |
| 10                      | 0303        | **Meaning:** The maximum number of rendezvous tokens have been reached for the address space.  
**Action:** Determine if the calling program is at fault because of a coding error. If there is no coding error, another program might be consuming all the rendezvous tokens for the address space. Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center. |
**FPZ4PRB — Probe device availability compression service**

**Description:** The FPZ4PRB service checks for the required hardware and software needed for zEDC. This service returns successful if they are available to the system. See "Requirements for zEnterprise Data Compression" on page 200 for the system requirements for zEDC.

**Table 33. Environment for the FPZ4PRB service**

<table>
<thead>
<tr>
<th>Environmental factor</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>Supervisor State with Key 0</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task or SRB</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>64-bit</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
</tbody>
</table>

**Table 34. Parameters for the FPZ4PRB service**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Input/Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ApplicationId</td>
<td>Fixed(32)</td>
<td>Input</td>
<td>The application type to use. 0x01 is the application type for zEDC.</td>
</tr>
<tr>
<td>FPZ4PRB_options</td>
<td>Bit(64)</td>
<td>Input</td>
<td>Options for the FPZ4PRB service:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PlusOne (X'80000000 00000000')</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If specified, only zEDC Express Adapters with the March 31, 2014 Firmware MCL release, or later, will be honored. The value returned in <em>NumDevices</em> will only indicate this subset of devices.</td>
</tr>
<tr>
<td>NumDevices</td>
<td>Fixed(32)</td>
<td>Output</td>
<td>The number of devices available for this application.</td>
</tr>
<tr>
<td>Return code</td>
<td>Fixed(31)</td>
<td>Output</td>
<td>The return code for the service.</td>
</tr>
<tr>
<td>Reason code</td>
<td>Fixed(32)</td>
<td>Output</td>
<td>The reason code for the service.</td>
</tr>
</tbody>
</table>

**Table 35. Return and Reason Codes for the FPZ4PRB service**

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>0000</td>
<td><strong>Meaning:</strong> Devices are available.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
<tr>
<td>08</td>
<td>0900</td>
<td><strong>Meaning:</strong> The z/OS software level is not correct for zEDC. See &quot;Requirements for zEnterprise Data Compression&quot; on page 200 for the details.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
<tr>
<td>08</td>
<td>0901</td>
<td><strong>Meaning:</strong> The hardware level is not correct for zEDC. See &quot;Requirements for zEnterprise Data Compression&quot; on page 200 for the details.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
</tbody>
</table>
Table 35. Return and Reason Codes for the FPZ4PRB service (continued)

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>08</td>
<td>0902</td>
<td><strong>Meaning:</strong> No zEDC devices are available. The hardware is at the correct level, but no zEDC devices were available. <strong>Action:</strong> If zEDC devices are available to this system, perform diagnostics to determine the reason for the failure.</td>
</tr>
<tr>
<td>08</td>
<td>0903</td>
<td><strong>Meaning:</strong> zEDC devices were available during this IPL at some point, but there are no zEDC devices available now. <strong>Action:</strong> Perform diagnostics to determine the reason for the failure.</td>
</tr>
</tbody>
</table>

**FPZ4RMR — Memory registration compression service**

**Description:** The FPZ4RMR service registers a segment of memory for use by zEDC Express. The result is that this storage becomes fixed. The data area passed to FPZ4RMR must be page-aligned, and the size must be a multiple of a page boundary.

**Note:** This is not compatible with existing page fix services. This storage is eligible to be used for I/O as a result of this service.

Table 36. Environment for the FPZ4RMR service

<table>
<thead>
<tr>
<th>Environmental factor</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>Supervisor State with Key 0</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task or SRB</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>64-bit</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
</tbody>
</table>

Table 37. Parameters for the FPZ4RMR service

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Input/ Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ApplicationId</td>
<td>Fixed(32)</td>
<td>Input</td>
<td>The application type to use. 0x01 is the application type for zEDC.</td>
</tr>
<tr>
<td>FPZ4RMR_options</td>
<td>Bit(64)</td>
<td>Input</td>
<td>There are no supported options for the FPZ4RMR service.</td>
</tr>
<tr>
<td>Rendezvous token</td>
<td>Char(16)</td>
<td>Input</td>
<td>The rendezvous token.</td>
</tr>
<tr>
<td>Data@</td>
<td>Ptr(64)</td>
<td>Input</td>
<td>The address of the data area to register.</td>
</tr>
<tr>
<td>DataLen</td>
<td>Fixed(64)</td>
<td>Input</td>
<td>The length of the data area to register.</td>
</tr>
<tr>
<td>Reserved</td>
<td>Fixed(32)</td>
<td>Input</td>
<td>Reserved. Must be 0.</td>
</tr>
<tr>
<td>DataKey</td>
<td>Fixed(8)</td>
<td>Input</td>
<td>The key of the data area to register. The format of this parameter is 0xk0, where k represents the key of the data area.</td>
</tr>
<tr>
<td>RMR Token</td>
<td>Char(8)</td>
<td>Output</td>
<td>The region memory registration token associated with this data area. This token needs to be passed to the FPZ4ABC service when this data area is used as input or output.</td>
</tr>
</tbody>
</table>
### Table 37. Parameters for the FPZ4RMR service (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Input/Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return code</td>
<td>Fixed(31)</td>
<td>Output</td>
<td>The return code for the service.</td>
</tr>
<tr>
<td>Reason code</td>
<td>Fixed(32)</td>
<td>Output</td>
<td>The reason code for the service.</td>
</tr>
</tbody>
</table>

### Table 38. Return and Reason Codes for the FPZ4RMR service

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00                      | 0000        | Meaning: The call completed successfully.  
Action: None.                                                   |
| 08                      | 0000        | Meaning: Memory cannot be registered because of lack of hardware support.  
Action: None.                                                   |
| 08                      | 0900        | Meaning: Incorrect software level for zEnterprise data compression accelerator support.  
Action: None.                                                   |
| 0C                      | 0207        | Meaning: The calling environment is invalid.  
Action: Determine if the calling program is at fault because of a coding error. |
| 0C                      | 0208        | Meaning: An invalid rendezvous token was passed.  
Action: Check that the application successfully called the FPZ4RZV service. |
| 0C                      | 021D        | Meaning: The supplied region was not CONTROL(AUTH).  
Action: Determine if the calling program is at fault because of a coding error. |
| 0C                      | 021E        | Meaning: The supplied region address is incorrect. It might not have been page-aligned.  
Action: Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center. |
| 0C                      | 021F        | Meaning: The region length is invalid. It is possible that it is not a multiple of page size.  
Action: Determine if the calling program is at fault because of a coding error. |
| 0C                      | 0220        | Meaning: There is a region key mismatch.  
Action: Determine if the calling program is at fault because of a coding error. |
| 0C                      | 0226        | Meaning: An invalid application ID was encountered.  
Action: Determine if the calling program is at fault because of a coding error. |
| 0C                      | 0227        | Meaning: Rendezvous was not created with data space support.  
Action: Determine if the calling program is at fault because of a coding error. |
Table 38. Return and Reason Codes for the FPZ4RMR service (continued)

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 10                      | 0301        | **Meaning:** An internal error has occurred.  
Action: Determine if the calling program is at fault because of a coding error. |
| 10                      | 0304        | **Meaning:** Compression services were not initialized. Rendezvous was not called.  
Action: Check that the application successfully called the FPZ4RZV service. |
| 10                      | 0305        | **Meaning:** Capacity has been reached for memory registrations.  
Action: Determine if the calling program is at fault because of a coding error. |
| 10                      | 0306        | **Meaning:** There is not enough DMA memory available.  
Action: Determine if the calling program is at fault because of a coding error. |

**FPZ4DMR — Deregister memory compression service**

**Description:** The FPZ4DMR service unregisters a segment of memory for use by zEDC Express. The result is that this storage becomes unfixed.

Table 39. Environment for the FPZ4DMR service

<table>
<thead>
<tr>
<th>Environmental factor</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>Supervisor State</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task or SRB</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>64-bit</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
</tbody>
</table>

Table 40. Parameters for the FPZ4DMR service

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Input/Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ApplicationId</td>
<td>Fixed(32)</td>
<td>Input</td>
<td>The application type to use. 0x01 is the application type for zEDC.</td>
</tr>
<tr>
<td>FPZ4DMR_options</td>
<td>Bit(64)</td>
<td>Input</td>
<td>There are no supported options for the FPZ4DMR service.</td>
</tr>
<tr>
<td>Rendezvous token</td>
<td>Char(16)</td>
<td>Input</td>
<td>The rendezvous token.</td>
</tr>
<tr>
<td>RMR token</td>
<td>Char(8)</td>
<td>Input</td>
<td>The region memory registration (RMR) token associated with this data area to be unregistered.</td>
</tr>
<tr>
<td>Return code</td>
<td>Fixed(31)</td>
<td>Output</td>
<td>The return code for the service.</td>
</tr>
<tr>
<td>Reason code</td>
<td>Fixed(32)</td>
<td>Output</td>
<td>The reason code for the service.</td>
</tr>
</tbody>
</table>
**Table 41. Return and Reason Codes for the FPZ4DMR service**

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>0000</td>
<td>Meaning: The call completed successfully. Action: None.</td>
</tr>
<tr>
<td>08</td>
<td>0900</td>
<td>Meaning: Incorrect software level for zEnterprise data compression accelerator support. Action: None.</td>
</tr>
<tr>
<td>0C</td>
<td>0207</td>
<td>Meaning: The calling environment is invalid. Action: Determine if the calling program is at fault because of a coding error.</td>
</tr>
<tr>
<td>0C</td>
<td>0208</td>
<td>Meaning: An invalid rendezvous token was passed. Action: Check that the application successfully called the FPZ4RZV service.</td>
</tr>
<tr>
<td>0C</td>
<td>0209</td>
<td>Meaning: An invalid RMR token was provided. Action: Determine if the calling program is at fault because of a coding error.</td>
</tr>
<tr>
<td>10</td>
<td>0301</td>
<td>Meaning: An internal error has caused recovery to be entered. Action: Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center.</td>
</tr>
<tr>
<td>10</td>
<td>0304</td>
<td>Meaning: Compression services were not initialized. Rendezvous was not called. Action: Check that the application successfully called the FPZ4RZV service.</td>
</tr>
</tbody>
</table>

**FPZ4ABC — Submit compression request**

**Description:** The FPZ4ABC service submits a single autonomous compression request for one or more DEFLATE blocks. The input and output buffers can be either direct buffers or scatter/gather lists. The maximum size of a request for FPZ4ABC is 1 MB.

**Table 42. Environment for the FPZ4ABC service**

<table>
<thead>
<tr>
<th>Environmental factor</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>Supervisor State with Key 0</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task or SRB</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>64-bit</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
</tbody>
</table>
### Table 43. Parameters for the FPZ4ABC service

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Input/Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ApplicationId</td>
<td>Fixed(32)</td>
<td>Input</td>
<td>The application type to use. 0x01 is the application type for zEDC.</td>
</tr>
<tr>
<td>FPZ4ABC_options</td>
<td>Bit(64)</td>
<td>Input</td>
<td>Options for the FPZ4ABC service:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Inflate (X'80000000 00000000')</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When ON, specifies that this is an inflation request.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Input Scatter List (X'40000000 00000000')</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When ON, the area pointed to by input@ is a scatter/gather list.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Output Scatter List (X'20000000 00000000')</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When ON, the area pointed to by output@ is a scatter/gather list.</td>
</tr>
<tr>
<td>Rendezvous token</td>
<td>Char(16)</td>
<td>Input</td>
<td>The rendezvous token.</td>
</tr>
<tr>
<td>Input@</td>
<td>Ptr(64)</td>
<td>Input</td>
<td>The address of the input area or input scatter/gather list.</td>
</tr>
<tr>
<td>Output@</td>
<td>Ptr(64)</td>
<td>Input</td>
<td>The address of the output area or output scatter/gather list.</td>
</tr>
<tr>
<td>Input@RMR Token</td>
<td>Char(8)</td>
<td>Input</td>
<td>The region memory registration (RMR) token for the input area or area pointed to by the input scatter/gather list.</td>
</tr>
<tr>
<td>Output@RMR Token</td>
<td>Char(8)</td>
<td>Input</td>
<td>The region memory registration (RMR) token for the output area or area pointed to by the output scatter/gather list.</td>
</tr>
<tr>
<td>InputLen</td>
<td>Fixed(64)</td>
<td>Input</td>
<td>The length of the area pointed to by Input@. In the event that a scatter/gather list was provided using Input@, the total length of the areas provided by the scatter/gather areas must be provided.</td>
</tr>
<tr>
<td>OutputLen</td>
<td>Fixed(64)</td>
<td>Input</td>
<td>The length of the area pointed to by Output@. In the event that a scatter/gather list was provided using Output@, the total length of the areas provided by the scatter/gather areas must be provided.</td>
</tr>
<tr>
<td>GeneratedOutputLen</td>
<td>Fixed(64)</td>
<td>Output</td>
<td>This length describes how much output was generated and stored in either the Output@ or the scatter/gather list specified by Output@. This length spans across scatter/gather entries.</td>
</tr>
<tr>
<td>Return code</td>
<td>Fixed(31)</td>
<td>Output</td>
<td>The return code for the service.</td>
</tr>
<tr>
<td>Reason code</td>
<td>Fixed(32)</td>
<td>Output</td>
<td>The reason code for the service.</td>
</tr>
</tbody>
</table>

The FPZ4ABC service allows for the input and output areas to span several non-contiguous areas. The header of the FPZ4ABC list is immediately followed by the list entries. **Note:** All entries in the scatter/gather list must be associated with the same RMR token.

Scatter/gather lists have alignment rules and every entry in the scatter/gather list is checked for the following conditions:

- The start of the first buffer in the list can be on any byte boundary.
- The end of the first buffer must be on the required byte boundary.
The start / end of the intermediate buffers must be on the required byte boundary.
The start of the last buffer must be on the required byte boundary.
The end of the last buffer can be on any boundary.

All required boundaries are on 128-byte alignment. A maximum of 8 scatter/gather entries are allowed.

Table 44. Header elements in the FPZ4ABC-generated list

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td># Of Entries</td>
<td>Fixed(32)</td>
<td>The number of entries in the list.</td>
</tr>
<tr>
<td>Version</td>
<td>Fixed(8)</td>
<td>The version associated with the list.</td>
</tr>
<tr>
<td>Reserved</td>
<td>Char(3)</td>
<td>Reserved space.</td>
</tr>
</tbody>
</table>

Table 45. Entries elements in the FPZ4ABC-generated list

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>Fixed(64)</td>
<td>The address into the area mapped by the region memory registration (RMR) token.</td>
</tr>
<tr>
<td>Length</td>
<td>Fixed(32)</td>
<td>The length of the area, starting at address, to use.</td>
</tr>
<tr>
<td>Reserved</td>
<td>Fixed(32)</td>
<td>Reserved space.</td>
</tr>
</tbody>
</table>

Table 46. Return and Reason Codes for the FPZ4ABC service

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>0000</td>
<td><strong>Meaning:</strong> The call completed successfully.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
<tr>
<td>04</td>
<td>2000</td>
<td><strong>Meaning:</strong> No zEDC devices are available. Inflate is completed in software when hardware is not available.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
<tr>
<td>Hexadecimal Return Code</td>
<td>Reason Code</td>
<td>Meaning and Action</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>
| 08                      | 0000        | **Meaning:** No zEDC devices are available.  
**Action:** If zEDC devices are available to this system, perform diagnostics to determine the reason for the failure. |
| 0C                      | 0202        | **Meaning:** One of the buffers had a length of 0, or the first word of a length was non-zero.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0203        | **Meaning:** A failure occurred while accessing one of the provided scatter/gather buffers.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0206        | **Meaning:** The output area was not large enough to complete the request.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0207        | **Meaning:** The calling environment is invalid. The caller is either Problem State, non-zero key, or in XMEM mode.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0208        | **Meaning:** The rendezvous token is invalid.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0209        | **Meaning:** The region memory registration (RMR) token is invalid.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0221        | **Meaning:** The header of the FPZ4ABC-generated list was not formed correctly.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0222        | **Meaning:** Either zero or a number greater than the maximum supported was specified for the number of entries in the FPZ4ABC-generated list.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0223        | **Meaning:** A buffer in the scatter/gather list was not aligned properly.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0224        | **Meaning:** The total length of the buffers in the scatter/gather list does not match the length in the parmlist.  
**Action:** Check the calling program for a probable coding error. Correct the program and rerun it. |
<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0C                      | 0225        | **Meaning**: Scatter/gather was requested, but it was not enabled for this rendezvous token.  
                      |             | **Action**: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 1202        | **Meaning**: An address range is not contained in the region denoted by the region memory registration (RMR) token.  
                      |             | **Action**: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 1203        | **Meaning**: An unsupported operation was requested.  
                      |             | **Action**: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 1205        | **Meaning**: An inflate request failed because of malformed data.  
                      |             | **Action**: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 2101        | **Meaning**: An inflate request failed in software mode due to malformed input data.  
                      |             | **Action**: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 2102        | **Meaning**: Not enough space in the output buffer to process the request in software mode.  
                      |             | **Action**: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 10                      | 0301        | **Meaning**: An internal component error occurred.  
                      |             | **Action**: Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center. |
| 10                      | 0304        | **Meaning**: A rendezvous has not yet occurred for this address space.  
                      |             | **Action**: Check that the application successfully called the FPZ4RZV service. |
| 10                      | 1203        | **Meaning**: There are no zEDC devices available and either the request was a deflate request or software inflate was not enabled.  
                      |             | **Action**: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 10                      | 1301        | **Meaning**: The request failed unexpectedly for an unknown reason.  
                      |             | **Action**: Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center. |

**FPZ4URZ — Unrendezvous compression request**

**Description**: The FPZ4URZ service removes the address space level information related to zEDC Express compression services. Any outstanding memory registrations are unregistered.
Table 47. Environment for the FPZ4URZ service

<table>
<thead>
<tr>
<th>Environmental factor</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>Supervisor State</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>64-bit</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
</tbody>
</table>

Table 48. Parameters for the FPZ4URZ service

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Input/Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ApplicationId</td>
<td>Fixed(32)</td>
<td>Input</td>
<td>The application type to use. 0x01 is the application type for zEDC.</td>
</tr>
<tr>
<td>FPZ4URZ_options</td>
<td>Bit(64)</td>
<td>Input</td>
<td>There are no supported options for the FPZ4URZ service.</td>
</tr>
<tr>
<td>Rendezvous token</td>
<td>Char(16)</td>
<td>Input</td>
<td>The rendezvous token.</td>
</tr>
<tr>
<td>Return code</td>
<td>Fixed(31)</td>
<td>Output</td>
<td>The return code for the service.</td>
</tr>
<tr>
<td>Reason code</td>
<td>Fixed(32)</td>
<td>Output</td>
<td>The reason code for the service.</td>
</tr>
</tbody>
</table>

Table 49. Return and Reason Codes for the FPZ4URZ service

<table>
<thead>
<tr>
<th>Hexadecimal Return Code</th>
<th>Reason Code</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00                      | 0000        | Meaning: The call completed successfully.  
Action: None. |
| 0C                      | 0207        | Meaning: The calling environment is invalid. The caller is either Problem State, non-zero key, or in XMEM mode.  
Action: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 0C                      | 0208        | Meaning: An invalid rendezvous token was passed.  
Action: Check the calling program for a probable coding error. Correct the program and rerun it. |
| 10                      | 0301        | Meaning: An internal error has caused recovery to be entered.  
Action: Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center. |
| 10                      | 0304        | Meaning: Compression services were not initialized.  
Action: Check the calling program for a probable coding error. Correct the program and rerun it. |

Usage example of a System z authorized service

The following example uses the authorized services to perform compression using zEDC Express. Note: If zEDC Express adapters are not available, data is written to the destination uncompressed.
The FPZ4PRB service is called intermittently after the FPZ4ABC service returns to the application with a return code that indicates that all zEDC devices have left the configuration.

```
Call FPZ4RZV(AppId, RzvOptions, RzvUserId, RzvToken, RetCode, RsnCode) /* Rendezvous with the compression device driver (once per address space) */
If RetCode = RcNoDevices Then /* If no devices available */
    NoDevices = ON /* Indicate no devices */
Call FPZ4RMR(AppId, RmrOptions, RzvToken, InBuffer@, InBufferLen, 0, InBufKey, InRmrToken, RetCode, RsnCode) /* Register the input buffer */
Call FPZ4RMR(AppId, RmrOptions, RzvToken, OutBuffer@, OutBufferLen, 0, OutBufKey, OutRmrToken, RetCode, RsnCode) /* Register the output buffer for compressed data */
Do Until End of Data
    Read next block of data into InBuffer@
    If NoDevices = ON Then /* If no devices available */
        Call FPZ4PRB(AppId, Options, NumDevices, RetCode, RsnCode) /* Probe for new devices */
        If RetCode = RcOk Then /* If devices now available */
            NoDevices = OFF /* Indicate we have devices */
        Else /* Else no devices */
            Write InBuffer /* Processed uncompressed data */
        End If
    Else /* If devices available */
        Call FPZ4ABC(RzvToken, InBuffer@, InBufferLen, InRmrToken, OutBuffer@, OutBufferLen, OutRmrToken, RetCode, RsnCode) /* Perform compression */
        If RetCode = RcOk Then /* If data was compressed */
            Write OutBuffer /* Process compressed data */
        Else If RetCode = RcNoDevices Then /* If no devices available */
            NoDevices = ON /* Indicate no devices */
            Write InBuffer /* Process uncompressed data */
        End If
    End If
End Loop
Call FPZ4DMR(DmrOptions, RzvToken, InRmrToken, RetCode, RsnCode)
Call FPZ4DMR(DmrOptions, RzvToken, OutRmrToken, RetCode, RsnCode)
```

Chapter 14. Application interfaces for zEnterprise Data Compression 221
Chapter 15. Troubleshooting for zEnterprise Data Compression

This topic explains troubleshooting techniques for zEnterprise Data Compression (zEDC).

RMF provides the following data for the System z accelerator device:

- Load current partition is putting on device.
- Compression and decompression request rate and throughput.
- Achieved compression ratio.

See z/OS RMF User’s Guide for the available options to specify on your Monitor I session for reporting on the System z compression accelerator.
Part 7. Other callable services
Chapter 16. IEAAFFN — Assign processor affinity for encryption or decryption

Call IEAAFFN when the only function performed by your program is to encrypt or decrypt data. Encryption and decryption take place on processors that have Integrated Cryptographic Features (ICRFs) associated with them. IEAAFFN assigns a program affinity to processors with an ICRF; that is, IEAAFFN makes sure the system runs your program on a processor that has an ICRF associated with it.

You do not have to use the IEAAFFN service to ensure the system runs a program on a processor with an ICRF; the system ensures that automatically. However, you can avoid some of the system overhead involved in the selection process by using the IEAAFFN service. IBM recommends that you use the service in programs whose only function is encryption or decryption.

Note: When you use this service to either establish or remove processor affinity for a program, the program permanently loses any processor affinity that the system programmer assigned to it in the SCHEDxx member of SYS1.PARMLIB.

Code the CALL following the syntax of the high level language you are using and specifying all parameters in the order shown below.

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL IEAAFFN</td>
<td>(feature, operation_type, return_code)</td>
</tr>
</tbody>
</table>

The parameters are explained as follows:

**feature**

Specifies the feature required by your program. Specify CRYPTO to indicate an ICRF.

Define feature as character data of length 10. Pad the string on the right with 4 blanks.

**operation_type**

Specifies the type of action you want to take. The types are:

- **GRANT**
  
  Establish affinity for the program to processors with an ICRF.

- **REMOVE**
  
  Remove affinity for the program to processors with an ICRF.

  **Note:** After you issue a REMOVE request, the program has no processor affinity; it can run on any processor.

Define operation_type as character data of length 6. If you specify GRANT, pad the string on the right with 1 blank.
When IEAAFFN completes, return_code contains the return code from the service. The return code value is also in register 15.

Define return_code as integer data of length 4. The return codes are explained under "Return codes."

Restrictions and limitations

Use the IEAAFFN service to request affinity to processors with an ICRF only for sections of a program that require an ICRF and not other features, such as a Vector Facility.

Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authorization:</td>
<td>Supervisor state or Problem state, any PSW key</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>You can be either in cross memory mode or not</td>
</tr>
<tr>
<td>AMODE:</td>
<td>24- or 31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>None held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Must be in the primary address space</td>
</tr>
</tbody>
</table>

Return codes

When IEAAFFN returns control to your program, return_code and register 15 contain a return code. The following table identifies the return codes in hexadecimal and decimal (in parentheses), tells what each means, and recommends an action that you should take.

Table 50. IEAAFFN Return Codes

<table>
<thead>
<tr>
<th>Return code</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000000 (0)</td>
<td>Meaning: The operation was successful. Action: None required.</td>
</tr>
<tr>
<td>00000004 (4)</td>
<td>Meaning: The program already had processor affinity assigned to it by the system programmer. The system replaces that affinity with the affinity you requested in this service. Action: None required.</td>
</tr>
<tr>
<td>0000000C (12)</td>
<td>Meaning: Your program was not running in task mode. Action: This service is not available to SRB mode programs. See the FEATURE= option on the SCHEDULE macro for the use of this function in SRB mode.</td>
</tr>
<tr>
<td>00000010 (16)</td>
<td>Meaning: The feature you specified was not a valid feature. Action: Specify a valid feature name.</td>
</tr>
<tr>
<td>00000014 (20)</td>
<td>Meaning: The operation type you specified was not valid. Action: Specify a valid operation type.</td>
</tr>
<tr>
<td>00000018 (24)</td>
<td>Meaning: The feature you specified is not installed on any of the processors in the system. Action: To the system programmer: See that the program runs on a system with the feature installed.</td>
</tr>
<tr>
<td>Return code</td>
<td>Meaning and Action</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>
| 0000001C (28) | **Meaning:** A system error has occurred.  
**Action:** To the system programmer: The error is recorded in LOGREC. Look for a record with a subcomponent of “IEAAFFN CSS”; then call your IBM Support Center. |
Chapter 17. CSRL16J — Transfer control to another routine

The CSRL16J service allows you to transfer control to another routine running under the same request block (RB) as the calling program. The CSRL16J service will transfer control with the contents of all 16 registers intact. When you transfer control to the other routine, use the CSRL16J service to:

- Define the entry characteristics and register contents for the target routine.
- Optionally free dynamic storage associated with the calling program.

When the service is successful, control transfers to the target routine. After the target routine runs, it can transfer control to any program running under the same request block (RB), including the calling program.

The CSRL16J service returns control to the calling program only when it cannot transfer control successfully to the target because of an error.

Defining the entry characteristics of the target routine

Specify the entry characteristics for the target in data area L16J, which forms the parameter list passed from the calling program to CSRL16J. Use the CSRYL16J mapping macro to see the format of the L16J parameter list. To build the L16J parameter list, first initialize the parameter list with zeroes and then fill in the desired fields. This ensures that all fields requiring zeroes are correct. You can specify the following characteristics for the target in L16J:

- Length of the L16J parameter list, L16JLENGTH field in mapping macro CSRYL16J.
- Contents of the general purpose registers (GPRs) 0-15, L16JGRS field in mapping macro CSRYL16J.
- Contents of the access registers (ARs) 0-15, L16JARS field in mapping macro CSRYL16J.
- PSW information for the target routine, field L16JPSW field in mapping macro CSRYL16J.
  - PSW address and AMODE
  - PSW ASC mode - primary or AR
  - PSW program mask
  - PSW condition code
  Authorized callers, (callers in supervisor state, with PSW key 0-7, or with a PKM that allows any key 0-7) can specify:
  - PSW state - problem or supervisor
  - PSW key.
  For unauthorized callers, the system uses the PSW state and key of the calling program for the target routine.
  See Principles of Operation for more information about the contents of the PSW.
- Bit indicating whether or not you want to specify the contents of the access registers (ARs) for the target routine. This is the L16JPROCESSARS bit in mapping macro CSRYL16J.
  Set the bit on if you want to specify the contents of the ARs. If you set the bit off, the system determines the contents of the ARs.
If the bit is set on when CSRL16J passes control to the target routine, the access registers (ARs) contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>Specified by the caller</td>
</tr>
</tbody>
</table>

If the bit is set off when CSRL16J passes control to the target routine, the access registers (ARs) contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Do not contain any information for use by the routine</td>
</tr>
<tr>
<td>2-13</td>
<td>The contents are the same as they were when the caller issued the CSRL16J service.</td>
</tr>
<tr>
<td>14-15</td>
<td>Do not contain any information for use by the routine</td>
</tr>
</tbody>
</table>

### Freeing dynamic storage associated with the caller

If the calling program has a dynamic storage area associated with it, you can specify that some or all of this storage area be freed before CSRL16J transfers control to the target. In the L16J parameter list, specify:

- The subpool of the area that you want the system to free. L16J.SUBPOOL field in mapping macro CSRYL16J.
- The length, in bytes, of the dynamic storage area you want the system to free. L16J.LENGTHTOFREE field in mapping macro CSRYL16J.
- The address of the dynamic storage area you want the system to free. L16J.AREAOFFREE field in mapping macro CSRYL16J.

Make sure that the address is on a double-word boundary. Otherwise the service ends with an abend code X'978'. See [z/OS MVS System Codes](z/OS MVS System Codes) for information on abend code X'978'.

The system frees the storage only when the CSRL16J service is successful.

### Programming requirements

These are the requirements:

- The calling program must be in 31-bit addressing mode.
- Before you use the CSRL16J service, you must build a parameter list, L16J, to pass to the service. The parameter list includes the entry characteristics and environment for the target.

  If you are coding in C/370, you can include the CSRLJC macro to provide declarations in the calling program for the L16J parameter area and return codes.

  If you are coding in PL/I, you can include the CSRLJPLI macro to provide declarations for the return codes only. See [Figure 20 on page 234](#) for the CSRLJPLI macro. Use the data area, mapped by the CSRYL16J mapping macro, as a model for the structure of your parameter list when coding in PL/I.

CSRLJC provides the following declarations for use in your C/370 program:

```c
 /*********************************************************************
 * Type Definitions for User Specified Parameters                    *
 */

 typedef struct ??<
```
int Version; /* Must be 0 */
int Length; /* Initialize to CSRL16J_LENGTH */
int SubPool; /* Subpool of storage to be freed */
union ??
    char GRs??(64??); /* General registers */
    int GR??(16??); /* General register 0-15 */
??> u1;
union ??
    char ARs??(64??); /* Access registers */
    int AR??(16??); /* Access register 0-15 */
??> u2;
union ??
    char PSW??(0??); /* PSW: the processing will use the address,
AMODE, ASC mode, CC, and program mask. For a
supervisor state or PKM 0-7 or key 0-7
caller, it will use the state and key from
the PSW. Otherwise, it will set to caller
key and state. */
struct ??
    int PSWByte0to3 : 32; /* First 4 bytes */
union ??
    void *PSWAddr; /* Address and AMODE */
struct ??
    int PSWAmode : 1; /* AMODE */
    int Rsvd0 : 31;
??> s2;
??> u4;
??> s1;
??> u3;
union ??
    struct ??
        int Flags : 8; /* Flags */
        int Rsvd0 : 24; /* Reserved */
??> s3;
struct ??
    int ProcessARs : 1; /* If on, ARs will be processed. Otherwise
not. If not processed, ARs 0, 14, and 15 are
unpredictable. ARs 2-13 are taken from the values
present when the service is entered. */
    int Rsvd0 : 31; /* Reserved */
??> s4;
??> u5;
void *AreaToFree; /* Address of area to free. If this is non-0
then the area will be freed using the subpool
specified in L16J.Subpool. This can be used
to free the caller's entire dynamic area if
so desired. When this option is specified, it
is necessary that the area begin on a
doubleword boundary. */
int LengthToFree; /* Length of area to free, in bytes. */
char Rsvd??(0??); /* Reserved */
??> L16J;
/* Fixed Service Parameter and Return Code Defines */
#define CSRL16J_LENGTH 168 /* Length of L16J */
/* Service Return Codes */
#define CSRL16J_OK 0
#define CSRL16J_BAD_VERSION 4
#define CSRL16J_BAD_AMODE 8
#define CSRL16J_BAD_RESERVED 12
#define CSRL16J_BAD_LENGTH 16
#define CSRL16J_BAD_PSW 24
Restrictions

None.

Performance implications

None.
Syntax diagram

Code the invocation following the syntax of the language you are using. Specify parameters in the order shown.

C/370 syntax

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>csrl16j</td>
<td>(&amp;L16J, &amp;return_code)</td>
</tr>
</tbody>
</table>

PL/I syntax

<table>
<thead>
<tr>
<th>Code</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL CSRL16J</td>
<td>(L16J, &amp;return_code)</td>
</tr>
</tbody>
</table>

Parameters

The parameters are explained as follows:

L16J
Specifies a parameter list that the service uses to define the entry characteristics and environment for the target.

return_code
When the service completes, return_code contains the return code.

Return codes

If the CSRL16J service returns control to the caller, an error has occurred and the service was unable to transfer control to the target routine. In this case, the return code is always nonzero. When the service successfully transfers control to the target routine, the return code is zero.

Return codes from the CSRL16J service are as follows:

Table 51. CSRL16J Return Codes

<table>
<thead>
<tr>
<th>Return Code (hexadecimal)</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00                        | **Meaning**: Successful completion. The calling program will never see this return code because it indicates that the target routine received control.  
**Action**: None. |
| 04                        | **Meaning**: The value specified in the L16JVERSION field of the L16J data area was not a zero. The L16JVERSION field must contain a value of zero.  
**Action**: When you build the L16J data area, first zero the entire L16J data area and then fill in the required fields. This process ensures that all fields that must contain zeroes are correct. |
Table 51. CSRL16J Return Codes (continued)

<table>
<thead>
<tr>
<th>Return Code (hexadecimal)</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 08                        | Meaning: The calling program was not in 31-bit addressing mode, which is required.  
|                           | Action: Make sure the calling program is in 31-bit addressing mode. |
| 0C                        | Meaning: One of the fields in the L16J data area that is reserved for IBM use contained a nonzero value. Any field reserved for IBM use must contain a value of zero.  
|                           | Action: When you build the L16J data area, first zero the entire L16J data area and then fill in the required fields. This process ensures that all fields that must contain zeroes are correct |
| 10                        | Meaning: The value specified in field L16JLENGTH in the L16J data area was less than the actual length of the L16J.  
|                           | Action: Make sure that the value in the L16JLENGTH field reflects the actual length of the L16J data area. |
| 18                        | Meaning: The PSW provided in field L16JP SW of the L16J data area specified an incorrect ASC mode.  
|                           | Action: In the L16JP SW field, specify either primary or AR ASC mode. |

Example

The following example, coded in C/370 uses CSRL16J to transfer control to a C/370 program. The target routine executes in the mode and with the register contents specified by the calling program in the L16J parameter list.

This example performs the following operations:

- Fills in L16J parameter list with PSW and execution mode data.
- Calls an assembler routine to obtain the current register contents of registers 0 through 13 and copies them to the L16J parameter list.
- Defines the contents of registers 14 and 15 for the target routine.
- Issues setjmp to allow return from the target routine.
- Invokes the C/370 function L16JPr g through CSRL16J.
- CSRL16J issues longjmp to return to caller and complete processing.

To use this example, you must also use the assembler program following the C/370 example.

C/370 example program

```c
#include <stdlib.h>  
#include <stdio.h>  
#include <string.h>  
#include <setjmp.h>  
#include "CSRLJC.H"  

#define FALSE 0  
#define TRUE 1  

#pragma linkage(REG0TO13,OS)  

int rcode;  
int i;  
```
unsigned int regs[{14}]; /* Register save area */
jmp_buf JumpBuffer; /* Buffer for setjmp/longjmp */
L16J L16JParmArea; /* L16J parameter list structure */

/* Function prototype for function to be called via L16J */
void L16JPrg();

/* Invoke a C/370 function via L16J Callable Services */
main()
{
    /* Start by initializing the entire L16J parameter list */
    memset(&L16JParmArea, '\0', sizeof(L16J));

    /* The following fields were implicitly initialized to zero
       by the preceding statement:
       L16JParmArea.Version
       L16JParmArea.SubPool
       L16JParmArea.AreaToFree
       L16JParmArea.LengthToFree
       These field do not need to be explicitly set unless a value
       other than zero is required */

    /* Place parameter list length size into parameter list */
    L16JParmArea.Length = sizeof(L16J);

    /* Create a Problem State/Key 8 PSW */
    L16JParmArea.u3.s1.PSWByteTo3 = 0x078D1000;
    L16JParmArea.u3.s1.u4.PSWAddr = (void *) &L16JPrg;

    /* Mode data */
    L16JParmArea.u3.s1.u4.s2.PSWAmode = 1;
    L16JParmArea.u5.s4.ProcessARS = 1;

    /* Call assembler assist routine to obtain current register
       values */
    REG0TO13(&regs);

    /* Place register values into parameter list */
    for (i=0;i<14;i++)
        L16JParmArea.u1.GR??(i??) = regs??(i??);

    /* Register 14 is not being used in this linkage, but we
       have set it to zero for this example */
    L16JParmArea.u1.GRArr??({14??}) = 0;

    /* Set register 15 for entry to routine */
    L16JParmArea.u1.GRArr??({15??}) = (void *) &L16JPrg;

    printf("L16JC - Call L16J to invoke L16JPrg\n");

    /* Use setjmp to allow return to this point in program. If
       setjmp is being called for the first time, invoke L16JPrg
       via L16J Callable Services. If returning from longjmp,
       skip call to L16J services and complete processing. */
    if (!setjmp(JumpBuffer))
    {
        csrl16j (&L16JParmArea, &rcode);

        /* Demonstrate use of L16J C/370 declares */
        switch (rcode)
        {
            /* Select on a particular return code value */
            case CSRL16J_BAD_PSW:
                printf("L16JC - L16J unsuccessful, bad PSW\n");
                break;
            /* Default error processing */
            default:
printf("L16JC - L16J unsuccessful, RC = %d\n",rcode);
break;
}
}
printf("L16JC - Returned from L16JPrg\n");
}

/* The routine below receives control via L16J Callable Services.
control is passed back to main via longjmp. */
void L16JPrg(void)
{
    printf("L16JC - L16JPrg got control\n");
    longjmp(JumpBuffer,1);
}

Assembler program for use with the C/370 example
To use this example you must assemble the following program and linkedit it with
the C/370 program.
SR0T013 CSECT
SR0T013 AMODE 31
SR0T013 RMODE ANY
*
* Assembler assist routine to save contents of registers 0 through 13
* to the area pointed to by register 1.
*
REG0TO13 DS 0H
    ENTRY REG0TO13
* Get address of the save area
L    15,0(,1)
* Save registers 0 to 13
STM  0,13,0(15)
* Return to the caller
BR   14
END   SR0T013
Chapter 18. CSRSI — System information service

Use the CSRSI service to retrieve system information. You can request information about the machine itself, the logical partition (LPAR) in which the machine is running, or the virtual machine hypervisor (VM) under which the system is running. The returned information is mapped by DSECTs in macro CSRSIIDF (for assembler language callers) or structures in header file CSRSIC (for C language callers).

The information available depends upon the availability of the Store System Information (STSI) instruction. When the STSI instruction is not available (which would be indicated by receiving the return code 4 (equate symbol CSRSI_STSINOTAVAILABLE), only the SI00PCCACPID, SI00PCCACPUA, and SI00PCCACAFM fields within the returned infoarea are valid. When the STSI instruction is available, the validity of the returned infoarea depends upon the system:

- If the system is running neither under LPAR nor VM, then only the CSRSI_Request_V1CPC_Machine data are valid.
- If the system is running under a logical partition (LPAR), then both the CSRSI_Request_V1CPC_Machine data and CSRSI_Request_V2CPC_LPAR data are valid.
- If the system is running under a virtual machine hypervisor (VM), then all of the data (CSRSI_Request_V1CPC_Machine, CSRSI_Request_V2CPC_LPAR, and CSRSI_Request_V3CPC_VM) are valid.

You can request any or all of the information regardless of your system, and validity bits will indicate which returned areas are valid.

**Description**

**Environment**

The requirements for the caller are:

- **Requirement**: Details
- **Minimum authorization**: Problem state, key 8–15
- **Dispatchable unit mode**: Task or SRB
- **Cross memory mode**: Any PASN, any HASN, any SASN
- **AMODE**: 24- or 31-bit when using the CALL CSRSI form (or csrsi in C), 31-bit when using an alternate form
- **ASC mode**: Primary
- **Interrupt status**: Enabled or disabled for I/O and external interrupts
- **Locks**: The caller may hold a LOCAL lock, the CMS lock, or the CPU lock but is not required to hold any locks.

**Programming requirements**

The caller should include the CSRSIIDF macro to map the returned information and to provide equates for the service.
System information service (CSRSI)

Restrictions

None.

Input register information

The caller is not required by the system to set up any registers.

Output register information

When control returns to the caller, the GPRs contain:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>Used as work registers by the system</td>
</tr>
<tr>
<td>2-13</td>
<td>Unchanged</td>
</tr>
<tr>
<td>14-15</td>
<td>Used as work registers by the system</td>
</tr>
</tbody>
</table>

Syntax

<table>
<thead>
<tr>
<th>CALL statement</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL CSRSI,</td>
<td>(Request, Infoarealen, Infoarea, Returncode)</td>
</tr>
</tbody>
</table>

In C: the syntax is similar. You can use either of the following techniques to invoke the service:

1. CSRSI (Request,...Returncode);
   - When you use this technique, you must link edit your program with a linkage-assist routine (also called a stub) in SYS1.CSSLIB.

2. CSRSI_byaddr (Request,...Returncode);
   - This second technique requires AMODE=31, and, before you issue the CALL, you must verify that the CSRSI service is available (in the CVT, both CVTOSEXT and CVTCSRSI bits are set on).

In Assembler: Link edit your program with a linkage-assist routine (also called a stub) in SYS1.CSSLIB unless you use either of the following techniques as an alternative to CALL CSRSI:

1. LOAD EP=CSRSI
   Save the entry point address
   ...
   Put the saved entry point address into R15
   Issue CALL (15),...

2. L 15,X'10'(,15) Get CVT
   L 15,X'220'(,15)
   L 15,X'30'(,15) Get address of CSRSI
   CALL (15),(...)

   - Both of these techniques require AMODE=31. If you use the second technique, before you issue the CALL, you must verify that the CSRSI service is available (in the CVT, both CVTOSEXT and CVTCSRSI bits are set on).
Parameters

Request
Supplied parameter:
- Type: Integer
- Length: Full word

Request identifies the type of system information to be returned. The field must contain a value that represents one or more of the possible request types. You add the values to create the full word. Do not specify a request more than once. The possible requests, and their meanings, are:

- **CSRSI_Request_V1CPC_Machine**: The system is to return information about the machine.
- **CSRSI_Request_V2CPC_LPAR**: The system is to return information about the logical partition (LPAR).
- **CSRSI_Request_V3CPC_VM**: The system is to return information about the virtual machine (VM).

,Infoarealen
Supplied parameter:
- Type: Integer
- Range: X'1040', X'2040', X'3040', X'4040'
- Length: Full word

Infoarealen specifies the length of the infoarea parameter.

,Infoarea
Returned parameter:
- Type: Character
- Length: X'1040', X'2040', X'3040', X'4040' bytes

Infoarea is to contain the retrieved system information. (Infoarealen specifies the length of the provided area.) The infoarea must be of the proper length to hold the requested information. This length depends on the value of the Request parameter.

- When the Request parameter is CSRSI_Request_V1CPC_Machine, the returned infoarea is mapped by SIV1 and the infoarealen parameter must be X'2040'.
- When the Request parameter is CSRSI_Request_V1CPC_Machine plus CSRSI_Request_V2CPC_LPAR, the returned infoarea is mapped by SIV1V2 and the infoarealen parameter must be X'3040'.
- When the Request parameter is CSRSI_Request_V1CPC_Machine plus CSRSI_Request_V2CPC_LPAR plus CSRSI_Request_V3CPC_VM, the returned infoarea is mapped by SIV1V2V3 and the infoarealen parameter must be X'4040'.
- When the Request parameter is CSRSI_Request_V1CPC_Machine plus CSRSI_Request_V3CPC_VM, the returned infoarea is mapped by SIV1V3 and the infoarealen parameter must be X'3040'.
- When the Request parameter is CSRSI_Request_V2CPC_LPAR, the returned infoarea is mapped by SIV2 and the infoarealen parameter must be X'1040'.
- When the Request parameter is CSRSI_Request_V2CPC_LPAR plus CSRSI_Request_V3CPC_VM, the returned infoarea is mapped by SIV2V3 and the infoarealen parameter must be X'2040'.
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- When the Request parameter is CSRSI_Request_V3CPC_VM, the returned infoarea is mapped by SIV3 and the infoarealen parameter must be X'1040'.

**Returncode**

- Returned parameter:
  - Type: Integer
  - Length: Full word

Returncode contains the return code from the CSRSI service.

**Return codes**

When the CSRSI service returns control to the caller, Returncode contains the return code. To obtain the equates for the return codes:

- If you are coding in assembler, include mapping macro CSRSIIDF, described in z/OS MVS Data Areas in the z/OS Internet library (http://www.ibm.com/systems/z/os/zos/bkserv/).
- If you are coding in C, use include file CSRSIC.

The following table describes the return codes, shown in decimal.

<table>
<thead>
<tr>
<th>Return Code and Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00 (0) CSRSI_SUCCESS          | **Meaning**: The CSRSI service completed successfully. All information requested was returned.  
**Action**: Check the si00validityflags field to determine the validity of each returned area. |
| 04 (4) CSRSI_STSINOTAVAILABLE | **Meaning**: The CSRSI service completed successfully, but since the Store System Information (STSI) instruction was not available, only the SI00PCCACPID, SI00PCCACPUA, and SI00PCCACAFM fields are valid.  
**Action**: None required. |
| 08 (8) CSRSI_SERVICENOTAVAILABLE | **Meaning**: Environmental error: The CSRSI service is not available on this system.  
**Action**: Avoid calling the CSRSI service unless running on a system on which it is available. |
| 12 (C) CSRSI_BADREQUEST       | **Meaning**: User error: The request parameter did not specify a word formed from any combination of CSRSI_Request_V1CPC_Machine, CSRSI_Request_V2CPC_LPAR, and CSRSI_Request_V3CPC_VM.  
**Action**: Correct the parameter. |
| 16 (10) CSRSI_BADINFOAREALEN  | **Meaning**: User error: The Infoarealen parameter did not match the length of the area required to return the requested information.  
**Action**: Correct the parameter. |
| 20 (14) CSRSI_BADLOCK         | **Meaning**: User error: The service was called while holding a system lock other than CPU, LOCAL/CML, or CMS.  
**Action**: Avoid calling in this environment. |
For the C programmer, include file CSRSIC provides equates for return codes and data constants, such as Register service request types. To use CSRSIC, copy the file from SYS1.SAMPLIB to the appropriate local C library. Here are the contents of the file:

```c
#ifndef __CSRSI
#define __CSRSI

/* Type Definitions for User Specified Parameters */

/* Type for Request operand of CSRSI */
typedef int CSRSIRequest;

/* Type for InfoAreaLen operand of CSRSI */
typedef int CSRSIInfoAreaLen;

/* Type for Return Code */
typedef int CSRSIReturnCode;

/* Function Prototypes for Service Routines */

#ifdef __cplusplus
extern "C" {
#else
#pragma linkage(CSRSI_calltype,OS)
#endif
typedef void CSRSI_calltype(
    CSRSIRequest __REQUEST, /* Input - request type */
    CSRSIInfoAreaLen __INFOAREALEN, /* Input - length of infoarea */
    void *__INFOAREA, /* Input - info area */
    CSRSIReturnCode *__RC); /* Output - return code */

extern CSRSI_calltype csrsi;

#ifdef __cplusplus
}
#else
#define csrsi_byaddr(Request, Flen, Fptr, Rcptr) CSRSI_pagezero = 0;
#endif

struct CSRSI_CSRT {
    unsigned char CSRSI_csrt_filler1 [48];
    CSRSI_calltype* CSRSI_addr;
}

struct CSRSI_CVT {
    unsigned char CSRSI_cvtoext [116];
    int CSRSI_cvtdcb_rsvd1 : 4; /* Not needed */
    int CSRSI_cvtoext : 1; /* If on, indicates that the
```
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```c
CVTOSVL fields are valid */
int CSRSI_cvtdcb_rsvd2 : 3; /* Not needed */
??> CSRSI_cvtdcb;
unsigned char CSRSI_cvtslerv2 ??(427??);
struct CSRSI_CSRT * CSRSI_cvtcsrt;
unsigned char CSRSI_cvtsrlerv3 ??(716??);
unsigned char CSRSI_cvtslerv0;
unsigned char CSRSI_cvtslerv1;
unsigned char CSRSI_cvtslerv2;
unsigned char CSRSI_cvtslerv3;
struct ??<
    int CSRSI_cvtcsrsi : 1; /* If on, indicates that the
    CSRSI service is available */
    int CSRSI_cvtslerv1_rsvd1 : 7; /* Not needed */
??> CSRSI_cvtslerv4;
unsigned char CSRSI_cvtslerv4 ??(11??); /* */
?>;

struct CSRSI_PSA ??<
    char CSRSI_psa_filler??(16??);
    struct CSRSI_CVT* CSRSI_cvt;
?>;

/* End of CSRSI Header */
#endif

/******************************************************************************/
/* si11v1 represents the output for a V1 CPC when general CPC */
/* information is requested */
/******************************************************************************/
typedef struct ??<
    unsigned char _filler1??(32??); /* Reserved */
    unsigned char si11v1cpmanufacturer??(16??); /*
        The 16-character (0-9
        or uppercase A-Z) EBCDIC name
        of the manufacturer of the V1
        CPC. The name is
        left-justified with trailing
        blank characters if necessary. */
    unsigned char si11v1cpctype??(4??); /* The 4-character (0-9) EBCDIC
        type identifier of the V1 CPC. */
    unsigned char _filler2??(12??); /* Reserved */
    unsigned char si11v1cpmodel??(16??); /* The 16-character (0-9 or
        uppercase A-Z) EBCDIC model
        identifier of the V1 CPC. The
        identifier is left-justified
        with trailing blank characters
        if necessary. */
    unsigned char si11v1cpsequencecode??(16??); /* The 16-character (0-9
        or uppercase A-Z) EBCDIC
        sequence code of the V1 CPC. The
        sequence code is
        right-justified with leading
        EBCDIC zeroes if necessary. */
    unsigned char si11v1cpplantofmanufacture??(4??); /* The 4-character
        (0-9 or uppercase A-Z) EBCDIC
        plant code that identifies the
        plant of manufacture for the
        V1 CPC. The plant code is
```
typedef struct {
  unsigned char _filler[32]; /* Reserved */
  unsigned char si11v1cpucapability[4]; /* An unsigned binary integer that specifies the capability of one of the CPUs contained in the V1 CPC. It is used as an indication of the capability of the CPU relative to the capability of other CPU models. */
  unsigned int si11v1totalcpucount : 16; /* A 2-byte unsigned integer that specifies the total number of CPUs contained in the V1 CPC. This number includes all CPUs in the configured state, the standby state, and the reserved state. */
  unsigned int si11v1configuredcpucount : 16; /* A 2-byte unsigned binary integer that specifies the total number of CPUs that are in the configured state. A CPU is in the configured state when it is described in the V1-CPC configuration definition and is available to be used to execute programs. */
  unsigned int si11v1standbycpucount : 16; /* A 2-byte unsigned integer that specifies the total number of CPUs that are in the standby state. A CPU is in the standby state when it is described in the V1-CPC configuration definition, is not available to be used to execute programs, but can be used to execute programs by issuing instructions to place it in the configured state. */
  unsigned int si11v1reservedcpucount : 16; /* A 2-byte unsigned binary integer that specifies the total number of CPUs that are in the reserved state. A CPU is in the reserved state when it is described in the V1-CPC configuration definition, is not available to be used to execute programs, but can be used to execute programs by issuing instructions to place it in the configured state. */
} si11v1;
programs, and cannot be made available to be used to execute programs by issuing instructions to place it in the configured state, but it may be possible to place it in the standby or configured state through manually initiated actions /*

struct ??<
    unsigned char _si22v1mpcpcapaf??(2??); /* Each individual adjustment factor. */
    unsigned char _filler2??(4050??);
?> si22v1mpcpcapafs;
?> si22v1;
#define si22v1mpcpcapaf si22v1mpcpcapafs._si22v1mpcpcapaf

/*******************************************************************************/
/* si22v2 represents the output for a V2 CPC when information is requested about the set of CPUs */
/*************************************************************************************/
typedef struct ??<
    unsigned char _filler1??(32??); /* Reserved */
    unsigned int si22v2cpcnumber : 16; /* A 2-byte unsigned integer which is the number of this V2 CPC. This number distinguishes this V2 CPC from all other V2 CPCs provided by the same logical-partition hypervisor */
    unsigned char _filler2; /* Reserved */
?> si22v2;

unsigned char _si22v2lcpudedicated : 1; /* When one, indicates that one or more of the logical CPUs for this V2 CPC are provided using V1 CPUs that are dedicated to this V2 CPC and are not used to provide logical CPUs for any other V2 CPCs. The number of logical CPUs that are provided using dedicated V1 CPUs is specified by the dedicated-LCPU-count value. When zero, bit 0 indicates that none of the logical CPUs for this V2 CPC are provided using V1 CPUs that are dedicated to this V2 CPC. */

unsigned int _si22v2lcpushared : 1; /* When one, indicates that one or more of the logical CPUs for this V2 CPC are provided using V1 CPUs that can be used to provide logical CPUs for other V2 CPCs. The number of logical CPUs that are provided using shared V1 CPUs is specified by the shared-LCPU-count value. When zero, it indicates that none of the logical CPUs for this V2 CPC are provided using...
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shared V1 CPUs.
 */

unsigned int _si22v2lcpuulimit : 1; /*
Utilization limit. When one, indicates that the amount of use of the V1-CPC CPUs that are used to provide the logical CPUs for this V2 CPC is limited. When zero, it indicates that the amount of use of the V1-CPC CPUs that are used to provide the logical CPUs for this V2 CPC is unlimited.
 */

unsigned int _filler3 : 5; /* Reserved */

unsigned int si22v2lcpuc; /* Characteristics */

unsigned int si22v2totallcpucount : 16; /*
A 2-byte unsigned integer that specifies the total number of logical CPUs that are provided for this V2 CPC. This number includes all of the logical CPUs that are in the configured state, the standby state, and the reserved state.
 */

unsigned int si22v2configuredlcpucount : 16; /*
A 2-byte unsigned binary integer that specifies the total number of logical CPUs for this V2 CPC that are in the configured state. A logical CPU is in the configured state when it is described in the V2-CPC configuration definition and is available to be used to execute programs.
 */

unsigned int si22v2standbylcpucount : 16; /*
A 2-byte unsigned binary integer that specifies the total number of logical CPUs that are in the standby state. A logical CPU is in the standby state when it is described in the V2-CPC configuration definition, is not available to be used to execute programs, but can be used to execute programs by issuing instructions to place it in the configured state.
 */

unsigned int si22v2reservedlcpucount : 16; /*
A 2-byte unsigned binary integer that specifies the total number of logical CPUs that are in the reserved state. A logical CPU is in the reserved state when it is described in the V2-CPC configuration definition, is not available to be used to execute programs, and cannot

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be made available to be used
to execute programs by issuing
instructions to place it in
the configured state, but it
may be possible to place it in
the standby or configured
state through manually
initiated actions */

unsigned char si22v2pcpename??(16??); /*
The 8-character EBCDIC name of
this V2 CPC. The name is
left-justified with trailing
blank characters if necessary. */

unsigned char si22v2cpccapabilityaf??(4??); /* Capability Adjustment
Factor (CAF). An unsigned
binary integer of 1000 or
less. The adjustment factor
specifies the amount of the
V1-CPC capability that is
allowed to be used for this V2
CPC by the logical-partition
hypervisor. The fraction of
V1-CPC capability is
determined by dividing the CAF
value by 1000. */

unsigned char _filler4??(16??); /* Reserved */
unsigned int si22v2dedicatedlcpucount : 16; /*
A 2-byte unsigned
binary integer that specifies
the number of configured-state
logical CPUs for this V2 CPC
that are provided using
dedicated V1 CPUs. (See the
description of bit
si22v2lcundefined.) */

unsigned int si22v2sharedlcpucount : 16; /*
A 2-byte unsigned
integer that specifies the
number of configured-state
logical CPUs for this V2 CPC
that are provided using shared
V1 CPUs. (See the description
of bit si22v2lcushared.) */

unsigned char _filler5??(4012??); /* Reserved */

#define si22v2lcpudirected si22v2lcpestsi22v2lcudirected
#define si22v2lcpushared si22v2lcpestsi22v2lcpushared
#define si22v2lcuulimit si22v2lcpestsi22v2lcuulimit

/* si22v3db is a description block that comprises part of the
si22v3 data. */

typedef struct ??
unsigned char _filler1??(4??); /* Reserved */
unsigned int si22v3dbtotallcpucount : 16; /*
A 2-byte unsigned
binary integer that specifies
the total number of logical
CPUs that are provided for
this V3 CPC. This number
includes all of the logical
CPUs that are in the configured state, the standby state, and the reserved state.

unsigned int si22v3dbconfiguredlcpucount : 16; /*
A 2-byte unsigned binary integer that specifies the number of logical CPUs for this V3 CPC that are in the configured state. A logical CPU is in the configured state when it is described in the V3-CPC configuration definition and is available to be used to execute programs.
*/

unsigned int si22v3dbstandbylcpucount : 16; /*
A 2-byte unsigned binary integer that specifies the number of logical CPUs for this V3 CPC that are in the standby state. A logical CPU is in the standby state when it is described in the V3-CPC configuration definition, is not available to be used to execute programs, but can be used to execute programs by issuing instructions to place it in the configured state.
*/

unsigned int si22v3dbreservedlcpucount : 16; /*
A 2-byte unsigned binary integer that specifies the number of logical CPUs for this V3 CPC that are in the reserved state. A logical CPU is in the reserved state when it is described in the V2-CPC configuration definition, is not available to be used to execute programs, and cannot be made available to be used to execute programs by issuing instructions to place it in the configured state, but it may be possible to place it in the standby or configured state through manually initiated actions.
*/

unsigned char si22v3dbcpcname??(8??); /* The 8-character EBCDIC name of this V3 CPC. The name is left-justified with trailing blank characters if necessary.
*/

unsigned char si22v3dbcpccaf??(4??); /* A 4-byte unsigned binary integer that specifies an adjustment factor. The adjustment factor specifies the amount of the V1-CPC or V2-CPC capability that is allowed to be used for this V3 CPC by the virtual-machine-hypervisor program.
*/
unsigned char si22v3dbvmpidentifier?(16??); /* The 16-character EBCDIC identifier of the virtual-machine-hypervisor program that provides this V3 CPC. (This identifier may include qualifiers such as version number and release level). The identifier is left-justified with trailing blank characters if necessary. */

unsigned char _filler2??(24??); /* Reserved */
/**/ si22v3db;
/**/ si22v3;

typedef struct ??<
unsigned char _filler1??(28??); /* Reserved */
unsigned char _filler2??(3??); /* Reserved */
struct ??<
unsigned int _filler3 : 4; /* Reserved */
unsigned int _si22v3dbcount : 4; /* Description Block Count. A 4-bit unsigned binary integer that indicates the number (up to 8) of V3-CPC description blocks that are stored in the si22v3dbe array. */
?> si22v3dbcountfield; /* */
si22v3db si22v3dbe??(8??); /* Array of entries. Only the number indicated by si22v3dbcount are valid */
unsigned char _filler5??(3552??); /* Reserved */
?> si22v3;

#define si22v3dbcount si22v3dbcountfield._si22v3dbcount
/**/ si22v3;

typedef struct ??<
char si00cpcvariety; /* SI00CPCVariety_V1CPC_MACHINE, SI00CPCVariety_V2CPC_LPAR, or SI00CPCVariety_V3CPC_VM */
struct ??<
int _si00valids1l1v1 : 1; /* s1l1v1 was requested and the information returned is valid */
int _si00valids1l2v1 : 1; /* s1l2v1 was requested and the information returned is valid */
int _si00valids1l2v2 : 1; /* s1l2v2 was requested and the information returned is valid */
int _si00valids1l2v3 : 1; /* s1l2v3 was requested and the information returned is valid */
int _filler1 : 4; /* Reserved */
?> si00validityflags;
unsigned char _filler2??(2??); /* Reserved */
unsigned char si00pccacpid??(12??); /* PCCACPID value for this CPU */
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unsigned char si00pccacpu??(2??); /* PCCACPUA value for this CPU */
unsigned char si00pccacafm??(2??); /* PCCACAFM value for this CPU */
unsigned char _filler3??(4??); /* Reserved */
unsigned char si00lastupdatetimestamp??(8??); /* Time of last STSI update, via STCK */
unsigned char _filler4??(32??); /* Reserved */

#define si00validsi11v1 si00validityflags._si00validsi11v1
#define si00validsi22v1 si00validityflags._si00validsi22v1
#define si00validsi22v2 si00validityflags._si00validsi22v2
#define si00validsi22v3 si00validityflags._si00validsi22v3

/*****************************************************************************/
/* siv1 represents the information returned when VICPC_MACHINE */
/* data is requested */
/*****************************************************************************/
typedef struct ??<
    si00 siv1s100;
    si11v1 siv1s11v1;
    si22v1 siv1s122v1;
    si00 validsi11v1;
    si00 validsi22v1;
    si00 validsi22v2;
    si00 validsi22v3;
> siv1;

/*****************************************************************************/
/* siv1v2 represents the information returned when VICPC_MACHINE */
/* data and V2CPC_LPAR data is requested */
/*****************************************************************************/
typedef struct ??<
    si00 siv1v2s100;
    si11v1 siv1v2s11v1;
    si22v1 siv1v2s122v1;
    si22v2 siv1v2s122v2;
    si22v3 siv1v2s122v3;
    si00 validsi11v1;
    si00 validsi22v1;
    si00 validsi22v2;
    si00 validsi22v3;
> siv1v2;

/*****************************************************************************/
/* siv1v2v3 represents the information returned when VICPC_MACHINE */
/* data, V2CPC_LPAR data and V3CPC_VM data is requested */
/*****************************************************************************/
typedef struct ??<
    si00 siv1v2v3s100;
    si11v1 siv1v2v3s11v1;
    si22v1 siv1v2v3s122v1;
    si22v2 siv1v2v3s122v2;
    si22v3 siv1v2v3s122v3;
    si00 validsi11v1;
    si00 validsi22v1;
    si00 validsi22v2;
    si00 validsi22v3;
> siv1v2v3;

/*****************************************************************************/
/* siv1v3 represents the information returned when VICPC_MACHINE */
/* data, V2CPC_LPAR data and V3CPC_VM data is requested */
/*****************************************************************************/
System information service (CSRSI)

/* data and V3CPC_VM data is requested */

typedef struct ??<
si00 siv1v3si00; /* Area mapped by struct s100 */
si11v1 siv1v3si11v1; /* Area mapped by struct s11v1 */
si22v1 siv1v3si22v1; /* Area mapped by struct s12v1 */
si22v3 siv1v3si22v3; /* Area mapped by struct s12v3 */

??> siv1v3;

/****************************************************/
/* siv2 represents the information returned when V2CPC_LPAR */
/* data is requested */

typedef struct ??<
si00 siv2si00; /* Area mapped by struct s100 */
si22v2 siv2si22v2; /* Area mapped by struct s12v2 */

??> siv2;

/****************************************************/
/* siv2v3 represents the information returned when V2CPC_LPAR */
/* and V3CPC_VM data is requested */

typedef struct ??<
si00 siv2v3si00; /* Area mapped by struct s100 */
si22v2 siv2v3si22v2; /* Area mapped by struct s12v2 */
si22v3 siv2v3si22v3; /* Area mapped by struct s12v3 */

??> siv2v3;

/****************************************************/
/* siv3 represents the information returned when V3CPC_VM */
/* data is requested */

typedef struct ??<
si00 siv3si00; /* Area mapped by struct s100 */
si22v3 siv3si22v3; /* Area mapped by struct s12v3 */

??> siv3;

/****************************************************/
* Fixed Service Parameter and Return Code Defines *
****************************************************/

/* SI00 Constants */

#define SI00CPCVARIETY_V1CPC_MACHINE 1
#define SI00CPCVARIETY_V2CPC_LPAR 2
#define SI00CPCVARIETY_V3CPC_VM 3

/* CSRSI Constants */

#define CSRSI_REQUEST_V1CPC_MACHINE 1
#define CSRSI_REQUEST_V2CPC_LPAR 2
System information service (CSRSI)

#define CSRSI_REQUEST_V3CPC_VM 4

/* CSRSI Return codes */

#define CSRSI_SUCCESS 0
#define CSRSI_STSINOTAVAILABLE 4
#define CSRSI_SERVICENOTAVAILABLE 8
#define CSRSI_BADREQUEST 12
#define CSRSI_BADINFOAREALEN 16
#define CSRSI_BADLOCK 20
System information service (CSRSI)
Part 8. Base Control Program internal interface (BCPii) services
Chapter 19. Base Control Program internal interface (BCPi)

IBM provides support within z/OS that allows authorized applications to query, change, and perform operational procedures against the installed System z hardware base through a set of application program interfaces. These applications can access the System z hardware that the application is running on and extend their reach to other System z processors within the attached process control (Hardware Management Console) network.

Using the Base Control Program internal interface (BCPi), an authorized z/OS application can perform the following actions:

- Obtain the System z topology of the current interconnected Central Processor Complexes (CPCs) as well as the images, capacity records, activation profiles, and user-defined image groups defined on a particular CPC.
- Query CPC, image (LPAR), capacity record, activation profile, and user-defined image group information.
- Set various configuration values related to CPC, image and activation profiles.
- Issue commands against CPCs, images (LPARs), and user-defined image groups to perform minor or even significant hardware- and software-related functions.
- Listen for various hardware and software events that might take place on various CPCs and images throughout the HMC-connected network.

Communication to the Support Element (SE) / Hardware Management Console (HMC) using BCPi is done completely within the base operating system and therefore does not require communication on an IP network (intranet) for connectivity, providing complete isolation of your System z hardware communication from any other network traffic within the intranet/internet.

Calls using the BCPii Application Programming Interfaces (APIs) can be made from the C, the REXX, or the assembler programming languages. See "Syntax, linkage and programming considerations" on page 268 for an explanation of how the APIs are called and see the explanation of each service for the syntax for each of the BCPii APIs.

BCPi setup and installation

Before an installation begins to issue BCPi APIs, a series of setup and installation steps must be performed. A summary of these steps is listed below. For additional details on each of these steps, see the supporting documentation that explains how each of these steps is accomplished:

1. Configure the local Support Element (SE) to support BCPi:
   a. Check the levels of hardware that BCPi supports.
   b. Enable cross-partition authority for each image (LPAR) that you want to grant BCPi access.
   c. Define an uppercase BCPi SNMP community name on the SE.
      See "Setting up connectivity to the support element" on page 258 for details.

2. Authorize an application to use BCPi, including authority to specific resources (such as CPCs, images and capacity records):
   a. Check that the BCPi application is program-authorized.
b. Check that the BCPii application has general authority to use BCPii.

c. Authorize the BCPii application to access the particular resource that requires BCPii service.

d. Define an uppercase BCPii SNMP community name in the security product for each CPC as it was defined on the SE. Use the APPLDATA field with the CPC profile definition to associate a BCPii SNMP community name with a particular CPC.

These steps enable communication to the local CPC and allows the BCPii address space to initialize. See “Setting up authority to use BCPii” on page 261 for details.

3. Configure the BCPii address space. See “BCPii configuration” on page 264 for details.

4. If the caller is running in a z/OS UNIX System Services environment, set up the notification mechanism to allow hardware and software events to be propagated to the z/OS UNIX application. See “Setting up event notification for BCPii z/OS UNIX applications” on page 264 for details.

5. If the installation allows TSO/E users to have access to the BCPii APIs using REXX, see “Setting up access for BCPii TSO/E REXX execs” on page 266.

After you have activated the BCPii address space, you need to know how to control the address space. See “BCPii startup and shutdown” on page 266 for details.

Figure 21 shows the steps needed to setup and install BCPii.

**Setting up connectivity to the support element**

BCPii uses a low-level operating system connection to establish communication between an authorized application running on a z/OS image (LPAR) and the Support Element (SE) associated with the Central Processor Complex (CPC) that contains this z/OS image. You must configure the support element to permit these BCPii communications if BCPii services are required to be available by your installation.
Note: In order to customize the API settings controls on the SE, your userid must have administrator rights to access these panels.

Levels of hardware that BCPii supports

The HWIBCPii address space, which supports the issuing of BCPii APIs from a z/OS image, will run on any hardware that supports a level of the z/OS operating system in which BCPii is included. However, there will be some reduced BCPii functionality when a BCPii request targets a system that is not running on a zEnterprise® machine. The BCPii restrictions increase the further downlevel the hardware is from a zEnterprise machine. To run with the fewest functionality restrictions possible, make sure the recommended microcode levels are installed for that SE, HMC and LPAR hardware.

BCPii applications might need to perform hardware or software functions on CPCs other than the CPC on which the application is running. Such requests can be targeted to other System z® hardware at a lower or higher hardware level than the local CPC, provided that these hardware levels are supported to coexist with the local CPC level.

The HWICMD service is only allowed to be targeted to at least a System z9® hardware level running on a particular microcode level. BCPii rejects the targeting of this service to any System z hardware level earlier than System z9. See “HWICMD — Issue a BCPii hardware management command” on page 278 for further information.

Consult Table 52 to determine the minimum level of microcode required to run BCPii on a specific hardware level.

Table 52. Minimum BCPii microcode levels by SE hardware level

<table>
<thead>
<tr>
<th>SE hardware level</th>
<th>Minimum microcode level</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM System z9 Driver 67</td>
<td>MCL 258 in the G40965 (SE-SYSTEM) EC stream</td>
</tr>
<tr>
<td>IBM System z10® Driver 79</td>
<td>MCL 163 in the N24409 (SE-SYSTEM) EC stream</td>
</tr>
<tr>
<td>IBM zEnterprise 196</td>
<td>MCL 220 in the N29802 (SE-SYSTEM) EC stream</td>
</tr>
<tr>
<td>IBM zEnterprise EC12</td>
<td>Any level</td>
</tr>
</tbody>
</table>

Consult Table 53 to determine the minimum level of microcode required to run BCPii on a specific HMC level.

Table 53. Minimum BCPii microcode levels by HMC level

<table>
<thead>
<tr>
<th>HMC level</th>
<th>Minimum microcode level</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM System z9 Driver 67</td>
<td>MCL 158 in the G40969 (HMC-SYSTEM) EC stream</td>
</tr>
<tr>
<td>IBM System z10 Driver 79</td>
<td>MCL 034 in the N24415 (HMC-SYSTEM) EC stream</td>
</tr>
<tr>
<td>IBM zEnterprise 196</td>
<td>Any level</td>
</tr>
<tr>
<td>IBM zEnterprise EC12</td>
<td>Any level</td>
</tr>
</tbody>
</table>

Consult Table 54 to determine the minimum level of microcode required to run BCPii on a specific LPAR level.

Table 54. Minimum BCPii microcode levels by LPAR level

<table>
<thead>
<tr>
<th>LPAR level</th>
<th>Minimum microcode level</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM System z9 Driver 67</td>
<td>MCL 008 in the G40954 (LPAR) EC stream</td>
</tr>
<tr>
<td>IBM System z10 Driver 79</td>
<td>MCL 002 in the N24404 (LPAR) EC stream</td>
</tr>
<tr>
<td>IBM zEnterprise 196</td>
<td>Any level</td>
</tr>
</tbody>
</table>
Table 54. Minimum BCPii microcode levels by LPAR level (continued)

<table>
<thead>
<tr>
<th>LPAR level</th>
<th>Minimum microcode level</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM zEnterprise EC12</td>
<td>Any level</td>
</tr>
</tbody>
</table>

Each version of hardware has subtle or sometimes significant changes in the way information is displayed and saved in the support element. The examples serve as a guide only to where the actual definitions that need to be modified are located within the support element configuration windows.

**Enable BCPii communications on the support element**

You need to enable cross-partition authority on the support element to allow the support element to accept the BCPii APIs flowing from the user application through the HWIBCPii address space. This setting controls whether a logical partition can issue a subset of control program instructions to other logical partitions activated on the same CPC.

**Note:** This setting must be selected on the local SE associated with the CPC of the image that the z/OS BCPii application is running on. It must also be selected for any other system for which BCPii communication is required.

To change this setting, perform the following steps on the HMC:

1. Select the CPC that is required.
3. Open the CPC Operational Customization task list.
4. Highlight the CPC icon.
5. Open the Change LPAR Security task, and the Change Logical Partition Security window displays.
6. Check the cross-partition authority checkbox for each image (LPAR) that you want to grant BCPii access. At a minimum, the image (LPAR) the BCPii address space is running needs to have this authority activated.
7. Select Save and Change.

See the HMC book and *System z9 Support Element Operations Guide* and *System z10 Support Element Operations Guide* for more information regarding changing the support element settings.

Failure to set this properly on the local SE associated with the image of z/OS that is running BCPii results in a severe BCPii address space initialization failure. You cannot start the address space and will receive communications error X’101’ with a reason code of X’D4’. Failure to set this up properly on remote SEs to which you want to connect results in the same return code and reason code on the HWICONN service call.

**Note:** Make the same updates to all CPCs that you want BCPii to communicate with and not just the CPC from which the BCPii application is going to run on.

**Define the BCPii community name on the support element**

BCPii uses an SNMP community name to provide a level of security between the z/OS image that is executing the BCPii service and the support element itself.

An SNMP community is a logical relationship between an SNMP agent and an SNMP manager. The community has a name, and all members of a community have the same access privileges: they are either read-only (members can view
configuration and performance information) or read-write (members can view
configuration and performance information, and also change the configuration).

To add the BCPii community name definition to the SE configuration, perform the
following steps on the HMC:

1. Select the CPC that is required.
3. Select the Console Actions view.
4. Select Support Element Settings.
5. Open the Customize API Settings.
6. Check the Enable SNMP APIs checkbox.
7. Consider checking the "Allow capacity change API requests" checkbox on a
z10 or higher operation system if the installation is to allow a BCPii
application to perform temporary capacity upgrades.
8. Make sure that the SNMP agent parameters are blank.
9. Add a BCPii community name. Click on Add. When a window is prompted,
fill in the following fields:

   **Name** The actual SNMP community name. This value is a 1– to 16–character
   alphanumeric field. Only uppercase letters and numbers are allowed.
   Because of restrictions with the security products on z/OS, the BCPii
   SNMP community name must not contain any lowercase characters.
   See "Community name defined in the security product for each CPC”
on page 263 for more information about the SNMP community name.

   **Address** For BCPii, this address (sometimes referred to as a loop-back address)
must be 127.0.0.1.

   **Network mask/Prefix**
   255.255.255.255.

   **Access Type**
   Read/write

10. Save the changes.

See System z9 Support Element Operations Guide and System z10 Support Element
Operations Guide for more information regarding changing the support element
settings.

Failure to set this properly on the local SE associated with the image of z/OS that
is running BCPii results in a severe BCPii failure and you cannot start the address
space. Message HWI022I might be issued if the community name defined on the
support element for the local CPC does not match the definition in the security
product for the local CPC. See "Community name defined in the security product
for each CPC” on page 263 for more information.

**Note:** Make the same updates to all CPCs that you want BCPii to communicate
with.

**Setting up authority to use BCPii**

Given the nature of the BCPii APIs and the capabilities of a BCPii application to
potentially modify vital hardware resources, a number of authority validations are
performed for each BCPii requestor. A BCPii application needs to have program
authority, general security product authority to be able to issue BCPii commands,
authority to the particular resource that the application is trying to access, and a
community name defined in the security product for each CPC to which
communication is required.

**Program authority**
BCPii applications must be program-authorized, meaning that one of the following
must be true of the application:
- Running in supervisor state.
- Running in an authorized key with PSW key mask (PKM) between 0 and 7.
- Residing in an APF-authorized library.

**General security product authority**
A BCPii application needs to have general authority to use BCPii. The profile
HWI.APPLNAME.HWISERV in the FACILITY resource class controls which
applications can use BCPii services. The security administrator must give at least
read authority to this resource, in addition to granting authority to any specific
resource that the application is attempting to access. In addition, BCPii requires
that the FACILITY class to be RACLIST-specified. The RACF syntax is as follows:

```
RDEFINE FACILITY HWI.APPLNAME.HWISERV UACC(NONE)
PERMIT HWI.APPLNAME.HWISERV CLASS(FACILITY) ID(userid) ACCESS(READ)
SETROPTS RACLIST(FACILITY) REFRESH
```

This RACF example allows user JOE to use BCPii services in general:

```
RDEFINE FACILITY HWI.APPLNAME.HWISERV UACC(NONE)
PERMIT HWI.APPLNAME.HWISERV CLASS(FACILITY) ID(JOE) ACCESS(READ)
SETROPTS RACLIST(FACILITY) REFRESH
```

Generic definitions may be created instead of specific users if the installation does
not have specific definitions for every user.

This RACF example defines user IDs BCPII and HWISTART to the security
product:

```
ADDUSER BCPII DFLTGRP(SYS1)
RDEFINE STARTED BCPII.** STDATA(USER(BCPII) GROUP(SYS1))
ADDUSER HWISTART DFLTGRP(SYS1)
RDEFINE STARTED HWISTART.** STDATA(USER(BCPII) GROUP(SYS1))
SETROPTS RACLIST(STARTED) REFRESH
```

**Authority to the particular resource**
A BCPii application needs to have authority to the particular resource that it is
trying to access. That particular resource can be the CPC itself, an image (LPAR)
on a particular CPC, or a particular capacity record on a particular CPC. BCPii
needs a profile defined in the FACILITY resource class that represents the target of
the particular BCPii request. The profile name required to be defined depends on
the type of the particular resource required.

<table>
<thead>
<tr>
<th>Request Type</th>
<th>FACILITY Class Profile Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPC</td>
<td>HWL.TARGET.netid.nau where netid.nau represents the 3– to 17–character SNA name of the particular CPC.</td>
</tr>
<tr>
<td>Image</td>
<td>HWL.TARGET.netid.nau.imagename where netid.nau represents the 3– to 17–character SNA name of the particular CPC and imagename represents the 1– to 8-character LPAR name.</td>
</tr>
<tr>
<td>Capacity record</td>
<td>HWL.CAPREC.netid.nau.caprec where netid.nau represents the 3– to 17–character SNA name of the particular CPC and caprec represents an 8–character capacity record name.</td>
</tr>
</tbody>
</table>
### Request Type | FACILITY Class Profile Required
---|---
Activation profiles | HWI.TARGET.netid.nau where netid.nau represents the 3– to 17–character SNA name of the particular CPC the activation profile is defined.
User-defined image groups | HWI.TARGET.netid.nau where netid.nau represents the 3– to 17–character SNA name of the particular CPC the user-defined image group is defined.

**Note:** For compatibility with security products, BCPii automatically transforms the following names to all uppercase characters: CPC names (including the local CPC name represented by "+"), image names, and capacity record names specified on the HWICONN service.

The access level required for the particular profile depends on the service that the BCPii application attempts to issue. See the BCPii API documentation in this chapter for specifics regarding the minimum access level required for each BCPii API service. The RACF syntax is as follows:

```rational
RDEFINE FACILITY HWI.TARGET.netid.nau UACC(NONE) APPLDATA('uppercasecommunityname')
PERMIT HWI.TARGET.netid.nau CLASS(FACILITY) ID(userid) ACCESS(READ)
SETROPTS RACLIST(FACILITY) REFRESH
```

where netid.nau represents the 3 to 17 character SNA name of the CPC.

This RACF example allows user JOE to have Connect, Event, List, and Query access to CPC NET1.CPC001, using community name XYZ123. See "Community name defined in the security product for each CPC" for more details.

```rational
RDEFINE FACILITY HWI.TARGET.NET1.CPC001 UACC(NONE) APPLDATA('XYZ123')
PERMIT HWI.TARGET.NET1.CPC001 CLASS(FACILITY) ID(JOE) ACCESS(READ)
SETROPTS RACLIST(FACILITY) REFRESH
```

This RACF example grants user JOE with Command, Connect, Event, List, Query, and Set access to any image (LPAR) on NET1.CPC001:

```rational
RDEFINE FACILITY HWI.TARGET.NET1.CPC001.\* UACC(NONE)
PERMIT HWI.TARGET.NET1.CPC001.\* CLASS(FACILITY) ID(JOE) ACCESS(ALTER)
SETROPTS RACLIST(FACILITY) REFRESH
```

**Community name defined in the security product for each CPC**

BCPii uses an SNMP community name to provide a minimal level of security between the z/OS image executing the BCPii service and the support element itself.

An SNMP community name is associated with a particular CPC. The same SNMP community name that was defined in the support element configuration for a particular CPC also must be defined in the security product for each CPC to which communication is required. This community name definition is extracted from the security product by BCPii and propagated to the support element. The support element validates that the community name passed by BCPii is correct before proceeding with the request. See Define the BCPii community name on the Support Element for information about how to define the community name on the SE or how to obtain the already-defined name.

To define the BCPii community name in the security product, use the APPLDATA field with the CPC profile definition to associate a community name with a particular CPC. The RACF syntax is as follows:
where netid.nau represents the 3 to 17 character SNA name of the CPC.

The APPLDATA field for the BCPii community name contains a 1– to 16–character alphanumeric field. Only uppercase letters and numbers are allowed. Because of restrictions with the security products on z/OS, the BCPii SNMP community name must not contain any lowercase characters.

This RACF example assigns a BCPii community name of XYZ123 to an existing CPC definition for CPC name NET1.CPC001:

```
RALTER FACILITY HWI.TARGET.NET1.CPC001 APPLDATA('XYZ123')
SETROPTS RACLIST(FACILITY) REFRESH
```

Note: A community name definition must be defined for at least the local CPC. Otherwise, BCPii cannot continue with initialization of its address space and BCPii services are not available. This is accompanied by message HWI022I.

**BCPii configuration**

The BCPii address space is the bridge between a z/OS application and the support element. The address space can perform the following steps:

- Manage all application connections.
- Builds and receive all internal communication requests to the SE.
- Provide an infrastructure for storage required by callers and by the transport communicating with the SE.
- Provide diagnostic capabilities to help with BCPii problem determination.
- Provide security authentication of requests.

The BCPii address space is mandatory for any BCPii API request. The system attempts to start the HWIBCPii address space during IPL.

BCPii requires the `high-level qualifier`.SCEERUN2 and `high-level qualifier`.SCEERUN data sets to be in the link list concatenation. IBM specifies these data sets in the default link list members (PROGxx) in z/OS 1.10 and higher. BCPii also requires the `high-level qualifier`.SCEERUN2 and `high-level qualifier`.SCEERUN data sets to be APF authorized. Failure to have these two data sets in the link list or APF authorized results in BCPii not being able to be started, accompanied by error message HWI009I that indicates that BCPii could not load a required Language Environment part.

BCPii also includes a parmlib member into SYS1.PARMLIB for default CTRACE settings (CT1HW100) when BCPii initializes. See z/OS MVS Diagnosis: Tools and Service Aids for further information regarding CTRACE settings in BCPii.

**Setting up event notification for BCPii z/OS UNIX applications**

Applications running in a started procedure, batch, TSO or other non z/OS UNIX environment can use the HWIEVENT service and provide their own ENF exit that receives control when the application-requested events occur on the target CPC or image.

Applications running in a z/OS UNIX environment do not have normal ENF exit processing capabilities available and cannot readily listen for ENF signals. The Common Event Adapter (CEA) address space allows z/OS UNIX applications to...
be able to receive such event notifications. BCPii provides several services that use the CEA functionality to deliver these same events to z/OS UNIX callers. See the documentation for the z/OS UNIX-only services of BCPii

“HWIBeginEventDelivery — Begin delivery of BCPii event notifications” on page 396, “HWIEndEventDelivery — End delivery of BCPii event notifications” on page 399, “HWIManageEvents — Manage the list of BCPii events” on page 402, and “HWIGetEvent — Retrieve outstanding BCPii event notifications” on page 407 for details about the services a z/OS UNIX application can use to receive event notification.

The use of the CEA address space by BCPii requires some minor CEA setup before z/OS UNIX-only services of BCPii can work properly.

**CEA address space setup**

The Common Event Adapter (CEA) address space must be active to allow the z/OS UNIX-only services of BCPii to operate. CEA has two modes of operation: minimum or full-function mode. If the z/OS UNIX-only services of BCPii are required to be available, CEA must be running in full-function mode. To activate full-function mode, a set of security product definitions are required. See z/OS Planning for Installation for more information about how to configure Common Event Adapter for full-function mode.

CEA, like BCPii, starts as part of a system IPL. It can be stopped and restarted as well. See z/OS Planning for Installation for more information.

**CEA ENF security configuration**

A z/OS UNIX BCPii application must be granted authority to listen to ENF68 events. With the CEA ENF controls, it is also possible to fine-tune which BCPii events a user is allowed to listen to.

This RACF example gives generic authority to the user id associated with a z/OS UNIX application authority to listen to any BCPii event:

```plaintext
AU user_id OMVS(Uid(n))
SETROPTS GENERIC(SERVAUTH)
RDEFINE SERVAUTH CEA.CONNECT UACC(NONE)
RDEFINE SERVAUTH CEA.SUBSCRIBE.ENF_0068* UACC(NONE)
PERMIT CEA.CONNECT CLASS(SERVAUTH) ID(user_id) ACCESS(READ)
PERMIT CEA.SUBSCRIBE.ENF_0068* CLASS(SERVAUTH) ID(user_id) ACCESS(READ)
SETROPTS RACLIST(SERVAUTH) REFRESH
```

To give specific authority to only certain BCPii events, use the event qualifier as part of the profile name. The event qualifier maps to the event mask for ENF68 in the ENFREQ documentation in z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXG. Hardware events are in the form ‘03xx00yy’ where xx is the event source (‘01’x = CPC, and ‘02’x =image) and yy denotes the particular event.

This RACF example allows user JOE authority to only receive events related to CPC command responses (CmdResp = ‘01’x):

```plaintext
AU JOE OMVS(Uid(5))
RDEFINE SERVAUTH CEA.CONNECT UACC(NONE)
RDEFINE SERVAUTH CEA.SUBSCRIBE.ENF_006803010001 UACC(NONE)
PERMIT CEA.CONNECT CLASS(SERVAUTH) ID(JOE) ACCESS(READ)
PERMIT CEA.SUBSCRIBE.ENF_006803010001 CLASS(SERVAUTH) ID(JOE) ACCESS(READ)
SETROPTS RACLIST(SERVAUTH) REFRESH
```
Setting up access for BCPii TSO/E REXX execs

The TSO/E environment is an unauthorized program environment. BCPii normally requires its APIs to be invoked from a program-authorized application. An installation may choose to allow BCPii APIs to be run under TSO/E REXX by making a configuration update to the "TSO/E Commands and Programs" parmlib member (IKJTSOxx). The program HWIC1TRX must be added to the list of APF-authorized programs that may be called through the TSO Service Facility (AUTHTSF).

The following example shows the syntax required to add BCPii to this list:

```
AUTHTSF NAMES(HWIC1TRX)
```

To activate this change on a live system, issue the SET command: SET IKJTSO=xx;
where xx is the two-character suffix of the IKJTSOxx parmlib member where the update was made.

Once this change is activated, the TSO/E user still requires SAF authorization to the correct BCPii profiles in order to successfully perform the desired BCPii operations.

BCPii startup and shutdown

The BCPii address space normally does not need to be started or shut down. BCPii initialization occurs during system IPL. If the configuration is correct, no further action is required. The address space remains active and ready to handle BCPii requests.

BCPii address space does not start up at IPL

If the HWIBCPii address space is not active after an IPL has been done, look for HWI* messages in the system log. Most of the time, these messages pinpoint the reason for the failure of BCPii to become active.

In most cases, the address space did not start for one of two main reasons:

1. The support element that controls the CPC that contains the image of z/OS on which BCPii is being started has the improper configuration. Make sure all the steps have been followed in "Setting up connectivity to the support element" on page 258.

2. The community name of the local CPC is either not defined in the security product or contains an incorrect value. This is accompanied by message HWI022I (when the value defined in the security product is incorrect). See "Community name defined in the security product for each CPC" on page 263 for detailed information.

When these problems have been corrected, restart the BCPii address space. See "Restarting the HWIBCPii address space" on page 267 for more information.

Ending the HWIBCPii address space

The application of certain kinds of code maintenance or other unusual circumstances might require that the BCPii address space be stopped. To stop the BCPii address space, issue the STOP command for the BCPii address space: P HWIBCPII. In most cases, the address space ends normally. BCPii services are no longer available until the address space is restarted. See z/OS MVS Initialization and Tuning Reference for more information about the STOP HWIBCPII command.

If the STOP command fails to completely bring down the BCPii address space, you can issue the CANCEL command: C HWIBCPII. The address space then ends in a
similar way to the STOP command. See  

z/OS MVS Initialization and Tuning Reference 

for more information about the CANCEL command.

If the CANCEL command still fails to completely bring down the BCPIi, you can issue the FORCE command as a last resort: FORCE HWIBCPII. See  

z/OS MVS Initialization and Tuning Reference 

for more information about the FORCE command.

BCPIi issues an ENF 68 broadcast to notify interested ENF listeners that BCPIi services are no longer available. See  

z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXG 

for more information regarding this ENF signal.

**Restarting the HWIBCPIi address space**

After the BCPIi address space has ended, it can be restarted. A procedure supplied by IBM in SYS1.PROCLIB allows the BCPIi address space to be restarted. Issue the S HWISTART command to restart the HWIBCPIi address space. When message HWI0011 appears, BCPIi is now active and all BCPIi requests may resume.

However, all prior connections are no longer valid, and applications will need to re-establish these connections in order to resume their current BCPIi activity. See  

z/OS MVS Initialization and Tuning Reference 

for more information about the START HWISTART command.

BCPIi issues an ENF 68 broadcast when the address space has completely initialized to notify interested ENF listeners that BCPIi services are now available. See  

z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXG 

for more information regarding this ENF signal.

---

**BCPIi callable services**

You can use base control program internal interface (BCPIi) services to connect an authorized z/OS application to System z configuration resources (such as CPC, image, capacity record, or activation profile data) and to allow that application to potentially modify these resources.

To use base control program internal interface (BCPIi) services, issue calls from high level language programs. Each service requires a set of parameters coded in a specific order on the CALL statement.

This topic describes the CALL statements that invoke BCPIi services. Each description includes a syntax diagram, parameter descriptions, return and reason code explanations with recommended actions. Return and reason codes are shown in hexadecimal and decimal with the associated equate symbols.

This topic contains the following subtopics:

- “Syntax, linkage and programming considerations” on page 268
- “HWICMD — Issue a BCPIi hardware management command” on page 278
- “HWICONN — Establish a BCPIi connection” on page 297
- “HWIDISC — Release a BCPIi connection” on page 308
- “HWIEVENT — Register or unregister for BCPIi events” on page 314
- “HWILIST — Retrieve HMC and BCPIi configuration-related information” on page 326
- “HWIQUERY — BCPIi retrieval of SE/HMC-managed attributes” on page 338
- “HWISET — BCPIi set SE/HMC-managed attributes” on page 366
- “HWIBeginEventDelivery — Begin delivery of BCPIi event notifications” on page 396
Syntax, linkage and programming considerations

Programming language definitions are provided in the following languages:
- In C (HWICIC) in data set SYS1.SIEAHDRV.H. Miscellaneous C constants are defined in HWIZHAPI in the same data set.
- In REXX (HWICIREX) in data set SYS1.MACLIB. Miscellaneous REXX constants are defined in HWIC2REX in the same data set.

Note:
1. If the REXX exec is running under System REXX using the TSO=YES environment, these include files may be read in at the time of execution by the REXX exec. A simple programming example that reads the values into the REXX exec through the use of the EXECIO function is provided in the IBM-supplied REXX samples. See “Programming Examples” on page 278 for further information.
2. If the REXX exec is running under System REXX using the TSO=NO environment, the definitions in these include files may be copied into the REXX exec.
- In assembler (HWICIASM) in data set SYS1.MACLIB. Miscellaneous assembler constants are defined in HWIC2ASM in the same data set.

Calling formats

Some specific calling formats for languages that can invoke the BCPii callable services are:

C      BCPii_service_name (return_code,parm1,parm2, ...)

REXX   ADDRESS BCPii “BCPii_service_name return_code parm1 parm2 ...”

Assembler Call macro
CALL BCPii_service_name,(return_code,parm1,parm2, ...),VLIST

BCPii connection scope

BCPii limits access to active BCPii connections. BCPii will not allow a program to use a previously established BCPii connection unless it is running in the proper environment. BCPii associates a connection with either an address space or a task, depending on the execution environment of the connector. It then uses this association (affinity) to determine if the connection is allowed to be used on subsequent requests.

Connections with address space affinity

The BCPii connections created by a C program, an assembler program, or a System REXX exec are associated with an address space.
- For C and assembler programs, BCPii creates an affinity between the connection and the address space that initiated the connection (via the HWICONN service).
- For a System REXX exec, BCPii creates an affinity between the connection and the address space that initiated the execution of the REXX exec (via the AXREXX authorized service call).
BCPii allows any task running in the same address space to use these connections on subsequent BCPii API calls. In addition, the connection remains active until the address space terminates.

**Connections with task affinity**
The BCPii connections created by a REXX exec running in either a TSO/E or ISV-provided REXX environment are associated with the task that initiated the execution of the REXX exec.

BCPii only allows the task that initiated the connection (via the HWICONN service) to access this connection on subsequent BCPii API calls. In addition, the connection only remains active until the task terminates.

**Linkage considerations**
There are two ways for a compiled BCPii application (non-REXX) to find BCPii callable services:
- Use the linkable stub routine HWICSS from SYS1.CSSLIB to link-edit your object code.
- Use the LOAD macro to find the address of the BCPii callable service at run time and then CALL the service.

**REXX programming considerations**
BCPii supports REXX execs being executed from the System REXX, TSO/E REXX, and independent software vendor (ISV) REXX programming environments. Each REXX environment is unique:
- System REXX supports all BCPii APIs and provides the capability to write sophisticated BCPii applications by utilizing REXX and other programming languages as part of a single application.

**Note:**
- To use the HWIEVENT and HWICMD services, a non-REXX adjunct helper program is needed to call z/OS system services to prepare for events and to coordinate with an event exit. See “Programming Examples” on page 278 for detailed information.
- The System REXX "MODIFY AXR" command is not supported by BCPii. See “Executing a BCPii REXX exec in the System REXX environment” on page 270.
- TSO/E REXX execs are easy to execute from a TSO user. This environment supports all the BCPii APIs, except HWIEVENT and HWICMD.
- ISV-provided REXX environments provide different features, depending on which ISV product is being used. These environments support all the BCPii APIs, except HWIEVENT and HWICMD.

The following table identifies the z/OS BCPii APIs supported in the three REXX environments:

<table>
<thead>
<tr>
<th>BCPii APIs</th>
<th>System REXX environment</th>
<th>TSO/E REXX environment</th>
<th>ISV-provided REXX environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWICONN</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWIDISC</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWILIST</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Chapter 19. Base Control Program internal interface (BCPii) 269
The syntax of the BCPii REXX execs are identical in all three REXX environments. Therefore, a BCPii REXX exec written to be used in one REXX environment can be run in another REXX environment without change.

**Executing a BCPii REXX exec in the System REXX environment**

BCPii supports the invocation of its APIs from the System REXX programming environment. Execs running in this environment are APF-authorized. A user may choose either of the following methods to have their exec run under System REXX:

- Invoke the authorized HWIREXX helper program for basic requests.
- Use the AXREXX macro from an authorized program for more customized requests.

The dataset where the REXX exec is to be run must be specified using the REXXLIB keyword in the AXRxx parmlib member, and users of this program must have the proper authority to run programs residing in LINKLIB.

**BCPii REXX programming restrictions for the System REXX environment:** BCPii does not support being invoked from a REXX exec which has been started via the MODIFY AXR command. Any attempt to run from this environment results in a return code of HWI_REXXInvalidExecutionEnv.

**Using the HWIREXX interface:** For basic REXX execs, BCPii API calls can be run easily from the System REXX programming environment using the supplied HWIREXX helper program, without the need to code an assembler program with an AXREXX macro invocation. IBM provides sample invocation JCL for HWIREXX in SAMPLIB member HWIXMRJL.

The HWIREXX interface provides some of the most common AXREXX macro keywords as input parameters. The following keywords are supported:

**Table 56. HWIREXX keywords**

<table>
<thead>
<tr>
<th>HWIREXX keyword</th>
<th>Required/Optional</th>
<th>Default value</th>
<th>AXREXX macro parameter equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAME=xxx; where xxx is a 1-8 character exec name to be executed.</td>
<td>Required</td>
<td>N/A</td>
<td>NAME</td>
</tr>
<tr>
<td>DSN=xxx.xxx.xxx; where xxx.xxx.xxx is a 1-44 character PDS data set name where the REXX exec output is directed.</td>
<td>Optional</td>
<td>NO_REXXOUTDSN</td>
<td>REXXOUTDSN</td>
</tr>
</tbody>
</table>

Note: The data set may be pre-allocated prior to execution of the exec. If the data set is not pre-allocated, the data set is allocated by System REXX. In either case, the output from the REXX exec is contained in a member name within the data set that matches the specified HWIREXX NAME.
Table 56. HWIREXX keywords (continued)

<table>
<thead>
<tr>
<th>HWIREXX keyword</th>
<th>Required/Optional</th>
<th>Default value</th>
<th>AXREXX macro parameter equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSO=&lt;Y/N&gt;; where 'Y' means to run in the TSO host command environment, and 'N' means to run in the standard MVS host environment.</td>
<td>Optional</td>
<td>N</td>
<td>TSO</td>
</tr>
<tr>
<td>SYNC=&lt;Y/N&gt;; where 'Y' means the request is synchronous, and 'N' means the request is asynchronous.</td>
<td>Optional</td>
<td>Y</td>
<td>SYNC</td>
</tr>
<tr>
<td>TIMELIM=&lt;Y/N&gt;; where 'Y' means that a time limit is applied, and 'N' means that no time limit is applied.</td>
<td>Optional</td>
<td>Y</td>
<td>TIMELIMIT</td>
</tr>
<tr>
<td>TIME=xxx; where xxx is a number value between 1 and 21474536 that represents the number of seconds to allow the exec to run.</td>
<td>Optional</td>
<td>System default value</td>
<td>TIMEINT</td>
</tr>
</tbody>
</table>

See the JCL example HWIXMRJL shipped in SAMPLIB for more information on the invocation of the HWIREXX helper program.

If additional AXREXX macro parameters are required (other than the AXREXX macro parameters listed above) to properly establish the System REXX environment, an explicit invocation of the AXREXX macro is required. See “Using the AXREXX macro” on page 272 for detailed information.

Return codes from the HWIREXX service:

Table 57. Return codes from the HWIREXX service

<table>
<thead>
<tr>
<th>HWIREXX return code (in decimal)</th>
<th>Meaning and action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Meaning: BCPii processed the REXX host command successfully. Action: Consult the BCPii return code on the BCPii service call to determine the final result of the request.</td>
</tr>
<tr>
<td>100</td>
<td>Meaning: Program error. Caller's JCL string has a syntax error. Action: Check for a probable coding error and correct the problem. See “Using the HWIREXX interface” on page 270 for detailed information.</td>
</tr>
<tr>
<td>101</td>
<td>Meaning: Program error. A required parameter is not found. Action: Check for a probable coding error and correct the problem.</td>
</tr>
<tr>
<td>102</td>
<td>Meaning: Program error. No input parameters were specified. Action: Check for a probable coding error and correct the problem.</td>
</tr>
<tr>
<td>103</td>
<td>Meaning: Program error. A parameter keyword was provided that is not supported by HWIREXX. Action: Check for a probable coding error and correct the problem. HWIREXX supports these keywords only: NAME, DSN, TSO, SYNC, TIMELIM, and TIME (which correspond to the AXREXX macro parameters: NAME, REXXOUTDSN, TSO, SYNC, TIMELIMIT, and TIMEINT, respectively.)</td>
</tr>
<tr>
<td>104</td>
<td>Meaning: Program error. Duplicate parameter keys are specified. Action: Check for a probable coding error and correct the problem.</td>
</tr>
<tr>
<td>HWIREXX return code (in decimal)</td>
<td>Meaning and action</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>
| 105                              | **Meaning:** Program error. A keyword may only consist of alphanumeric characters.  
**Action:** Check for a probable coding error and correct the problem. |
| 106                              | **Meaning:** Program error. Parameter values may only consist of alphanumeric characters and periods (.) .  
**Action:** Check for a probable coding error and correct the problem. |
| 107                              | **Meaning:** Program error. The TSO parameter must be Y or N.  
**Action:** Check for a probable coding error and correct the problem. |
| 108                              | **Meaning:** Program error. The SYNC parameter must be Y or N.  
**Action:** Check for a probable coding error and correct the problem. |
| 109                              | **Meaning:** Program error. The TIMELIM parameter must be Y or N.  
**Action:** Check for a probable coding error. Reduce the length to the appropriate size based on the specified parameter. |
| 110                              | **Meaning:** Program error. A parameter value is too long. Name values are limited to 8 characters; data set names are limited to forty-four (44) characters; the TSO value is one character; the SYNC value is one character; the TIMELIM value is one character; and the TIME value is limited to 8 characters.  
**Action:** Check for a probable coding error. Reduce the length to the appropriate size based on the specified parameter. |
| 111                              | **Meaning:** Program error. Blank character is not allowed in the JCL string.  
**Action:** Check for a probable coding error. |
| 2049 - 4111                      | **Meaning:** Reason code returned from AXREXX.  
**Action:** See the AXREXX macro in [z/OS MVS Programming](http://www.ibm.com/support/docdisplay?rs=8787&uid=swg21683829). |
| 4095                             | **Meaning:** System error. An unexpected error is detected. The system rejects the service call.  
**Action:** Search the problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center. |

**Using the AXREXX macro:** If HWIREXX does not provide the options for your REXX exec requires, you can run your REXX exec using the AXREXX macro from the System REXX programming environment.

For example, an assembler program running in supervisor state, PKM 0-7, or APF-authorized can invoke the AXREXX macro to execute a REXX exec as follows:

```plaintext
AXREXX REQUEST=EXECUTE,
    NAME=execname,  
    TSO=NO,  
    REXXARGS=rexxargs,  
    REXXOUTDSN=outsdn,  
    RETCODE=retcode,  
    RETCODE=retcode,  
    RETCODE=retcode,  
```

-----

272  z/OS V2R1.0 MVS Callable Services for HLL
RSNCODE=rncode,  ---- R10 as a result of REXX exec
TIMELIMIT=[YES,NO],  ---- Do you want the REXX exec to timeout?
TIMEINT=numofsecs  ---- If TIMELIMIT=YES, how much time to wait?

After the invocation of the above AXREXX macro, the REXX exec gets control and
the input parameters are passed to the REXX exec. If any output is generated from
the exec, it is directed to the specified output data set and member name. Lastly,
the return code and reason code are returned.

For a complete description of the AXREXX macro and its usage, see z/OS MVS
Programming: Authorized Assembler Services Guide and z/OS MVS Programming:
Authorized Assembler Services Reference ALE-DYN. For a BCPII example showing the
invocation of the AXREXX macro, see SAMPLIB member HWIXMRA1.

Executing a BCPII REXX exec in the TSO/E REXX environment
BCPII supports the invocation of its APIs from the TSO/E REXX programming
environment, as long as the installation has allowed BCPIII to be available from the
TSO/E environment. See Setting up access for BCPII TSO/E REXX execs on page
266 for information on setting up BCPII to run in a TSO/E REXX environment.

BCPII APIs can be run from REXX execs under TSO/E in the following ways:
• TSO/E foreground:
  – Issue the exec from the TSO/E READY mode, or
  – ISPF by using the TSO EXECUTE command.
  See TSO/E REXX User’s Guide for the syntax of the EXECUTE command.
• TSO/E background:
  – Issue the exec from JCL, specifying IKJEFT01 as the program name on the JCL
    EXEC statement. See TSO/E REXX Reference for more information about
    running REXX execs using IKJEFT01.

BCPII REXX programming restrictions for the TSO/E environment: The
following are not supported in BCPII REXX execs running in the TSO/E
environment:
• HWICMD
• HWIEVENT
• HWI_LIST_EVENTS for the BCPII HWILIST service

Executing a BCPII REXX exec in an ISV-provided REXX
environment
BCPII supports the invocation of its APIs from ISV-provided REXX programming
environments, provided that the REXX execs running in this environment are
program-authorized.

Because BCPII support is not native to ISV-provided REXX environments, the BCPII
host command environment must first be enabled. To accomplish this, the BCPII
REXX exec must first invoke the BCPII-provided hwihost function to enable the
BCPII host command environment prior to any BCPII API invocation using "address
bcpii".

Note: It is also recommended (but not required) that you invoke the hwihost
function to disable the BCPII host environment when it is no longer needed by the
BCPII REXX exec.
To enable the BCPii host command environment, add the following statement to your BCPii REXX exec:

```rexx
RC = hwihost("ON")
```

To disable the BCPii host command environment, add the following statement to your BCPii REXX exec:

```rexx
RC = hwihost("OFF")
```

Invocations of the `hwihost` function in an exec running in either the System REXX or TSO/E REXX programming environments are ignored, and the resulting return code is always zero. This ensures compatibility of REXX execs running in any REXX programming environment on z/OS.

**BCPii REXX programming restrictions for an ISV-provided REXX environment:**
The following are not supported in BCPii REXX execs running in an ISV-provided REXX environment:

- HWICMD
- HWIEVENT
- HWL_LIST_EVENTS for the BCPii HWILIST service

**REXX Programming tips**

When programming a BCPii application using REXX, see the specific REXX programming considerations for each individual BCPii callable service for all necessary interface distinctions. Users of the BCPii REXX interface should be aware of the following:

- All parameters passed on BCPii REXX service calls must be REXX variables. Literals are not supported (for example, a variable name which has been assigned the value of a ListType should be specified on the call instead of the value itself).
- Variable names specified on BCPii REXX service calls are limited to 40 characters in length.
- Output variables specified on BCPii REXX service calls may be initialized or un-initialized. On input, the value of output variables are not verified. Output variables are initialized and set by BCPii.
- If the value of an input variable is incompatible with the parameter type required on a particular BCPii REXX service call, an error is flagged. See the REXX programming considerations for each BCPii callable service for the specific interface distinctions.
- The DiagArea for each BCPii REXX service call is returned using stem variables in the form: `x.Diag_Index, x.Diag_Key, x.Diag_Actual, x.Diag_Expected, x.Diag_CommErr` and `x.Diag_Text` (where `x` is the name of the stem variable specified on the parameter list). If no DiagArea information is filled in by BCPii, the value of the DiagArea stem-variable on return is all blanks.
- Stem variables utilized by BCPii have hard-coded stem variable tail values which usually correspond to the documented parameter name. For example, the QueryParm. stem must be prepared in REXX with the exact stem variable "ATTRIBUTEIDENTIFIER".
- The ConnectToken parameter returned on the HWICONN call and passed as input on all subsequent services contains non-displayable characters. Ensure that this ConnectToken is untouched by the REXX exec, thereby allowing subsequent BCPii services to read the value correctly.
- For System REXX execs only: Consider the length of time necessary to run your BCPii REXX exec. BCPii applications are interacting with the CPC’s support
element. Therefore, BCPii REXX execs may take longer to run than other REXX execs. To avoid having your BCPii REXX application end prematurely, even when the amount of time calculated is reasonable to complete your BCPii REXX exec, consider using the TIMELIMIT and TIMEINT keywords on the AXREXX service call. The default TIMELIMIT=YES, TIMEINT=SYSTEM causes the REXX exec to stop running after a predetermined amount of time. The TIMEINT value may be increased to give the REXX exec additional time to complete its execution before being timed out by the system. In certain circumstances, it may be necessary to specify TIMELIMIT=NO to prevent the REXX exec from timing out. This option should be used with caution as System REXX has a finite number of system-wide regions where the System REXX execs are executed. If TIMELIMIT=NO is specified unnecessarily, this could eventually lead to a constrained System REXX environment.

- BCPii connections created under System REXX can be used by any program running in the address space of the connector (Address space affinity). BCPii connections created under the TSO/E or ISV-provided REXX environments can only be used by the same task as the connector (Task affinity). See "BCPii connection scope" on page 268 for detailed information.

- BCPii requires all callers to be program-authorized. REXX execs in the zFS cannot run as APF-authorized when invoked from the shell. Therefore, any calls to BCPii services from REXX execs in this environment will result in a HWI_AUTH_FAILURE return code.

- The built-in REXX RC variable contains the return code from the REXX BCPii host command. This return code indicates BCPii’s acceptance of the supplied REXX BCPii host command. The return codes returned in the RC variable are generally unique to the REXX environment. In contrast, the BCPii service return code, the variable supplied on the service call itself, is only filled in if the RC variable has a value of HWI_OK (0) or HWI_REXXParmSyntaxError (1). Possible return codes returned by BCPii in the RC variable are:

### Return codes from a REXX BCPii host command

<table>
<thead>
<tr>
<th>REXX RC returned from a BCPii host command (in decimal)</th>
<th>Meaning and action</th>
</tr>
</thead>
</table>
| 0 HWI_OK                                               | **Meaning:** BCPii processed the REXX host command successfully.  
  **Action:** Consult the BCPii return code on the BCPii service call to determine the final result of the request. |
| 1 HWI_REXXParmSyntaxError                              | **Meaning:** Program error. The REXX BCPii host command has detected that the format of the parameters is not in the proper form to be accepted by BCPii.  
  **Action:** Check for a probable coding error. See the BCPii return code on the BCPii service call to determine the reason for the syntax error. See the REXX programming considerations of the BCPii service to see the exact calling specifications. Compare the BCPii REXX service call attempted with service call examples in the supplied BCPii REXX programming sample found in SYS1.SAMPLIB. See the DiagArea for further diagnostic information. |
| 2 HWI_REXXUnsupportedService                           | **Meaning:** Program error. An unknown BCPii service name was specified on the BCPii REXX host command.  
  **Action:** Check for a probable coding error. Specify a valid BCPii service name (for example, HWICONN, HWILIST, and so on). |
### Table 58: Return codes from a REXX BCPii host command (continued)

<table>
<thead>
<tr>
<th>REXX RC returned from a BCPii host command (in decimal)</th>
<th>Meaning and action</th>
</tr>
</thead>
</table>
| 3 HWI_REXXInvalidNumofParms | **Meaning:** Program error. The number of parameters specified on the BCPii REXX host command for the service name specified does not match the number of parameters expected.  
**Action:** Check for a probable coding error. See the REXX programming considerations of the BCPii service to see the exact calling specifications. Compare the BCPii REXX service call attempted with service call examples found in the supplied BCPii REXX programming sample found in SYS1.SAMPLIB. |
| 4 HWI_REXXStemVarRequired | **Meaning:** Program error. The BCPii REXX service specified on the BCPii REXX host command is missing one or more required stem variables in the positional parameter list.  
**Action:** Check for a probable coding error. See the REXX programming considerations of the BCPii service to see the exact calling specifications. A stem variable parameter must specify a “.” following the variable name (for example, “var.”). Also, compare the BCPii REXX service call attempted with service call examples found in the supplied BCPii REXX programming sample found in SYS1.SAMPLIB. |
| 5 HWI_REXXParmNameTooLong | **Meaning:** Program error. One or more variables specified on the BCPii REXX service call on the BCPii REXX host command is greater than the BCPii maximum REXX variable length (40).  
**Action:** Check for a probable coding error. Reduce the variable name lengths on the BCPii REXX service call to be 40 characters or less in length. |
| 6 HWI_REXXInvalidHostEnv | **Meaning:** System error. BCPii detected an unexpected error. The system rejects the service call.  
**Action:** Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center. |
| 7 HWI_REXXInvokerNotFound | **Meaning:** Program error. The address space issuing the AXREXX invocation is no longer running. No new BCPii connections are allowed.  
**Action:** Determine the reason that the AXREXX-invoking address space terminated prior to the termination of the REXX exec. Correct the situation and start again. |
| 8 HWI_REXXInvalidExecutionEnv | **Meaning:** Program error. BCPii does not support the BCPii host command running in the current execution environment.  
If the current execution environment is System REXX, it may mean that an attempt was made to issue a BCPii host command from an exec that was started using the MODIFY AXR command.  
If the current execution environment is either TSO/E or ISV-provided REXX, it may mean that the requested service was not supported in this environment.  
**Action:** Run the BCPii host command from a supported environment. |
| 9 HWI_REXXUnSupportedListType | **Meaning:** Program error. BCPii does not support the specified ListType on the BCPii HWILIST service in the current execution environment.  
**Action:** Correct the specified ListType value or try this request again in a valid execution environment (for example, the System REXX environment). |
### Table 58. Return codes from a REXX BCPii host command (continued)

<table>
<thead>
<tr>
<th>REXX RC returned from a BCPii host command (in decimal)</th>
<th>Meaning and action</th>
</tr>
</thead>
</table>
| 32 HWI_REXXInternalSystemError | **Meaning:** System error. BCPii detected an unexpected error while invoking REXX services. The system rejects the service call.  
**Action:** A symptom record has been written to LOGREC to record the problem. Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center. |
| 4095 HWI_Unexpected_Error | **Meaning:** System error. BCPii detected an unexpected error. The system rejects the service call.  
**Action:** A symptom record has been written to LOGREC to record the problem. Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center. |

### REXX return codes from the BCPii hwihost function

Table 59. REXX return codes from the BCPii hwihost function. The following return codes apply only to callers running their BCPii REXX execs in an ISV-provided REXX environment.

<table>
<thead>
<tr>
<th>REXX RC returned by the BCPii hwihost function</th>
<th>Meaning and action</th>
</tr>
</thead>
</table>
| 1 HWI_hwihost_ParmSyntaxError | **Meaning:** Program Error. The specified argument is not "ON" or "OFF".  
**Action:** Check for a probable coding error. Try this request again with an argument of "ON" or "OFF". |
| 2 HWI_hwihost_InternalSystemError | **Meaning:** System error. BCPii detected an unexpected error while invoking TSO/E REXX services. The system rejects the service call.  
**Action:** A symptom record has been written to LOGREC to record the problem. Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center. |

### Sample REXX exec

Here is a sample REXX exec using BCPii calls that lists the names of all of the interconnected CPCs and then attempts to connect to each one of them:

```rexx
/* REXX */
ListType = HWI_LIST_CPCS;
Address BCPII "HWILIST Retcode ConnectToken ListType AnswerArea.
DiagArea."

If RC = 0 & retcode = 0 Then
  Do
    ConnectType = HWI_CPC  
    Do i = 1 To AnswerArea.0
      Say "CPC" i ":" AnswerArea.i

    InConnectToken = 0
    Address BCPII "HWICONN Retcode InConnectToken OutConnectToken
    ConnectType AnswerArea.i DiagArea."
    If RC = 0 & retcode = 0 Then
      Say "Connected to CPC "AnswerArea.i"."
  End
End
```
For REXX execs running in an ISV-provided environment, make sure to add the following line prior to the first address BCPii statement:

RC = hwihost("ON")

**Assembler programming considerations**

Callers must also use the following linkage conventions:

- Register 1 must contain the address of a parameter list that is a list of consecutive words, each containing the address of a parameter to be passed. The last word in this list must have a 1 in the high-order (sign) bit.
- Register 13 must contain the address of an 18-word save area.
- Register 14 must contain the return address.
- Register 15 must contain the entry point address of the service being called.
- If the caller is running in AR ASC mode, access registers 1, 13, 14, and 15 must all be set to zero.

On return from the service, general and access registers 2 through 14 are restored (registers 0, 1 and 15 are not restored).

**Programming Examples**

BCPii provides sample programs to aid in the creation of BCPii applications in both C and REXX programming languages. The samples are shipped in SYS1.SAMPLIB.

HWIXMCS1 (Metal C programming language) provides an example of how to use all of the BCPii APIs and how to construct a simple BCPii application. HWIXMCX1 (Metal C programming language) provides a simple example of how a BCPii Event Notification Facility (ENF) exit could be coded to field various BCPii-registered events.

HWIXMRS1 (REXX programming language) provides an example of how to use the most common BCPii APIs. It can easily be invoked in the System REXX environment by utilizing the IBM-provided HWIREXX program using the provided sample JCL HWIXMRJL.

Another REXX sample (HWIXMRS2) is provided to show how a REXX application can utilize the HWIEVENT and HWICMD APIs. It is invoked using an AXREXX macro invocation in the sample assembler "helper" program (HWIXMRA1). This second sample can utilize the Metal C ENF exit HWIXMCX1.

**HWICMD — Issue a BCPii hardware management command**

Call the HWICMD service to perform a command against an HMC-managed object that is associated with central processor complexes (CPCs) and CPC images (LPARs). User-defined image groups can also be utilized to target multiple images with a single command.

BCPii commands, because of the very nature of what they are attempting to do, may take a significant amount of time to complete. To prevent applications from being tied up for an excessive amount of time while waiting for the command to complete, HWICMD will return to the caller either when the command has been accepted by the target support element (SE) or when the command was found to contain errors. The actual completion of the command can be determined by consulting the final return code returned in the BCPii command response event.
To receive this BCPii command response event, an application must have registered for the Hwi_Event_CmdResp event prior to the HWICMD invocation. Registration for this or any event is accomplished by calling the HWIEVENT service, or for z/OS UNIX callers, by calling HwiManageEvents. The HWIEVENT service requires a user-supplied Event Notification Facility (ENF) exit.

When the command completes, BCPii will signal the ENF to notify registered applications that a command response has been received. For non-z/OS UNIX callers, the ENF exit specified will receive control and the command response event returned data will contain the final return code of the request. For z/OS UNIX callers, the HwiGetEvent service can be used to receive the event notification and to determine the final return code of the HWICMD service.

**Description**

**Environment**

The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization</td>
<td>One of the following: PKM allowing key 0-7, supervisor state, or APF-authorized</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary or access register (AR)</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage</td>
<td>Standard MVS linkage conventions are used</td>
</tr>
</tbody>
</table>

**Programming requirements**

See "Syntax, linkage and programming considerations” on page 268 for details about how to call BCPii services in the various programming languages.

The microcode level that supports the command service call (HWICMD) of BCPii is required to be installed on the target CPC. See the HWI_CMD_NOT_SUPPORT_WARNING return code in “HWICONN — Establish a BCPii connection” on page 297 for more information.

See “HWICMD” on page 428 for the summary table of the BCPii HWICMD types and the objects that can be targeted for each command.

**REXX programming considerations for the HWICMD service**

All information for the HWICMD service applies for REXX requests except:

- A stem variable (for example, CmdParm_ptr) replaces CmdParm_ptr.
- The CmdParm structure names in Table 60 on page 284 are used as the dot-qualified names in the CmdParm stem variable. The following are exceptions:
  - On the HWI_CMD_POWER_CONTROL, HWI_CMD_TEMPCAP, and HWI_CMD_SYSPLEX_TIME_SET_STP_CONFIG commands, XML replaces XML_ptr and XML_Size is ignored.
  - On the HWI_CMD_SYSRESET_IPLT command, IPL_Token replaces IPL_Token_Ptr and IPL_Token_Len is ignored.
Restrictions
- BCPii does not allow any HWICMD to be targeted to a CPC that is earlier than a z9 platform.
- BCPii does not allow HWICMD to be issued from within a BCPii ENF exit routine.
- BCPii does not allow any HWICMD to be issued from a REXX exec running in a TSO/E or ISV-provided REXX environment.

Authorization
The client application must have access to consult the local CPC. This is granted by allowing the application at least read access to the SAF-protected FACILITY class resource HWLAPPLNAME.HWISERV.

The client application must have at least control access to the following SAF-protected FACILITY class resource profiles:
- HWI.TARGET.netid.nau for a ConnectToken that represents a CPC connection or an image group connection.
- HWI.TARGET.netid.nau.imagename for a ConnectToken that represents an image connection.
- HWI.TARGET.netid.nau.imagename for all individual images within the image group for a ConnectToken that represents a user-defined image group.

Note: BCPii requires the FACILITY class to be RAclist-specified.

Syntax
Write the call as shown in the syntax diagram. You must code all parameters on the CALL statement in the order shown.

<table>
<thead>
<tr>
<th>Non-REXX parameters</th>
<th>REXX parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL HWICMD(</td>
<td>address bcpii “hwicmd</td>
</tr>
<tr>
<td>ReturnCode,</td>
<td>ReturnCode</td>
</tr>
<tr>
<td>ConnectToken,</td>
<td>ConnectToken</td>
</tr>
<tr>
<td>CmdType,</td>
<td>CmdType</td>
</tr>
<tr>
<td>CmdParm_Ptr,</td>
<td>CmdParm.</td>
</tr>
<tr>
<td>DiagArea);</td>
<td>DiagArea.”</td>
</tr>
</tbody>
</table>

Parameters
The parameters are explained as follows:

ReturnCode
  Returned parameter
  • Type: Integer (non-REXX), character representation of an integer (REXX)
  • Length: 4 bytes (non-REXX)
  ReturnCode contains the return code from the service.

ConnectToken
  Supplied parameter
  • Type: Character string
  • Length: 16 bytes
  ConnectToken specifies the connect token that this command is executed against. A ConnectToken represents a logical connection between the application and a CPC or an image, and is returned as an output parameter on the HWICONN service call.
A ConnectToken representing a user-defined image group may also be specified. In this case, the command will be executed on all members in the group, and not just on a single image.

The ConnectToken specified must have originated from a HWICONN service call that was issued from the same address space as this service call.

**CmdType**

Supplied parameter

- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

CmdType specifies the type of the requested command.

See the following publications for more information about how the various commands operate, what inputs are required, and what outputs are expected:

- System z Application Programming Interfaces (SB10-7030-13)
- System z10 and eServer zSeries Application Programming Interfaces (SB10-7030-09)
- System z9 and eServer zSeries Application Programming Interfaces (SB10-7030-08)
- zEnterprise System Support Element Operations Guide (SC28-6896-02)
- System z10 Support Element Operations Guide (SC28-6858-02)
- System z9 Support Element Operations Guide (SC28-6858-01)

<table>
<thead>
<tr>
<th>Constant in Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Activate request to start target systems with the default activation profile name (HWI_APROF) associated with a CPC or an image. Note: The input connection token represents a CPC connection, an image connection, or an image group connection. This command cannot be issued specifying a connect token that represents either the local CPC or the local image.</td>
</tr>
<tr>
<td>(1) HWI_CMD_ACTIVATE</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Deactivate request to close down target systems. Note: The input connection token represents a CPC connection, an image connection, or an image group connection. This command cannot be issued specifying a connect token that represents either the local CPC or the local image.</td>
</tr>
<tr>
<td>(2) HWI_CMD_DEACTIVATE</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Hardware messages request. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>(3) HWI_CMD_HWMSG</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Capacity backup CPC feature operation. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>(4) HWI_CMD_CBU</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>On/Off capacity on demand request. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>(5) HWI_CMD_OOCOD</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Access CPC activation profiles. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>(6) HWI_CMD_PROFILE</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Set exclusive CPC control. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>(7) HWI_CMD_RESERVE</td>
<td></td>
</tr>
<tr>
<td>Symbol</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
</tbody>
</table>
| 8      | HWI_CMD_SYSRESET | System reset request for target systems. See Cmdtype HWI_CMD_SYSRESET_IPLT for the latest version of the Sysreset command.  
**Note:** The input connection token must only represent an image connection or an image group connection. This command cannot be issued specifying a connect token that represents the local image. |
| 9      | HWI_CMD_START | Start request for all CPs on target systems.  
**Note:** The input connection token must only represent an image connection or an image group connection. This command cannot be issued specifying a connect token that represents the local image. |
| A      | HWI_CMD_STOP | Stop request for all CPs on target systems.  
**Note:** The input connection token must only represent an image connection or an image group connection. This command cannot be issued specifying a connect token that represents the local image. |
| B      | HWI_CMD_PSWRESTART | Restart request for one CP on target systems. The first CP that is found to be in the correct state is reset.  
**Note:** The input connection token must only represent an image connection or an image group connection. This command cannot be issued specifying a connect token that represents the local image. |
| C      | HWI_CMD_OSCMD | Send operating system command request.  
**Note:** The input connection token must only represent an image connection. |
| D      | HWI_CMD_LOAD | Load request to IPL target operating systems.  
**Note:** The input connection token must only represent an image connection or an image group connection. This command cannot be issued specifying a connect token that represents the local image. |
| E      | HWI_CMD_TEMPCAP | Addition or removal of temporary capacity.  
**Note:** The input connection token must only represent a CPC connection. |
| F      | HWI_CMD_SYSRESET_IPLT | System reset request for target systems with IPL token correlation. This is an enhanced version of HWI_CMD_SYSRESET.  
**Note:** The input connection token must only represent an image connection. |
| 10     | HWI_CMD_ACTIVATE _WITH_ACTPROF | Activate request to start target systems using a supplied activation profile name. This is an enhanced version of the HWI_CMD_ACTIVATE command.  
**Note:** The input connection token must only represent a CPC connection or an image connection. |
| 11     | HWI_CMD_POWER_CONTROL | Control the power usage characteristics.  
**Note:** The input connection token must only represent a CPC connection. |
| 12     | HWI_CMD_SCSI_LOAD | SCSI Load from FCP (Fibre Channel Protocol for SCSI) attached SCSI (Small Computer System Interface) disks.  
**Note:** The input connection token must only represent an image connection or an image group connection. |
| 13     | HWI_CMD_SCSI_DUMP | SCSI Dump to FCP (Fibre Channel Protocol for SCSI) attached SCSI (Small Computer System Interface) disks.  
**Note:** The input connection token must only represent an image connection. |
<table>
<thead>
<tr>
<th>Constant in Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 (20) HWI_CMD_SYSPLEX_TIME_SWAP_CTS</td>
<td>In a configured STP-only coordinated timing network (CTN), one CPC has the role of current time server (CTS). If the CTN has both a preferred time server and a backup time server configured, either one can be the CTS. This command swaps the role of CTS from preferred time server to backup time server or vice versa. The target system must be the system that will become the CTS. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>15 (21) HWI_CMD_SYSPLEX_TIME_SET_STP_CONFIG</td>
<td>This command sets the configuration for an STP-only coordinated timing network (CTN). The target system must be the system that will become the current time server (CTS). Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>16 (22) HWI_CMD_SYSPLEX_TIME_CHANGE_STP_ONLY_CTN</td>
<td>This command, sent to the defined CPC with the role of current time server (CTS) in an STP-only coordinated timing network (CTN), changes the STP_ID portion of the CTN ID for the entire STP-only CTN. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>17 (23) HWI_CMD_SYSPLEX_TIME_JOIN_STP_ONLY_CTN</td>
<td>This command allows a CPC to join an STP-only coordinated timing network (CTN). The target system cannot be the current time server. If the CPC is already participating in an STP-only CTN, it will be removed from that CTN and joined to the specified one. If the CPC has an ETR ID, it will be removed. Note: The input connection token must only represent a CPC connection. Attention: Use extreme caution when issuing this command. Joining the STP-only CTN may result in a disabled wait state for all images that are in a parallel sysplex on the target CPC.</td>
</tr>
<tr>
<td>18 (24) HWI_CMD_SYSPLEX_TIME_LEAVE_STP_ONLY_CTN</td>
<td>This command removes a CPC from an STP-only coordinated timing network (CTN). The target system cannot be the current time server. Note: The input connection token must only represent a CPC connection. Attention: Use extreme caution when issuing this command. Leaving the STP-only CTN may result in a disabled wait state for all images that are in a parallel sysplex on the target CPC.</td>
</tr>
</tbody>
</table>

**CmdParm_Ptr (non-REXX)**
**CmdParm. (REXX)**
Supplied parameter
- Type: Pointer (non-REXX), stem variable (REXX)
- Length: 4 bytes (non-REXX)

**Non-REXX:**
CmdParm_Ptr specifies the address of the command parameter that contains a structure of the input parameters for the requested command.

Take the following action according to the different conditions:
- For all optional parameters, callers are required to initialize the parameters to zero for BCPii to interpret them as null parameters unless otherwise specified.
- For commands with one or more required parameters and also with one or more optional parameters, callers are required to initialize each optional parameter to zero if they require BCPii to take the default action for that parameter.
- For commands that have only optional parameters, callers can initialize the CmdParm_Ptr to zero if they require BCPii to take the default action for all parameters.
- For commands that have no parameters, the CmdParm_Ptr is ignored.
• All string type parameters are required to be padded with trailing blanks unless otherwise specified.

• For commands that target image groups, the parameters specified in the CmdParm must be appropriate for all the images in the image group.

**REXX:**
CmdParm stem contains compound (stem) variables which represent input parameters for the requested command. The tail names of the stem variable are constants which must match the parameter names in the table below.

For optional parameters that are not initialized, BCPII interprets them as null parameters.

**Table 60. Structure pointed to by CmdParm_Ptr (non-REXX); CmdParm stem variable (REXX)**

<table>
<thead>
<tr>
<th>CmdType</th>
<th>CmdParm (non-REXX)</th>
<th>Parameters in Structure (non-REXX) / Tail name constant of the user-defined CmdParm stem (REXX)</th>
<th>Parameter Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTIVATE</td>
<td>HWI_CMD_ACT_PARM</td>
<td>ForceType</td>
<td>A 4-byte integer (optional, the default is FORCE):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means Force YES (HWI_CMD_FORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means Force NO (HWI_CMD_NOFORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> Only a ForceType of HWI_CMD_FORCE will result in a successful activation of the target CPC or image if the target CPC or image is already active.</td>
</tr>
<tr>
<td>DEACTIVATE</td>
<td>HWI_CMD_DEACT_PARM</td>
<td>ForceType</td>
<td>A 4-byte integer (optional, the default is FORCE):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means Force YES (HWI_CMD_FORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means Force NO (HWI_CMD_NOFORCE)</td>
</tr>
<tr>
<td>HWMSG</td>
<td>HWI_CMD_HWMSG_PARM</td>
<td>HWMSGType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means REFRESH (HWI_CMD_HWMSG_REFRESH)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means DELETE (HWI_CMD_HWMSG_DELETE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HWMSGTimestamp</td>
<td>A null-terminated character string, up to 32 characters long. Required only for HWMSGType = HWI_CMD_HWMSG_DELETE.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The timestamp specified must be an exact match of a timestamp returned on a HWMSGType = HWI_CMD_HWMSG_REFRESH request.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>An example of a timestamp: '08-20-2010 11:01: 23:145'.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>To delete a message, first run an HWI_CMD_HWMSG_REFRESH request to obtain the full timestamp and then issue the HWI_CMD_HWMSG_DELETE request, specifying the timestamp.</td>
</tr>
</tbody>
</table>
Table 60. Structure pointed to by CmdParm_Ptr (non-REXX); CmdParm stem variable (REXX) (continued)

<table>
<thead>
<tr>
<th>CmdType : HWI_CMD_</th>
<th>CmdParm (non-REXX)</th>
<th>Parameters in Structure (non-REXX) / Tail name constant of the user-defined CmdParm stem (REXX)</th>
<th>Parameter Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBU</td>
<td>HWI_CMD_CBU_PARM</td>
<td>CBUType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means ACTIVATE (HWI_CMD_ACT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means UNDO (HWI_CMD_UNDO)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ActivateType</td>
<td>A 4-byte integer (required only for CBUType = HWI_CMD_ACT):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means REAL CBU (HWI_CMD_REAL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means TEST CBU (HWI_CMD_TEST)</td>
</tr>
<tr>
<td>OOCOD</td>
<td>HWI_CMD_OOCOD_PARM</td>
<td>OOCODType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means ACTIVATE (HWI_CMD_ACT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means UNDO (HWI_CMD_UNDO)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OrderNumber</td>
<td>Required for OOCODType = HWI_CMD_ACT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AreaNumber</td>
<td>A 2-byte integer area number is required and must be in the range of 1 to 4.</td>
</tr>
<tr>
<td>PROFILE</td>
<td>HWI_CMD_PROFILE_PARM</td>
<td>ProfileType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means IMPORT (HWI_CMD_PROFILE_IMPORT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means EXPORT (HWI_CMD_PROFILE_EXPORT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ApplName</td>
<td>An 8-character application name (required) padded with trailing blanks.</td>
</tr>
<tr>
<td>RESERVE</td>
<td>HWI_CMD_reserve_PARM</td>
<td>ReserveType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means ADD (HWI_CMD_RESERVE_ADD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means DELETE (HWI_CMD_RESERVE_DELETE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ResetType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means NORMAL (HWI_CMD_RESET_NORMAL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means CLEAR (HWI_CMD_RESET_CLEAR)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ForceType</td>
<td>A 4-byte integer (optional, the default is FORCE):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means Force YES (HWI_CMD_FORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means Force NO (HWI_CMD_NOFORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Note: Only a ForceType of HWI_CMD_FORCE will result in a successful sysreset of the target CPC or image if the target CPC or image is already active.</td>
</tr>
<tr>
<td>START</td>
<td>0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>STOP</td>
<td>0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>PSWRESTART</td>
<td>0</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Table 60. Structure pointed to by CmdParm_Ptr (non-REXX); CmdParm stem variable (REXX) (continued)

<table>
<thead>
<tr>
<th>CmdType : HWI_CMD_</th>
<th>CmdParm (non-REXX)</th>
<th>Parameters in Structure (non-REXX) / Tail name constant of the user-defined CmdParm stem (REXX)</th>
<th>Parameter Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSCMD</td>
<td>HWI_CMD_OSCMD_PARM</td>
<td>PriorityType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means Priority (HWI_CMD_PRIORITY)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means Non-Priority (HWI_CMD_NONPRIORITY)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> For WTOR replies targeting a z/OS image, a PriorityType of Non-Priority may need to be specified to allow z/OS to receive the reply command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OSCMDString</td>
<td>A 126-null-terminated character operating system command string (required).</td>
</tr>
<tr>
<td>LOAD</td>
<td>HWI_CMD_LOAD_PARM</td>
<td>LoadAddr</td>
<td>A 4-character string consisting only of hexadecimal characters identifying the device address to be used when performing the load (optional).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LoadParm</td>
<td>An 8-character string as determined by the operating system being loaded (optional).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ForceType</td>
<td>A 4-byte integer (optional, the default is FORCE):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means Force YES (HWI_CMD_FORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means Force NO (HWI_CMD_NOFORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> Only a ForceType of HWI_CMD_FORCE will result in a successful load of the target CPC or image if the target CPC or image is already active.</td>
</tr>
<tr>
<td>TEMPCAP</td>
<td>HWI_CMD_TEMPCAP_Parm</td>
<td>TEMPCAPType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means Add (HWI_CMD_TEMPCAP_ADD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means Remove (HWI_CMD_TEMPCAP_REMOVE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XML_Ptr (non-REXX)</td>
<td>A character string pointer that points to the address of the XML information that illustrates the markup used to perform activation of the temporary capacity (required).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XML (REXX)</td>
<td>XML information that illustrates the markup used to perform activation of the temporary capacity (required).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XML_Size (non-REXX)</td>
<td>A 4-byte integer (required).</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Length in bytes of the XML that the XML_Ptr points to.</td>
</tr>
<tr>
<td>SYSRESET</td>
<td>HWI_CMD_SYSRESET_IPLT</td>
<td>ResetType</td>
<td>A 4-byte integer (required):</td>
</tr>
<tr>
<td></td>
<td>_IPLT_PARM</td>
<td></td>
<td>• 1 – means NORMAL (HWI_CMD_RESET_NORMAL)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means CLEAR (HWI_CMD_RESET_CLEAR)</td>
</tr>
<tr>
<td>CmdType : HWI_CMD_</td>
<td>CmdParm (non-REXX)</td>
<td>Parameters in Structure (non-REXX) / Tail name constant of the user-defined CmdParm stem (REXX)</td>
<td>Parameter Values</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------</td>
<td>---------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>HWI_CMD_ACT_</td>
<td>_ACTPROF</td>
<td>ForceType</td>
<td>A 4-byte integer (optional, the default is FORCE):</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means Force YES (HWI_CMD_FORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means Force NO (HWI_CMD_NOFORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> Only a ForceType of HWI_CMD_FORCE will result in a successful sysreset of the target CPC or image if the target CPC or image is already active.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPL_Token_Ptr (non-REXX)</td>
<td>A character string pointer that specifies the address of the IPL token used to correlate a SYSRESET with other outstanding HMC-related activities. This ensures that this SYSRESET is operating with the same IPL instance as when the IPL_Token was retrieved (required).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPL_Token (REXX)</td>
<td>IPL token used to correlate a SYSRESET with other outstanding HMC-related activities. This ensures that this SYSRESET is operating with the same IPL instance as when the IPL_Token was retrieved (required).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPL_Token_Len (non-REXX)</td>
<td>A 4-byte integer (required). Length in bytes of the IPL token to which the IPL_Token_Ptr points.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ACTIVATE_ WITH _ACTPROF_PARM</td>
<td>ActProfName</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POWER _CONTROL _CONTROL_PARM</td>
<td>ForceType</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 1 – means Force YES (HWI_CMD_FORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• 2 – means Force NO (HWI_CMD_NOFORCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Note:</strong> Only a ForceType of HWI_CMD_FORCE will result in a successful activation of the target CPC or image if the target CPC or image is already active.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XML_Ptr (non-REXX)</td>
<td>A character string pointer that points to the address of the XML fragment describing the power characteristics to be applied to the CPC specified by the connect token (required).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XML (REXX)</td>
<td>XML fragment describing the power characteristics to be applied to the CPC specified by the connection token (required).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>XML_Size (non-REXX)</td>
<td>A 4-byte integer (required). Length in bytes of the XML that the XML_Ptr points to.</td>
</tr>
</tbody>
</table>
## Table 60. Structure pointed to by CmdParm_Ptr (non-REXX); CmdParm stem variable (REXX) (continued)

<table>
<thead>
<tr>
<th>CmdType : HWI_CMD_</th>
<th>CmdParm (non-REXX)</th>
<th>Parameters in Structure (non-REXX) / Tail name constant of the user-defined CmdParm stem (REXX)</th>
<th>Parameter Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCSI_LOAD</td>
<td>HWI_CMD_SCSI_LOAD_PARM</td>
<td>LoadAddr</td>
<td>A 4-character string (optional) consisting only of hexadecimal characters (0-9, A-F) identifying the device address to be used when performing the SCSI load. Defaults to value last used when previous SCSI Load was performed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LoadParm</td>
<td>An 8-character string (optional) as determined by the operating system being loaded. Defaults to value last used when previous SCSI Load was performed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WW_Portname</td>
<td>A 16-character string (optional) identifying the World Wide Port Name to be used when performing a SCSI Load. Defaults to value last used when previous SCSI Load was performed. The character string must be comprised of hexadecimal values only (0-9, A-F).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LU_Num</td>
<td>A 16-character string (optional) identifying the logical unit number (LUN) to be used when performing the SCSI Load. Defaults to value last used when previous SCSI Load was performed. The character string must be comprised of hexadecimal values only (0-9, A-F).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boot_Pgm_Selector</td>
<td>A 4-byte integer (optional) identifying the boot program selector to be used for the SCSI Load. Defaults to value last used when previous SCSI Load was performed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Opsys_Loadparm</td>
<td>A 256-character string (optional) representing the operating system-specific load parameters to be used for the SCSI Load. Defaults to value last used when previous SCSI Load was performed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bootrec_Blk_Addr</td>
<td>A 16-character string (optional) representing the boot record logical block address to be used for the SCSI Load. Defaults to value last used when previous SCSI Load was performed. The character string must be comprised of hexadecimal values only (0-9, A-F).</td>
</tr>
</tbody>
</table>
|                  |                    | ForceType | A 4-byte integer (optional), the default is FORCE:  
|                  |                    |          | • 1 – means Force YES (HWI_CMD_FORCE)  
|                  |                    |          | • 2 – means Force NO (HWI_CMD_NOFORCE)  
<p>|                  |                    |          | <strong>Note:</strong> Only a ForceType of HWI_CMD_FORCE will result in a successful load of the target CPC or image if the target CPC or image is already active. |
| SCSI_DUMP        | HWI_CMD_SCSI_DUMP_PARM | LoadAddr | A 4-character string (optional) consisting only of hexadecimal characters (0-9, A-F) identifying the device address to be used when performing the SCSI Dump. Defaults to value last used when previous SCSI Dump was performed. |</p>
<table>
<thead>
<tr>
<th>CmdType : HWI_CMD_</th>
<th>CmdParm (non-REXX)</th>
<th>Parameters in Structure (non-REXX) / Tail name constant of the user-defined CmdParm stem (REXX)</th>
<th>Parameter Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>LoadParm</td>
<td>An 8-character string (optional) used when performing the SCSI dump. Defaults to value last used when previous SCSI Dump was performed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WW_Portname</td>
<td>A 16-character string (optional) identifying the World Wide Port Name to be used when performing a SCSI Dump. Defaults to value last used when previous SCSI Dump was performed. The character string must be comprised of hexadecimal values only (0-9, A-F).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LU_Num</td>
<td>A 16-character string (optional) identifying the logical unit number (LUN) to be used when performing the SCSI Dump. Defaults to value last used when previous SCSI Load was performed. The character string must be comprised of hexadecimal values only (0-9, A-F).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boot_Pgm_Selector</td>
<td>A 4-byte integer (optional) identifying the boot program selector to be used for the SCSI Dump. Defaults to value last used when previous SCSI Load was performed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opsys_Loadparm</td>
<td>A 256-character string (optional) representing the operating system-specific load parameters to be used for the SCSI Dump. Defaults to value last used when previous SCSI Dump was performed. Note: If less than 256 bytes, a null terminator signifies the end of the string.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bootrec_Blk_Addr</td>
<td>A 16-character string (optional) representing the boot record logical block address to be used for the SCSI Dump. Defaults to value last used when previous SCSI Dump was performed. The character string must be comprised of hexadecimal values only (0-9, A-F).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ForceType</td>
<td>A 4-byte integer (optional, the default is FORCE):</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 1 - means Force YES (HWI_CMD_FORCE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 2 - means Force NO (HWI_CMD_NOFORCE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYSPLEX_TIME_SWAP_CTS</td>
<td>HWI_CMD_SYSPLXTIME_SWAP_CTS_PARM</td>
<td>STP_ID</td>
<td>An 8-character non-terminated string (required) representing the current STP identifier associated with this CPC.</td>
</tr>
<tr>
<td>SYSPLEX_TIME_SET_STP_CONFIG</td>
<td>HWI_CMD_SYSPLXTIME_SET_STP_CONFIG_PARM</td>
<td>STP_ID</td>
<td>An 8-character non-terminated string (required) representing the current STP identifier associated with this CPC.</td>
</tr>
</tbody>
</table>
### Table 60. Structure pointed to by CmdParm_Ptr (non-REXX); CmdParm stem variable (REXX) (continued)

<table>
<thead>
<tr>
<th>CmdType : HWI_CMD_</th>
<th>CmdParm (non-REXX)</th>
<th>Parameters in Structure (non-REXX) / Tail name constant of the user-defined CmdParm stem (REXX)</th>
<th>Parameter Values</th>
</tr>
</thead>
</table>
|                   |                    | ForceType                                                                                       | A 4-byte integer (required):  
|                   |                    |                                                                                                 | • 1 – means Force YES (HWI_CMD_FORCE)  
|                   |                    |                                                                                                 | • 2 – means Force NO (HWI_CMD_NOFORCE) |
|                   |                    | XML_Ptr (non-REXX)                                                                             | A character string pointer (required) points to the address of the XML fragment describing the configuration for the STP-only CTN. |
|                   |                    | XML (REXX)                                                                                      | XML fragment describing the configuration for the STP-only CTN. (required) |
|                   |                    | XML_Size (non-REXX)                                                                            | A 4-byte integer (required). Length in bytes of the XML that the XML_Ptr points to. |
|                   | HWI_CMD_SYSPLXTIME_CHG_STPONLYCTN_PARM | STP_ID                                                                                          | An 8-character non-terminated string (required) representing the desired STP identifier for the CPC and all CPCs that are members of the same STP-only CTN. |
|                   | HWI_CMD_SYSPLXTIME_JOIN_STPONLYCTN_PARM | STP_ID                                                                                          | An 8-character non-terminated string (required) representing the current STP identifier for the CPC. |
| 0                 |                    | N/A                                                                                             | N/A |

#### DiagArea (non-REXX)

**DiagArea. (REXX)**

- **Returned parameter**
  - **Type**: Character string (non-REXX), stem variable (REXX)
  - **Length**: 32 bytes (non-REXX)

DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

**Note**: For all environmental errors (with return code X'F00' and higher), the DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name (non-REXX) / Tail name constant of the user-defined DiagArea stem (REXX)</th>
<th>Field Type (non-REXX)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value that is specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code that is returned from the console application API or the BCPii transport layer.</td>
</tr>
</tbody>
</table>
See Appendix A, “BCPii communication error reason codes,” on page 415 for a partial list of the descriptive communication transport error return codes and suggested actions.

**ABEND codes**

If BCPii is unable to properly access the user-supplied parameter list, the call might result in an abend X'042' with a reason code of X'0001yyyy' because of one of the following reasons:

*Table 61. Reasons for abend X'042', RC X'0001yyyy'*

<table>
<thead>
<tr>
<th>yyyy</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>The parameters passed by the caller are not in the primary address space.</td>
</tr>
<tr>
<td>0001</td>
<td>The parameters passed by the caller are not accessible.</td>
</tr>
<tr>
<td>0002</td>
<td>The number of parameters passed by the caller is not correct.</td>
</tr>
</tbody>
</table>

For other severe BCPii errors encountered during the call, an abend X'042' with a different reason code may result. See [z/OS MVS System Codes](z/OS MVS System Codes) for additional information.

**Return codes**

When the service returns control to the caller, GPR 15 and the ReturnCode contain a hexadecimal return code.

<table>
<thead>
<tr>
<th>0 HWI_OK</th>
<th><strong>Meaning:</strong> The command has been accepted by the support element.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Action:</strong> Determine the final command completion result by consulting the return code value found in the data returned by the command response event. This ENF event is signaled if the application has already registered to receive this event (HWIEVENT or HwiManageEvents service).</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 100 HWI_CONNECT_TOKEN_INV | **Meaning:** Program error. The specified connect token is not valid. This return code indicates that one of the following conditions has occurred:  
|          | - The connect token does not exist. A previous HWICONN service call has never returned the value specified on OutConnectToken.  
|          | - The connect token does not represent an active connection. The connection specified might have already been disconnected using the HWIDISC service call.  
|          | - The connect token is not associated with the caller's address space. The ConnectToken specified is associated with a different address space than the caller of this service call.  
|          | **Action:** Check for probable coding error.                  |                                                                                                                                              |
| 101 HWI_COMMUNICATION_ERROR | **Meaning:** A communication error is detected. The hardware management console application API (HWMCA) or the BCPii transport layer has returned with a failing return code.  
|          | **Action:** See the DiagArea for further diagnostic information. The Diag_CommErr indicates the return code that is returned from HWMCA APIs or the BCPii transport layer.  
|          |                                                             | HWMCA API and BCPii transport return codes are provided in Appendix A, "BCPii communication error reason codes," on page 415.                                                                         |
| 102 HWI_DIAGAREA_INV | **Meaning:** Program error. The DiagArea is not accessible.  
|          | **Action:** Check for probable coding error. Verify that the specified DiagArea is defined as a 32-byte character field. |                                                                                                                                              |
| 103 HWI_CONNECT_TOKEN_INACTIVE | **Meaning:** The specified connect token is no longer valid. The connection has been disconnected or it is in the progress of being disconnected.  
|          | **Action:** Check for probable coding error. Verify that the specified connect token is still active. If connectivity to the targeted CPC connection no longer exists, all connections associated with that CPC will no longer have a connect token that can be used. |                                                                                                                                              |
### 602 HWI_CMDTYPE_INV

**Meaning:** Program error. The requested CMDTYPE specified in the call is not valid. The system rejects the service call. This return code indicates that one of the following conditions has occurred:

- The CmdType specified is not in the acceptable value range of possible command types. The Diag_Text indicates this error with the text of 'Invalid Cmd'.
- The CmdType specified applies only to CPC connections, but the ConnectToken specified represents an image connection. The Diag_Text indicate this error with the text of 'Mismatch'.
- The CmdType specified applies only to image connections, but the ConnectToken specified represents a CPC connection. The Diag_Text indicates this error with the text of 'Mismatch'.
- The CmdType specified applies only to image connections, but the ConnectToken specified represents an image group connection. The Diag_Text will indicate this error with the text of 'Mismatch'.

**Action:** Check for probable coding error. Verify that the specified CmdType is in the acceptable value range. See the CmdType parameter section to verify that the specified connect token is applied for the requested command. See the DiagArea for further diagnostic information.

### 603 HWI_CMDPARM_INV

**Meaning:** Program error. This return code indicates that one of the following conditions has occurred:

- Required parameters are missing.
- One or more parameters specified are not valid.

**Action:** Check for probable coding error. See the DiagArea for additional diagnostic information. The Diag_Index specifies the value of the CmdType parameter. The Diag_Text specifies the name of the parameter in the CmdParm structure. Note that the name might be abbreviated because of the limited size of the Diag_Text field.
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Meaning</th>
<th>Action</th>
</tr>
</thead>
</table>
| 604 | HWI_CMD_TARGET_DEST_NOT_ALLOWED | Program error. Certain commands are not allowed to be targeted to the same CPC and image on which the BCPii application is currently running. Such commands can cause the local system to be inoperable. Commands that cannot target the local CPC are:  
- Hwi_Cmd_Activate  
- Hwi_Cmd_Activate_With_Actprof  
- Hwi_Cmd_Deactivate  

Commands that cannot target the local image include:  
- Hwi_Cmd_Activate_With_Actprof  
- Hwi_Cmd_Sysreset_IPLT  

Commands that cannot target the local image (by itself or as a member of a user-defined image group) are:  
- Hwi_Cmd_Activate  
- Hwi_Cmd_Deactivate  
- Hwi_Cmd_Load  
- Hwi_Cmd_PswRestart  
- Hwi_Cmd_Start  
- Hwi_Cmd_Stop  
- Hwi_Cmd_Sysreset  
- Hwi_Cmd_SCSI_Load  
- Hwi_Cmd_SCSI_Dump | BCPii does not allow this command to be executed against the local CPC or local image. Validate the name of the target represented by the input connection token. If the target is correct, the command can only be issued from another CPC for a CPC-related command, or from another image for an image-related command.  
If the ConnectToken represents a user-defined image group, verify that the group does not contain the local image where this command is executing. |
| 605 | HWI_CMDPARM_INACCESSIBLE | Program error. The CmdParm data area cannot be accessed. This return code indicates that one of the following conditions has occurred:  
- The CmdParm data area is either partially or completely not accessible by the application, or BCPii, or both.  
- The CmdParm data area can be too small. | Check for probable coding error. Validate that the CmdParm_Ptr points to a data area where the CmdParm is and that the data area is accessible. |
| 606 | HWI_CMDTYPE_NOT_SUPPORTED | The targeted hardware of the HWICMD request does not recognize the type of command being requested. | Verify that the targeted hardware is at a level that supports the type of command being issued. |
## HWICMD

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>607 HWI_CMD_NOT_SUPPORTED</td>
<td><strong>Meaning:</strong> HWICMD is not supported with the current microcode level (MCL) installed on the target CPC, or the target CPC is at a lower hardware level than HWICMD supports (BCPii requires the target of an HWICMD to be at least at the z9 hardware level). The warning return code, HWI_CMD_NOT_SUPPORTED WARNING, should have been returned on the previous HWICONN service call when the requested connect token was created to establish a connection to the CPC. See the return code section in <a href="#">HWICONN — Establish a BCPii connection</a> on page 297 for more information.</td>
<td><strong>Action:</strong> Install the MCL that supports HWICMD on the target CPC or refrain from issuing HWICMD with a target older than the z9 hardware level. See the HWI_CMD_NOT_SUPPORTED WARNING return code in the HWICONN section for the microcode level/engineering change (MCL/EC) that is required for HWICMD service call.</td>
</tr>
<tr>
<td>608 HWI_CMD_IMAGE_GROUP_IS_EMPTY</td>
<td><strong>Meaning:</strong> Command did not execute because the connect token represents an image group that contains no images.</td>
<td><strong>Action:</strong> Ensure that the correct connect token was specified on the HWICMD request. If so, check with the SE/HMC engineer to determine the members that are in the group.</td>
</tr>
<tr>
<td>F00 HWI_NOT_AVAILABLE</td>
<td><strong>Meaning:</strong> BCPii services are not available, and the system rejects the service request.</td>
<td><strong>Action:</strong> Notify the system programmer to start the BCPii address space and try the request again. See &quot;Restarting the HWIBCPI address space&quot; on page 267 about how to start the BCPii address space. Programs can also listen to ENF68 to determine when BCPii services are available. See z/OS MVS Programming: Authorized Assembler Services Reference [EDT-IKZ] for how to listen for BCPii activation messages.</td>
</tr>
<tr>
<td>F01 HWI_AUTH_FAILURE</td>
<td><strong>Meaning:</strong> The caller is PKM8-15 problem state and the program does not reside in an APF-authorized library.</td>
<td><strong>Action:</strong> Check the calling program for a probable coding error.</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
<td>Meaning</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td>---------</td>
</tr>
</tbody>
</table>
| F02 HWI_NO_SAF_AUTH | | The user does not have correct SAF authorization for the request. | Check for probable error. Consider one or more of the following possible actions:  
- Define read access authorization to the FACILITY class resource profile HWI.APPLNAME.HWISERV.  
- Define control access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau for a CPC or image group connection.  
- Define control access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename for an image connection.  
- Define CONTROL access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename for each image within the target image group for an image group connection. Note: It is possible that an application may have the proper authority to all images in a user-defined image group returned on a prior HWILIST invocation, yet still receive this error return code. This could be because HWILIST will only return image names that the user has the proper authority to view. In this case, it will be necessary to contact the HMC/SE administrator to find out if there are other image names contained in the user-defined image group that were not returned on the HWILIST invocation. Once these names have been acquired, the security administrator may be contacted to give CONTROL or higher access to these additional image names.  
- Ensure that the referenced Facility Class Profile is RACLIST-specified. |
<p>| F03 HWI_INTERRUPT_STATUS_INV | | The calling program is disabled. The system rejects this service request. | Check the calling program for a probable coding error. |
| F04 HWI_MODE_INV | | The calling program is not in task mode. The system rejects this service request. | Check the calling program for a probable error. |
| F05 HWI_LOCKS_HELD | | The calling program is holding one or more locks. The system rejects this service request. | Check the calling program for a probable error. |
| F06 HWI_UNSUPPORTED_RELEASE | | The system level does not support this service. The system rejects this service request. | Remove the calling program from the system, and install it on a system that supports BCPIi services. Then run the calling program again. |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Meaning</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>F07</td>
<td>HWI_UNSUPPORTED_ENVIRONMENT</td>
<td>The system does not support execution of the service from the current environment (for example, calling a BCPii service from within a BCPii ENF exit routine).</td>
<td>Issue the BCPii service from a different execution environment.</td>
</tr>
<tr>
<td>FFF</td>
<td>HWI_UNEXPECTED_ERROR</td>
<td>System error. The service that was called encountered an unexpected error. The system rejects the service call.</td>
<td>In many cases, BCPii has taken an abend to gather further diagnostic information. Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center.</td>
</tr>
</tbody>
</table>

**Example**

In the pseudocode example, the caller issues a call to activate an activation profile.

```plaintext
CmdType = HWI_CMD_ACTIVATE;
HWI_CmdTypeParm.ForceType = HWI_CMD_Force;
CmdParm_Ptr = addr(HWI_CmdTypeParm);
CALL HWICMD (ReturnCode, ConnectToken, CmdType, 
             CmdParm_Ptr, DiagArea)
```

A REXX programming example for the HWICMD service:

```plaintext
myCmdType = HWI_CMD_OSCMD /* oscmd */
myCmdParm.PriorityType = Hwi_CMD_Priority
myCmdParm.OSCMDString = 'd a,l'
address bcpii
   "hwicmd RetCode myImgConnectToken myCmdType myCmdParm. myDiag."
If (RC <> 0) | (Retcode <> 0) Then
   Do
     Say 'Service failed with REXX RC = 'RC' and API Retcode = 'Retcode'.
     If (RC=Hwi_REXXParmSyntaxError | Retcode<>0) Then
       Do
         Say ' Diag_index=' myDiag.DIAG_INDEX
         Say ' Diag_key=' myDiag.DIAG_KEY
         Say ' Diag_actual=' myDiag.DIAG_ACTUAL
         Say ' Diag_expected=' myDiag.DIAGEXPECTED
         Say ' Diag_commerr=' myDiag.DIAGCOMMERR
         Say ' Diag_text=' myDiag.DIAG_TEXT
       End
     End
   End
```

**HWICOND — Establish a BCPii connection**

Call the HWICOND service to establish a logical connection between the application and a central processor complex (CPC), a CPC image (LPAR), a capacity record, different types of activation profiles, or a user-defined image group. This facilitates subsequent services to perform operations related to that CPC, image, capacity record, activation profile, or a user-defined image group.
BCPii limits the total number of system-wide connections from all BCPii users to be no more than 4096 simultaneous connections.

**Note:** A connection remains active until one of the following occurs:
- A Disconnect service call (HWIDISC) has been invoked.
- A parent connection has been disconnected.
- A loss of connectivity to the associated CPC has been detected by BCPii.
- The address space of the caller has terminated.
- The current task of the caller has terminated if the connection has task affinity (TSO/E REXX or ISV-provided REXX execution environments).
- The BCPii address space has terminated.

Under normal circumstances, a connection remains active indefinitely. Since there are a finite number of total BCPii connections available in the entire system, a BCPii application should disconnect any BCPii connection it no longer needs.

**Note:** BCPii requires the FACILITY class to be RACLIST-specified. BCPii also automatically transforms the following to all uppercase characters when building the profile names passed to the security product: CPC, image, and caprec values pointed to by the ConnectTypeValue_Ptr.

### Description

#### Environment

The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>One of the following: PKM allowing key 0-7, supervisor state, or APF-Authorized</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary or access register (AR)</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard MVS linkage conventions are used</td>
</tr>
</tbody>
</table>

#### Programming requirements

See "Syntax, linkage and programming considerations" on page 268 for details about how to call BCPii services in the various programming languages.

**REXX programming considerations for the HWICONN service**

All information for the HWICONN service applies for REXX requests except:

- ConnectTypeValue replaces ConnectTypeValue_Ptr.

#### Restrictions

BCPii does not allow HWICONN to be issued from within a BCPii ENF exit routine.
Authorization
The client application must have access to consult the local CPC. This is granted by allowing the application at least read access to the SAF-protected FACILITY class resource HWI.APPLNAME.HWISERV.

The client application must also have at least one of the following access:
• Read access to the SAF-protected FACILITY class resource HWI.TARGET.netid.nau for HWI_CPC, HWI_RESET_ACTPROF, HWI_IMAGE_ACTPROF, HWI_LOAD_ACTPROF, or HWI_IMAGE_GROUP connections.
• Read access to the SAF-protected FACILITY class resource HWI.TARGET.netid.nau.imagename for HWI_IMAGE connections.
• Read access to the SAF-protected FACILITY class resource HWI.CAPREC.netid.nau.caprecid for HWI_CAPREC connections.

Note: BCPii requires the FACILITY class to be RACLIST-specified.

Syntax
Write the call as shown in the syntax diagram. You must code all parameters on the CALL statement in the order shown.

<table>
<thead>
<tr>
<th>Non-REXX parameters</th>
<th>REXX parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL HWICONN(</td>
<td>address bcpii “hwiconn</td>
</tr>
<tr>
<td>ReturnCode,</td>
<td>ReturnCode</td>
</tr>
<tr>
<td>InConnectToken,</td>
<td>InConnectToken</td>
</tr>
<tr>
<td>OutConnectToken,</td>
<td>OutConnectToken</td>
</tr>
<tr>
<td>ConnectType,</td>
<td>ConnectType</td>
</tr>
<tr>
<td>ConnectTypeValue_Ptr,</td>
<td>ConnectTypeValue</td>
</tr>
<tr>
<td>DiagArea);</td>
<td>DiagArea.”</td>
</tr>
</tbody>
</table>

Parameters
The parameters are explained as follows:

ReturnCode
• Returned parameter
  • Type: Integer (non-REXX), character representation of an integer (REXX)
  • Length: 4 bytes (non-REXX)

ReturnCode contains the return code from the service.

InConnectToken
• Supplied parameter
  • Type: Character string
  • Length: 16 bytes

InConnectToken represents a connect token that was returned by a previous HWICONN HWI_CPC invocation. For image, capacity record, activation profile, and user-defined image group connections, the input connection token must represent an active CPC connection.

In most cases, the ConnectToken specified must have originated from a HWICONN service call that was issued from the same address space as this service call. For BCPii REXX execs running under TSO/E or ISV-provided REXX environments, the ConnectToken specified must have originated from a HWICONN service call that was issued from the same task as this service call.
InConnectToken is not relevant to a connect type of HWI_CPC, and it is ignored.

OutConnectToken

Returned parameter
- Type: Character string
- Length: 16 bytes

OutConnectToken returns a connect token that uniquely represents a connection to BCPii. This parameter can be used as input on subsequent BCPii invocations to identify which connection the service wants to communicate.

A connect token returned for an HWI_CPC connection can be specified on subsequent services to perform operations against this particular CPC, or on a subsequent HWICONN as the InConnectToken parameter when attempting a connection to a particular image (LPAR), capacity record (CAPREC), or activation profile.

Likewise, a connect token returned for an HWI_IMAGE or HWI_CAPREC connection can be specified on subsequent services to perform operations against this particular image (LPAR) or capacity record (CAPREC) respectively.

A connect token returned for an HWI_RESET_ACTPROF, HWI_IMAGE_ACTPROF, or HWI_LOAD_ACTPROF connection can be specified on subsequent HWIQUERY or HWISET service calls to query or set specific values associated with the specified Reset, image, or Load activation profile respectively.

A connection token returned for an HWI_IMAGE_GROUP can be specified on a subsequent HWIQUERY service call to query values associated with the group profile, on a subsequent HWICMD service call to issue commands to all members in the image group, or on a subsequent HWILIST service call to list the images in the image group.

ConnectType

Supplied parameter
- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

ConnectType specifies the type of connection to be established.

<table>
<thead>
<tr>
<th>Constant in Hexadecimal (Decimal)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Requests to establish a connection to a target CPC that the application is to communicate with.</td>
</tr>
<tr>
<td>(1)</td>
<td>HWI_CPC</td>
</tr>
<tr>
<td>2</td>
<td>Requests to establish a connection to an image of a CPC that the application is to communicate with. The input connection token must represent an active CPC connection.</td>
</tr>
<tr>
<td>(2)</td>
<td>HWI_IMAGE</td>
</tr>
<tr>
<td>3</td>
<td>Requests to establish a connection to a capacity record of a CPC that the application is to communicate with. The input connection token must represent an active CPC connection.</td>
</tr>
<tr>
<td>(3)</td>
<td>HWI_CAPREC</td>
</tr>
<tr>
<td>Constant in Hexadecimal (Decimal)</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>4 (4) HWI_RESET_ACTPROF</td>
<td>Requests to establish a connection to a reset activation profile associated with a particular CPC. The input connection token must represent an active CPC connection.</td>
</tr>
<tr>
<td>5 (5) HWI_IMAGE_ACTPROF</td>
<td>Requests to establish a connection to an image activation profile associated with a particular CPC. The input connection token must represent an active CPC connection.</td>
</tr>
<tr>
<td>6 (6) HWI_LOAD_ACTPROF</td>
<td>Requests to establish a connection to a load activation profile associated with a particular CPC. The input connection token must represent an active CPC connection.</td>
</tr>
<tr>
<td>7 (7) HWI_IMAGE_GROUP</td>
<td>Requests to establish a connection to a user-defined image group on a particular CPC. The input connection token must represent an active CPC connection. <strong>Note:</strong> This ConnectType is only available when targeting a z10 or higher CPC.</td>
</tr>
</tbody>
</table>

**ConnectTypeValue_Ptr (non-REXX) ConnectTypeValue (REXX)**

**Supplied parameter**
- **Type:** Pointer (non-REXX), character (REXX)
- **Length:** 4 bytes (non-REXX)

**Non-REXX:**
ConnectTypeValue_Ptr specifies the address of the name of the requested target to be connected to. The type of connection determines the value required.

**REXX:**
ConnectTypeValue is the name of the requested target to be connected to. The type of connection determines the value required.

**Connect Types**

<table>
<thead>
<tr>
<th>Values to be specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_CPC</td>
</tr>
</tbody>
</table>
| - A 17-character network address (sometimes referred to as the SNA address) that uniquely represents a CPC in the attached process control network. The network address should be in the form of a 1- through 8-character network identifier (netid), followed by a period, and then followed by a 1- through 8-character network addressable unit (NAU) name. The network address should be padded with trailing blanks if the total string length of the network address is less than 17 characters. **Example:** netid.nau1
| **Note:** netid.nau is 1- to 17-character symbolic NAU name. The network ID and name of a resource must both begin with a letter (A-Z), @, #, or $. The remaining characters can be letters (A-Z), numbers (0-9), @, #, or $.
| - An "*" is a special value that can also be specified with this ConnectType. If specified, this allows the application to connect to the local host CPC without having to know the network address of the local host CPC (netid.nau). **Note:** An HWILIST HWI_LIST_CPCS operation returns a list of CPCs available to be connected to in the form of netid.nau. |
| HWI_IMAGE              |
| - An 8-character image name padded with trailing blanks. **Note:** The LPAR name is a 1- through 8-alphanumeric (0-9, A-Z) character name that must have an alphabetic first character. Special characters ($, @, #), although currently allowed, are being reserved for future use. See PR/SM Planning Guide for details. |
| HWI_CAPREC             |
| - An 8-character capacity record (CAPREC) name padded with trailing blanks. **Note:** The CAPREC name is a 1- through 8-alphanumeric (0-9, A-Z) character name. |
Connect Types | Values to be specified
---|---
HWI_RESET_ACTPROF | A 16-character alphanumeric (0-9, A-Z) reset activation profile name padded with trailing blanks.
HWI_IMAGE_ACTPROF | A 16-character alphanumeric (0-9, A-Z) image activation profile name padded with trailing blanks.
HWI_LOAD_ACTPROF | A 16-character alphanumeric (0-9, A-Z) load activation profile name padded with trailing blanks.
HWI_IMAGE_GROUP | A 30 character null-terminated image group name.

DiagArea (non-REXX)

DiagArea (REXX)

Returned parameter

- Type: Character string (non-REXX), stem variable (REXX)
- Length: 32 bytes (non-REXX)

DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

**Note:** For all environmental errors (with return code X'F00' and higher), the DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name (non-REXX) / Tail name constant of the user-defined DiagArea stem (REXX)</th>
<th>Field Type (non-REXX)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value that is specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code that is returned from the console application API or the BCPii transport layer.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Additional diagnostic information in text format.</td>
</tr>
</tbody>
</table>

See [Appendix A, “BCPii communication error reason codes,” on page 415](#) for a partial list of the descriptive communication transport error return codes and suggested actions.

**ABEND codes**

If BCPii is unable to properly access the user-supplied parameter list, the call might result in an abend X'042' with a reason code of X'0002yyyy' because of one of the following reasons:

<table>
<thead>
<tr>
<th>YYYY</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>The parameters passed by the caller are not in the primary address space.</td>
</tr>
<tr>
<td>0001</td>
<td>The parameters passed by the caller are not accessible.</td>
</tr>
<tr>
<td>0002</td>
<td>The number of parameters passed by the caller is not correct.</td>
</tr>
</tbody>
</table>

For other severe BCPii errors encountered during the call, an abend X'042' with a
different reason code may result. See IBM MVS System Codes for additional information.

Return codes

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0 HWI_OK                                 | **Meaning:** Successful completion.  
  **Action:** None. |
| 4 HWI_CMD_NOT_SUPPORTED_WARNING          | **Meaning:** Successful completion. This warning return code is informational.  
  The target CPC being connected to has a microcode level (MCL) that does not support HWICMD, or the target CPC is at a lower hardware level than HWICMD supports (BCPii requires the target of an HWICMD to be at least at the z9 hardware level). If a subsequent HWICMD is issued with this returned connect token, the call will be rejected with a return code of HWI_CMD_NOT_SUPPORTED.  
  **Action:** Install the MCL/EC that supports HWICMD for the target CPC. The required MCL/EC are G40965.133 for a z9 CPC, and F85906.116 for a z10 CPC. |
| 100 HWI_CONNECT_TOKEN_INV                | **Meaning:** Program error. The specified input connection token is not valid. This return code indicates that one of the following conditions has occurred:  
  • The input connection token does not exist. A previous HWICONN service call has never returned the value specified on OutConnectToken.  
  • The input connection token does not represent an active connection. The connection specified might have already been disconnected by the HWIDISC service call, or have been implicitly disconnected by BCPii because of loss of connectivity with the target CPC.  
  • The input connection token is not associated with the address space of the caller. The InConnectToken specified is associated with a different address space than the caller of this service call.  
  **Action:** Check for probable coding error. |
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 101 HWI_COMMUNICATION_ERROR | **Meaning:** A communication error is detected. The hardware management console application API (HWMCA) or the BCPii transport layer has returned with a failing return code.  
**Action:** See the DiagArea for further diagnostic information. The Diag_CommErr indicates the return code that is returned from HWMCA APIs or the BCPii transport layer.  
HWMCA API and BCPii transport return codes are provided in Appendix A, "BCPii communication error reason codes," on page 415. |
| 102 HWI_DIAGAREA_INV | **Meaning:** Program error. The DiagArea is not accessible.  
**Action:** Check for probable coding error. Verify that the specified DiagArea is defined as a 32-byte character field. |
| 103 HWI_CONNECT_TOKEN_INACTIVE | **Meaning:** The specified connect token is no longer valid. The connection has been disconnected or it is in the progress of being disconnected.  
**Action:** Check for probable coding error. Verify that the specified connect token is still active. If connectivity to the targeted CPC connection no longer exists, all connections associated with that CPC will no longer have a connect token that can be used. |
| 201 HWI_CONNTYPE_INV | **Meaning:** Program error. The connection type specified in the call is not valid. The system rejects the service call.  
**Action:** Check for probable coding error. Validate that the conntype value passed to the service is one of the accepted values. |
| 202 HWI_CONNTYPE_VALUE_INV | **Meaning:** Program error. The connection name specified in the call is not valid. The specified connection name is not syntactically valid, it does not exist, or it is currently not available. The system rejects the service call.  
**Action:** Check for probable coding error. Verify that the connection name is syntactically correct, valid in the current HMC configuration, and currently available. |
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 203 HWI_CONNTYPE_VALUE_INACCESSIBLE     | **Meaning:** Program error. The connection type value data area is either partially or completely inaccessible by the application, or the Base Control Program internal interface (BCPii) address space, or both.  
**Action:** Check for probable coding error. Verify that the ConnectTypeValue_Ptr points to a data area where the connect type value is, and make sure that the data area is accessible. |
| 204 HWI_MAX_CONNECTIONS_REACHED         | **Meaning:** The number of connections has reached the maximum number of system-wide connections (4096) that BCPii permits, or BCPii has run out of system resources to satisfy the HWICONN request, or both.  
**Action:** Disconnect connections that are no longer needed, and try the request again. |
| 205 HWI_CONNTYPE_NOT_SUPPORTED         | **Meaning:** The targeted hardware of the HWICONN request does not support the connect type specified.  
**Action:** Verify that the targeted hardware supports the type of request being made. |
| F00 HWI_NOT_AVAILABLE                  | **Meaning:** BCPii services are not available, and the system rejects the service request.  
**Action:** Notify the system programmer to start the BCPii address space and try the request again. See “Restarting the HWIBCI address space” on page 267 about how to start the BCPii address space.  
Programs can also listen to ENF68 to determine when BCPii services are available. See [z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXG](https://publib.boulder.ibm.com/infocenter/zos/v2r13/index.jsp?topic=%252Fcom.ibm.zos.v2r13.depar%252Fch080042.html) for how to listen for BCPii activation messages. |
| F01 HWI_AUTH_FAILURE                   | **Meaning:** The caller is PKM8-15 problem state and the program does not reside in an APF-authorized library.  
**Action:** Check the calling program for a probable coding error. |
Return Code in Hexadecimal Equate

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
<th>Action</th>
</tr>
</thead>
</table>
| F02 HWI_NO_SAF_AUTH | **Meaning:** The user does not have correct SAF authorization for the request.  
                   | **Action:** Check for probable error. Consider one or more of the following possible actions:  
                   |   • Define read access authorization to the FACILITY class resource profile HWI.APPLNAME.HWISERV.  
                   |   • Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau for a CPC, activation profile, or image group connection.  
                   |   • Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename for an image connection.  
                   |   • Define read access authorization to the FACILITY class resource profile HWI.CAPREC.netid.nau.caprecid for a capacity record connection.  
                   |   • Ensure that the referenced Facility Class Profiles are RACLIST-specified.  
                   |   • For CPC connections only: The SNMP community name specified in the security product (SAF) for a particular target CPC does not match the SNMP community name defined in the support element of the target CPC. See “Community name defined in the security product for each CPC” on page 263 for further information regarding community name setup. |
| F03 HWI_INTERRUPT_STATUS_INV | **Meaning:** The calling program is disabled. The system rejects this service request.  
                          | **Action:** Check the calling program for a probable coding error.  
| F04 HWI_MODE_INV | **Meaning:** The calling program is not in task mode. The system rejects this service request.  
                   | **Action:** Check the calling program for a probable error.  
| F05 HWI_LOCKS_HELD | **Meaning:** The calling program is holding one or more locks. The system rejects this service request.  
                   | **Action:** Check the calling program for a probable coding error.  |
### Return Code in Hexadecimal Equate

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| F06 HWI_UNSUPPORTED_RELEASE | **Meaning:** The system level does not support this service. The system rejects this service request.  
**Action:** Remove the calling program from the system, and install it on a system that supports BCPii services. Then run the calling program again. |
| F07 HWI_UNSUPPORTED_ENVIRONMENT | **Meaning:** The system does not support execution of the service from the current environment (for example, calling a BCPii service from within a BCPii ENF exit routine).  
**Action:** Issue the BCPii service from a different execution environment. |
| FFF HWI_UNEXPECTED_ERROR | **Meaning:** System error. The service that was called encountered an unexpected error. The system rejects the service call.  
**Action:** Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center. |

### Example

In the pseudocode example, the application attempts to establish a connection between the application and the target CPC.

```
InConnectToken = 16blanks;
ConnectType = HWI_CPC;
ConnectTypeValue_Ptr = Addr(ConnectTypeValue);
ConnectTypeValue = 'CPCLEX1.CPC01';
CALL HWICONN (ReturnCode, InConnectToken, OutConnectToken, 
    ConnectType, ConnectTypeValue_Ptr, DiagArea)
```

(After the call, OutConnectToken contains a token that can be used on all subsequent calls to perform CPC functions against the 'CPCLEX1.CPC01' CPC including connecting to images, capacity records, and activation profiles residing on the CPC.)

A REXX programming example for the HWICONN service:

```
myConnectType = HWI_CPC /* CPC connect type */
myConnectTypeValue = 'IBM390xx.H123' /* 17-char CPC name */
address bcpii
    "hwiconn Retcode myInConnectToken myOutConnectToken myConnectType 
    myConnectTypeValue myDiag."
If (RC <> 0) | (Retcode <> 0) Then
    Do
        Say 'Service failed with REXX RC = 'RC' and API Retcode = 'Retcode'.
        If (RC=Hwi_REXXParmSyntaxError | Retcode=0) Then
            Do
                Say 'Diag_index=' myDiag.DIAG_INDEX
                Say 'Diag_key=' myDiag.DIAG_KEY
                Say 'Diag_actual=' myDiag.DIAG_ACTUAL
```
HWIDISC — Release a BCPIi connection

Call the HWIDISC service to release the logical connection between the application and the identified CPC, image, capacity record, different types of activation profiles, or user-defined image groups. If the connect token represents a CPC, any subordinate image, capacity record, activation profile, or user-defined image group connection associated with the same CPC connection is also released.

Description

Environment

The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>One of the following: PKM allowing key 0-7, supervisor state, or APF-Authorized</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary or access register (AR)</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard MVS linkage conventions are used</td>
</tr>
</tbody>
</table>

Programming requirements

See “Syntax, linkage and programming considerations” on page 268 for details about how to call BCPIi services in the various programming languages.

REXX programming considerations for the HWIDISC service

All information for the HWIDISC service applies for REXX requests except:

- In the System REXX environment, BCPIi connections are associated with the address space that issued the AXREXX macro service call. When this address space terminates, BCPIi will implicitly disconnect the connection.
- In the TSO/E and ISV-provided REXX environments, BCPIi connections are associated with the current running task. When this task terminates, BCPIi will implicitly disconnect the connection.

Restrictions

BCPIi does not allow HWIDISC to be issued from within a BCPIi ENF exit routine.

Authorization

The client application must have access to consult the local CPC. This is granted by allowing the application at least read access to the SAF-protected FACILITY class resource HWI.APPLNAME.HWISERV.

The client application must also have at least read access to the following class resources:
HWIDISC

- The SAF-protected FACILITY class resource HWI.TARGET.netid.nau for
  HWI_CPC, HWI_RESET_ACTPROF, HWI_IMAGE_ACTPROF,
  HWI_LOAD_ACTPROF, or HWI_IMAGE_GROUP connections.
- The SAF-protected FACILITY class resource HWI.TARGET.netid.nau.imagename
  for HWI_IMAGE connections.
- The SAF-protected FACILITY class resource HWI.CAPREC.netid.nau.caprecid for
  HWI_CAPREC connections.

Note: BCpi requires the FACILITY class to be RACLIST-specified.

Syntax
Write the call as shown in the syntax diagram. You must code all parameters on
the CALL statement in the order shown.

<table>
<thead>
<tr>
<th>Non-REXX parameters</th>
<th>REXX parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL HWIDISC(</td>
<td>address bcpii &quot;hwidisc</td>
</tr>
<tr>
<td>ReturnCode,</td>
<td></td>
</tr>
<tr>
<td>ConnectToken,</td>
<td></td>
</tr>
<tr>
<td>DiagArea);</td>
<td></td>
</tr>
</tbody>
</table>

Parameters
The parameters are explained as follows:

ReturnCode
- Returned parameter
  - Type: Integer (non-REXX), character representation of an integer (REXX)
  - Length: 4 bytes (non-REXX)
  
  ReturnCode contains the return code from the service.

ConnectToken
- Supplied parameter
  - Type: Character string
  - Length: 16 bytes

  ConnectToken specifies the logical connection to be released. A ConnectToken
  represents a logical connection between the application and a CPC, image,
  capacity record, activation profile, or user-defined image group and is returned
  as an output parameter on the HWICONN service call.

  In most cases, the ConnectToken specified must have originated from a
  HWICONN service call that was issued from the same address space as this
  service call. For BCpi REXX execs running under the TSO/E or ISV-provided
  REXX environments, the ConnectToken specified must have originated from a
  HWICONN service call that was issued from the same task.

DiagArea (non-REXX)

DiagArea. (REXX)
- Returned parameter
  - Type: Character string (non-REXX), stem variable (REXX)
  - Length: 32 bytes (non-REXX)

  DiagArea contains diagnostic data to help determine the cause of a failure
  from the service. For many return codes, the DiagArea can contain further
  information to help determine the cause of the failure. See the descriptions of
different return codes for a partial list of data returned in this area.
Note: For all environmental errors (with return code XF00' and higher), the DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name (non-REXX) / Tail name constant of the user-defined DiagArea stem (REXX)</th>
<th>Field Type (non-REXX)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code that is returned from the console application API or the BCPii transport layer.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Additional diagnostic information in text format.</td>
</tr>
</tbody>
</table>

See Appendix A, “BCPii communication error reason codes,” on page 415 for a partial list of the descriptive communication transport error return codes and suggested actions.

**ABEND codes**

If BCPii is unable to properly access the user-supplied parameter list, the call might result in an abend X'042' with a reason code of X'0003yyyy' because of one of the following reasons:

**Table 63. Reasons for abend X'042', RC X'0003yyyy'**

<table>
<thead>
<tr>
<th>yyyy</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>The parameters passed by the caller are not in the primary address space.</td>
</tr>
<tr>
<td>0001</td>
<td>The parameters passed by the caller are not accessible.</td>
</tr>
<tr>
<td>0002</td>
<td>The number of parameters passed by the caller is not correct.</td>
</tr>
</tbody>
</table>

For other severe BCPii errors encountered during the call, an abend X'042' with a different reason code may result. See z/OS MVS System Codes for additional information.

**Return codes**

When the service returns control to the caller, GPR 15 and ReturnCode contain a hexadecimal return code.

**Table 64. Return code meaning and action**

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0 HWI_OK | **Meaning**: Successful completion.  
**Action**: None. |
### Return Code in Hexadecimal Equate

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| **100 HWI_CONNECT_TOKEN_INV** | **Meaning**: Program error. The specified connect token is not valid. This return code indicates that one of the following conditions has occurred:  
  - The input connection token does not exist.  
  - A previous HWICONN service call has never returned the value specified on OutConnectToken.  
  - The connect token does not represent an active connection. The connection specified might have already been disconnected using the HWIDISC service call.  
  - The connect token is not associated with the address space of the caller. The ConnectToken specified is associated with a different address space than the caller of this service call.  
  **Action**: Check for probable coding error. |
| **101 HWI_COMMUNICATION_ERROR** | **Meaning**: A communication error is detected. The hardware management console application API (HWMCA) or the BCPIi transport layer has returned with a failing return code.  
  **Action**: See the DiagArea for further diagnostic information. The Diag_CommErr indicates the return code that is returned from HWMCA APIs or the BCPIi transport layer.  
  HWMCA API and BCPIi transport return codes are provided in Appendix A, “BCPIi communication error reason codes,” on page 415. |
| **102 HWI_DIAGAREA_INV** | **Meaning**: Program error. The DiagArea is not accessible.  
  **Action**: Check for probable coding error. Verify that the specified DiagArea is defined as a 32-byte character field. |
| **901 HWI_DISC_INPROGRESS** | **Meaning**: Another Disconnect request is already in progress. This request is redundant.  
  **Action**: None. |
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| F00 HWI_NOT_AVAILABLE                    | **Meaning**: BCPii services are not available, and the system rejects the service request.  
**Action**: Notify the system programmer to start the BCPii address space and try the request again. See [“Restarting the HWIBCPii address space” on page 267](#) about how to start the BCPii address space.  
Programs can also listen to ENF68 to determine when BCPii services are available. See [z/OS MVS Programming: AuthorizedAssembler Services Reference EDT-IXG](#) for how to listen for BCPii activation messages. |
| F01 HWI_AUTH_FAILURE                     | **Meaning**: The caller is PKM8-15 problem state and the program does not reside in an APF-authorized library.  
**Action**: Check the calling program for a probable coding error. |
| F02 HWI_NO_SAF_AUTH                      | **Meaning**: The user does not have correct SAF authorization for the request.  
**Action**: Check for probable error. Consider one or more of the following possible actions:  
• Define read access authorization to the FACILITY class resource profile HWI.APPLNAME.HWISERV.  
• Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau for a CPC, activation profile, or image group connection.  
• Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename for an image connection.  
• Define read access authorization to the FACILITY class resource profile HWI.CAPREC.netid.nau.caprecid for a capacity record connection.  
• Ensure that the referenced Facility Class Profiles are RACLIST-specified. |
| F03 HWI_INTERRUPT_STATUS_INV             | **Meaning**: The calling program is disabled. The system rejects this service request.  
**Action**: Check the calling program for a probable coding error. |
| F04 HWI_MODE_INV                         | **Meaning**: The calling program is not in task mode. The system rejects this service request.  
**Action**: Check the calling program for a probable error. |
### Return Code in Hexadecimal Equate

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>F05 HWI_LOCKS_HELD</td>
<td><strong>Meaning:</strong> The calling program is holding one or more locks. The system rejects this service request.&lt;br&gt;<strong>Action:</strong> Check the calling program for a probable coding error.</td>
<td></td>
</tr>
<tr>
<td>F06 HWI_UNSUPPORTED_RELEASE</td>
<td><strong>Meaning:</strong> The system level does not support this service. The system rejects this service request.&lt;br&gt;<strong>Action:</strong> Remove the calling program from the system, and install it on a system that supports BCPii services. Then run the calling program again.</td>
<td></td>
</tr>
<tr>
<td>F07 HWI_UNSUPPORTED_ENVIRONMENT</td>
<td><strong>Meaning:</strong> The system does not support execution of the service from the current environment (for example, calling a BCPii service from within a BCPii ENF exit routine).&lt;br&gt;<strong>Action:</strong> Issue the BCPii service from a different execution environment.</td>
<td></td>
</tr>
<tr>
<td>FFF HWI_UNEXPECTED_ERROR</td>
<td><strong>Meaning:</strong> System error. The service that was called encountered an unexpected error. The system rejects the service call.&lt;br&gt;<strong>Action:</strong> Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center.</td>
<td></td>
</tr>
</tbody>
</table>

### Example

In the pseudocode example, the caller issues a call to release a connection between the application and a CPC.

```
CALL HWIDISC (ReturnCode, ConnectToken, DiagArea)
```

A REXX programming example for the HWIDISC service:

```
address bcpii
    "hwidisc Retcode myConnectToken myDiag."
If (RC <> 0) | (Retcode <> 0) Then
    Do
        Say 'Service failed with REXX RC = 'RC' and API Retcode = 'Retcode.'
        If (RC=Hwi_REXXParmSyntaxError | Retcode<>0) Then
            Do
                Say ' Diag_index=' myDiag.DIAG_INDEX
                Say ' Diag_key=' myDiag.DIAG_KEY
                Say ' Diag_actual=' myDiag.DIAG_ACTUAL
                Say ' Diag_expected=' myDiag.DIAG_EXPECTED
                Say ' Diag_commerr=' myDiag.DIAG_COMMERR
                Say ' Diag_text=' myDiag.DIAG_TEXT
            End
        End
    End
```

---

**HVIDISC**

Chapter 19. Base Control Program internal interface (BCPii) 313
HWIEVENT — Register or unregister for BCPii events

Call the HWIEVENT service for the following purposes:

1. Register an application and its connection to receive notification of:
   • One or more hardware or software events occurring on the connected CPC or image.
   • Communication errors between BCPii and the connected CPC or image.
2. Delete the registration for one or more previously registered events.

Monitoring events occurring on a particular CPC or image

For hardware and software events, an application can register with BCPii to be notified when an event occurs for the targeted CPC or image. Under the covers, BCPii communicates the registration request with the support element (SE) of the targeted CPC or image if necessary and also registers the user-provided exit with the Event Notification Facility (ENF). When the event occurs on the targeted CPC or image, BCPii receives notification and signals the appropriate ENF68. The user’s exit receives control with data unique for the event that just occurred. The data mapping for these different events can be found in the public interface files shipped with BCPii (HWICIC for the C programming language, HWICIREX for the REXX programming language, and HWICIASM for the assembler programming language). BCPii also provides a sample of an ENF event exit in SYS1.SAMPLIB (HWIXMCX1) that can be a good starting point for coding a BCPii ENF exit.

Note: BCPii user-defined image groups are a powerful way to issue commands to all members of a group simultaneously. Commands targeted to a user-defined image group will result in one image command response event being generated for each image in the image group. If event notification is desired for an image in an image group, register the image for the command response event to enable delivery of the event to the BCPii ENF exit.

Monitoring operating system message events (Hwi_Event_OpSysMsg)

Your application can monitor all operating system messages appearing on a z/OS console by using the HWIEVENT service to register for the EventIDs parameter value Hwi_Event_OpSysMsg.

For the majority of messages issued on the image being monitored, a single BCPii operating system message event will contain the entire message in the returned event data (HWIENF68 data mapping).

For messages that are larger than approximately 3000 bytes, it is possible that the operating system message is longer than the architected maximum buffer size allowed by the communications protocol used by both the z/OS consoles component and BCPii to communicate with the support element. As a result, BCPii delivers these single large messages in multiple operating system message events. Each of these operating system message events representing a single large message will have the same values in the HWIENF68 data mapping for the msgId, msgDate, and msgTime fields. An application can determine that all of the operating system message events have been delivered for the single large message by consulting the msgId of a subsequent message event. If it has changed from the previous msgId, the operating system message event represents a new operating system message.
Monitoring communication availability between BCPii and the CPC

While not common, BCPii may occasionally experience communication delays or interruptions of service between itself and the targeted CPC and its associated support element. BCPii provides a mechanism through its BCPii communication error class of events to detect these interruptions and to allow an application to know when these interruptions of service have been resolved.

BCPii keeps a heartbeat between itself and each CPC where its applications desire connectivity. If BCPii fails to receive its regular heartbeat from an SE associated with a CPC, BCPii attempts a communication flow to this SE. If the SE responds successfully to this communication attempt by BCPii, BCPii signals a temporary communication error, (ENF QUAL value 02010001), meaning that the reason for the heartbeat not being received is not known, but the communication path between BCPii and the SE seems to be operational at this time. During the past few minutes, one or more events may have been lost.

If the SE does not respond to the BCPii communication attempt, BCPii assumes that there is a serious communication problem and signals a permanent communication error, (ENF QUAL value 02010002). At this point, no HWIEVENT or HWICMD API requests to this CPC are processed by BCPii and no event delivery take place for events registered on this CPC and its images. BCPii closes its internal connections with the CPC and cleans up resources associated with command processing and event delivery to and from this CPC.

BCPii then regularly attempts to restart its command processing and event delivery connections to this CPC. When this connection to the CPC has been re-established, BCPii signals a communication available event, (ENF QUAL value 02010003). At this point, applications currently having valid connections to this CPC and its images are allowed to use the HWIEVENT and HWICMD APIs to the CPC and its images. Receipt of events originating from the CPC and its images commence once again.

An application may choose to register for these communication availability events via the HWIEVENT ADD service (EventIDs parameter value Hwi_Event_HwCommError), or it may choose to use the ENFREQ LISTEN macro to listen for these events apart from any specific BCPii connection.

Monitoring the status of the BCPii address space

An application can monitor the status of the BCPii address space itself by using the ENFREQ LISTEN service and specifying the appropriate QUAL values to monitor when the BCPii address space becomes active and when it terminates:

- BCPii signals an ENF68 with a QUAL value of 01000002 when the BCPii address space becomes active.
- BCPii signals an ENF68 with a QUAL value of 01000001 when the BCPii address space becomes unavailable.

While it is possible to use the HWIEVENT service to allow an application to register for the Hwi_Event_BCPiiStatus event, this is not a recommended way to monitor initialization or termination of the BCPii address space. When the BCPii address space terminates, BCPii asynchronously asks the system to delete all ENF registrations made on behalf of applications that have issued HWIEVENT Add requests. If the deletion of the ENF registration occurs prior to the BCPii address space termination, the ENF exit will no longer receive control when BCPii signals that it is down.
HWIEVENT

Description

Environment
The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>One of the following: PKM allowing key 0-7, supervisor state, or APF-Authorized</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary or access register (AR)</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard MVS linkage conventions are used</td>
</tr>
</tbody>
</table>

Programming requirements
See "Syntax, linkage and programming considerations" on page 268 for details about how to call BCPii services in the various programming languages. For programming language C, see restrictions below.

See "HWIEVENT" on page 430 for the summary table of the BCPii HWIEVENT types and the objects that can be registered or unregistered for each event.

REXX programming considerations for the HWIEVENT service
All information for the HWIEVENT service applies for REXX requests except:
- EventIDs is a 32-element stem-variable representing all of the event bits as defined in the HWICIREX include file.
- Because the Event Notification Facility (ENF) does not support REXX exits, the caller must provide the address of a non-REXX ENF exit routine.
- The EventExitAddr must be specified as the 8-character representation of a 4-byte hexadecimal value.

Restrictions
- This service is not used by C language callers running in a z/OS UNIX System Services environment. See "HWIManageEvents — Manage the list of BCPii events" on page 402.
- BCPii does not allow HWIEVENT to be issued from within a BCPii ENF exit routine.
- BCPii does not allow HWIEVENT to be issued from a REXX exec running in the TSO/E or ISV-provided REXX environments.

Authorization
The client application must have access to consult the local CPC. This is granted by allowing the application at least read access to the SAF-protected FACILITY class resource HWI.APPLNAME.HWISERV.

The client application must have at least read access to the SAF-protected FACILITY class resource HWI.TARGET.netid.nau for a ConnectToken representing a CPC connection, or HWI.TARGET.netid.nau.imagename for ConnectToken representing an image connection.
**Note:** BCPii requires the FACILITY class to be RACLST-specified.

**Syntax**
Write the call as shown in the syntax diagram. You must code all parameters on the CALL statement in the order shown.

<table>
<thead>
<tr>
<th>Non-REXX parameters</th>
<th>REXX parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL HWIEVENT(</td>
<td>address bcpii &quot;hwievent</td>
</tr>
<tr>
<td>ReturnCode,</td>
<td>ReturnCode</td>
</tr>
<tr>
<td>ConnectToken,</td>
<td>ConnectToken</td>
</tr>
<tr>
<td>EventAction,</td>
<td>EventAction</td>
</tr>
<tr>
<td>EventIDs,</td>
<td>EventIDs</td>
</tr>
<tr>
<td>EventExitMode,</td>
<td>EventExitMode</td>
</tr>
<tr>
<td>EventExitAddr,</td>
<td>EventExitAddr</td>
</tr>
<tr>
<td>EventExitParm,</td>
<td>EventExitParm</td>
</tr>
<tr>
<td>DiagArea);</td>
<td>DiagArea&quot;</td>
</tr>
</tbody>
</table>

**Parameters**
The parameters are explained as follows:

**ReturnCode**
- Returned parameter
- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

ReturnCode contains the return code from the service.

**ConnectToken**
- Supplied parameter
- Type: Character string
- Length: 16 bytes

ConnectToken represents a logical connection between the application and a CPC or image. The ConnectToken is an output parameter on the HWICONN service call.

The ConnectToken specified must have originated from a HWICONN service call that was issued from the same address space as this service call.

**EventAction**
- Supplied parameter
- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

EventAction specifies the type of action for the service.

<table>
<thead>
<tr>
<th>Constant in Hexadecimal (Decimal)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registers to be notified when the requested events occur.</td>
</tr>
<tr>
<td>(1)</td>
<td>HWI_EVENT_ADD</td>
</tr>
<tr>
<td>2</td>
<td>Deletes the registration for notification.</td>
</tr>
<tr>
<td>(2)</td>
<td>HWI_EVENT_DELETE</td>
</tr>
</tbody>
</table>
**EventID**s (non-REXX)  
**EventId**s (REXX)

Supplied parameter

- Type: Integer (non-REXX), stem variable (REXX)
- Length: 128 bits (16 bytes) (non-REXX)

EventIDs specifies the events to be added or deleted.

**Non-REXX:**

Each event is a 1-bit field from bit position 97 to 128 in this data area. If the bit is on, the service performs the EventAction operation for the event on the requested connection.

**REXX:**

Each event is represented by an IBM-supplied EventIDs tail label or tail value constant. If the value is on, the service performs the EventAction operation for the event on the requested connection.

It is recommended to use the IBM-supplied EventIDs tail labels defined in HWICIREX.

**Note:** A single connection may not register for a particular event more than once.

The following event IDs or tail labels can be specified:

<table>
<thead>
<tr>
<th>EventIDs (non-REXX) / tail label for EventIDs stem (REXX)</th>
<th>Bit position in structure specified on EventIDs (non-REXX)</th>
<th>Tail value constant of the user-defined EventIDs stem (REXX)</th>
<th>Description</th>
</tr>
</thead>
</table>
| Hwi_EventID_EyeCatcher                                   | 1-96                                                     | N/A                                                        | Control block identifier.  
**Note:** HWI_EVENTID_TEXT can be used to initialize this field. |
| Hwi_Event_CmdResp                                         | 97                                                       | 1                                                         | Requests to add or delete the registration for notification of the command response events.  
**Note:** The input connection token represents a CPC connection or an image connection. |
| Hwi_Event_StatusChg                                       | 98                                                       | 2                                                         | Requests to add or delete the registration for notification of the status change events.  
**Note:** The input connection token represents a CPC connection or an image connection. |
| Hwi_Event_NameChg                                         | 99                                                       | 3                                                         | Requests to add or delete the registration for notification of the object name change events.  
**Note:** The input connection token represents a CPC connection or an image connection. |
| Hwi_Event_ActProfChg                                      | 100                                                      | 4                                                         | Requests to add or delete the registration for notification of the change events for the activation profile name.  
**Note:** The input connection token represents a CPC connection or an image connection. |
| Hwi_Event_ObjCreate                                       | 101                                                      | 5                                                         | Requests to add or delete the registration for notification of the object created events.  
**Note:** The input connection token represents a CPC connection or an image connection. |
| Hwi_Event_ObjDestroy                                     | 102                                                      | 6                                                         | Requests to add or delete the registration for notification of the object destroyed (deleted) events.  
**Note:** The input connection token represents a CPC connection or an image connection. |
<table>
<thead>
<tr>
<th>EventIDs (non-REXX) / tail label for EventIDs stem (REXX)</th>
<th>Bit position in structure specified on EventIDs (non-REXX)</th>
<th>Tail value constant of the user-defined EventIDs stem (REXX)</th>
<th>Description</th>
</tr>
</thead>
</table>
| Hwi_Event_ObjException                                   | 103                                                     | 7                                                       | Requests to add or delete the registration for notification of the exception state events.  
Note: The input connection token represents a CPC connection or an image connection. |
| Hwi_Event_ApplStarted                                    | 104                                                     | 8                                                       | Requests to add or delete the registration for notification of the console application started events.  
Note: The input connection token must only represent a CPC connection. |
| Hwi_Event_ApplEnded                                      | 105                                                     | 9                                                       | Requests to add or delete the registration for notification of the console application ended events.  
Note: The input connection token must only represent a CPC connection. |
| Hwi_Event_HwMsg                                          | 106                                                     | 10                                                      | Requests to add or delete the registration for notification of the hardware message events.  
Note: The input connection token must only represent a CPC connection. |
| Hwi_Event_HwMsgDel                                       | 107                                                     | 11                                                      | Requests to add or delete the registration for notification of the hardware message deletion events.  
Note: The input connection token must only represent a CPC connection. |
| Hwi_Event_SecurityEvent                                  | 108                                                     | 12                                                      | Requests to add or delete the registration for notification of the support element (SE) console security events.  
Note: The input connection token must only represent a CPC connection. |
| Hwi_Event_CapacityChg                                    | 109                                                     | 13                                                      | Requests to add or delete the registration for notification of the capacity change events.  
Note: The input connection token must only represent a CPC connection. |
| Hwi_Event_CapacityRecord                                 | 110                                                     | 14                                                      | Requests to add or delete the registration for notification of the capacity record change events.  
Note: The input connection token must only represent a CPC connection. |
| Hwi_Event_OpSysMsg                                       | 111                                                     | 15                                                      | Requests to add or delete the registration for notification of the operating system message events.  
Note: The input connection token must only represent an image connection. |
| Hwi_Event_HwCommError                                    | 112                                                     | 16                                                      | Requests to add or delete the registration for notification of the hardware communication error events.  
Note: The input connection token must only represent a CPC connection. |
| Hwi_Event_BCPiiStatus                                    | 113                                                     | 17                                                      | Requests to add or delete the registration for notification of BCPii status change events.  
Note: This method is not recommended for determining if the BCPii address space becomes available or unavailable. See the description of the HWIEVENT service for more information. |
| Hwi_Event_DisabledWait                                   | 114                                                     | 18                                                      | Requests to add or delete the registration for notification of disabled wait events.  
Note: The input connection token must only represent an image connection. |
**HWIEVENT**

<table>
<thead>
<tr>
<th>EventIDs (non-REXX) / tail label for EventIDs stem (REXX)</th>
<th>Bit position in structure specified on EventIDs (non-REXX)</th>
<th>Tail value constant of the user-defined EventIDs stem (REXX)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hwi_Event_PowerChange</td>
<td>115</td>
<td>19</td>
<td>Requests to add or delete the registration for notification of any power characteristics change events. Note: The input connection token must represent a CPC connection.</td>
</tr>
<tr>
<td>Hwi_Event_Reserved</td>
<td>116-128</td>
<td>N/A</td>
<td>Reserved, must be initialized to binary zeros.</td>
</tr>
</tbody>
</table>

**EventExitMode**

- **Supplied parameter**
  - **Type**: Integer (non-REXX), character representation of an integer (REXX)
  - **Length**: 4 bytes (non-REXX)

  EventExitMode specifies the type of the exit mode for the service.

<table>
<thead>
<tr>
<th>Constant in Hexadecimal (Decimal)</th>
<th>Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(1)</td>
<td>HWI_EVENT_TASK</td>
</tr>
</tbody>
</table>

The base control program internal interface gives control in task mode to an ENF listen-exit routine as specified on the EventExitAddr parameter. Task mode ENF exits must reside in common storage.

At present, only one value is allowed for this parameter. In the future, IBM might choose to allow additional values to be specified.

**EventExitAddr**

- **Supplied parameter**
  - **Type**: Pointer (non-REXX), character representation of a pointer (REXX)
  - **Length**: 4 bytes (non-REXX), 8 characters (REXX)

  EventExitAddr specifies the address of an ENF listen-exit routine that receives control when the requested event occurs. The application is responsible for writing this ENF exit routine, as described in the ENFREQ documentation for ENF 68 found in [z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXC](../z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXC). For further information regarding the coding of ENF exits, see the "Listening for System Events" chapter in the [z/OS MVS Programming: Authorized Assembler Services Guide](../z/OS MVS Programming: Authorized Assembler Services Guide).

**EventExitParm**

- **Supplied parameter**
  - **Type**: Pointer or integer (non-REXX), character representation of a pointer or integer (REXX)
  - **Length**: 4 bytes (non-REXX), up to 8 numeric characters (REXX)

  EventExitParm specifies an optional value to be passed to the ENF listen-exit when invoked, as described in the ENFREQ documentation for ENF 68 found in [z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXC](../z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXC).

**DiagArea (non-REXX)**

- **Returned parameter**
  - **Type**: Character string (non-REXX), stem variable (REXX)
  - **Length**: 32 bytes (non-REXX)

  DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the DiagArea can contain further
information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

**Note:** For all environmental errors (with return code X'F00' and higher), the DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name (non-REXX) / Tail name constant of the user-defined DiagArea stem (REXX)</th>
<th>Field Type (non-REXX)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The return code that is returned from the console application API or the BCPii transport layer.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Additional diagnostic information in text format.</td>
</tr>
</tbody>
</table>

See Appendix A, “BCPii communication error reason codes,” on page 415 for a partial list of the descriptive communication transport error return codes and suggested actions.

**ABEND codes**

If BCPii is unable to properly access the user-supplied parameter list, the call might result in an abend X'042' with a reason code of X'0004yyyy' because of one of the following reasons:

**Table 64. Reasons for abend X'042', RC X'0004yyyy'**

<table>
<thead>
<tr>
<th>yyyy</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>The parameters passed by the caller are not in the primary address space.</td>
</tr>
<tr>
<td>0001</td>
<td>The parameters passed by the caller are not accessible.</td>
</tr>
<tr>
<td>0002</td>
<td>The number of parameters passed by the caller is not correct.</td>
</tr>
</tbody>
</table>

For other severe BCPii errors encountered during the call, an abend X'042' with a different reason code may result. See [z/OS MVS System Codes](#) for additional information.

**Return codes**

When the service returns control to the caller, GPR 15 and ReturnCode contain a hexadecimal return code.

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 HWI_OK</td>
<td>Meaning: Successful completion. Action: None.</td>
</tr>
<tr>
<td>Return Code in Hexadecimal Equate Symbol</td>
<td>Meaning and Action</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>
| 100 HWI_CONNECT_TOKEN_INV               | **Meaning:** Program error. The specified connect token is not valid. This return code indicates that one of the following conditions has occurred:  
  • The connect token does not exist. A previous HWICONN service call has never returned the value specified on OutConnectToken.  
  • The connect token does not represent an active connection. The connection specified might have already been disconnected by the HWIDISC service call.  
  • The connect token is not associated with the address space of the caller. The ConnectToken specified is associated with a different address space than the caller of this service call.  
  **Action:** Check for probable coding error. |
| 101 HWI_COMMUNICATION_ERROR            | **Meaning:** A communication error is detected. The hardware management console application API (HWMCA) or the BCPii transport layer has returned with a failing return code.  
  **Action:** See the DiagArea for further diagnostic information. The Diag_CommErr indicates the return code that is returned from HWMCA APIs or the BCPii transport layer. BCPii CTRACE might provide further diagnostic information if the problem cannot easily be resolved. See [z/OS MVS System Commands](#) for further information about starting and stopping CTRACE. |
| 102 HWI_DIAGAREA_INV                   | **Meaning:** Program error. The DiagArea is not accessible.  
  **Action:** Check for probable coding error. Verify that the specified DiagArea is defined as a 32-byte character field. |
| 103 HWI_CONNECT_TOKEN_INACTIVE         | **Meaning:** The specified connect token is no longer valid. The connection has been disconnected, or it is in the progress of being disconnected.  
  **Action:** Check for probable coding error. Verify that the specified connect token is still active. If connectivity to the targeted CPC connection no longer exists, all connections associated with that CPC will no longer have a connect token that can be used. |
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 701 HWI_EVENT_EXITMODE_INV             | **Meaning**: Program error. The requested EventExitMode on the call is not valid. The system rejects the service call.  
**Action**: Check for probable coding error. |
| 702 HWI_EVENT_EXITADDR_INV             | **Meaning**: Program error. The requested EventExitAddr on the call is not valid. The system rejects the service call.  
**Action**: Check for probable coding error. |
| 703 HWI_EVENT_ACTION_INV               | **Meaning**: Program error. The requested EventAction on the call is not valid. The system rejects the service call.  
**Action**: Check for probable coding error. |
| 704 HWI_EVENT_IDS_INV                  | **Meaning**: Program error. The requested EventIDs on the call is not valid. The system rejects the service call. This return code indicates one of the following conditions has occurred:  
• The first 12 bytes of the EventIDs parameter is not equal to the expected Eyecatcher of HWIEVENTBLCK (non-REXX only).  
• The reserved area of the EventIDs parameter contains a non-zero value.  
• The EventIDs specified applies only to a CPC connection, but the ConnectToken specified represents an image or capacity record connection.  
• The EventIDs specified applies only to image connections, but the ConnectToken specified represents a CPC or capacity record connection.  
• A request which specified an EventAction of HWI_EVENT_DELETE also specified EventIDs of one or more events that were not registered on a previous HWIEVENT EventAction = HWI_EVENT_ADD request for the connection.  
**Action**: Check for probable coding error. |
| F00 HWI_NOT_AVAILABLE                  | **Meaning**: BCPIi is not available, and the system rejects the service request.  
**Action**: Notify the system programmer to start the BCPIi address space and try the request again. See “Restarting the HWIBCPIi address space” on page 267 about how to start the BCPIi address space.  
Programs can also listen to ENF68 to determine when BCPIi services are available. See [z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXG](https://www.ibm.com/support/knowledgecenter/en/SHEXJ1_2.3.0/com.ibm.zos.bks.doc/ctr_zospsa_zosmvs/service/admin_services.html) for how to listen for BCPIi activation messages. |
### Return Code in Hexadecimal Equate

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>F01 HWI_AUTH_FAILURE</td>
<td><strong>Meaning</strong>: The caller is PKM8-15 problem state and the program does not reside in an APF-authorized library.</td>
</tr>
<tr>
<td></td>
<td><strong>Action</strong>: Check the calling program for a probable coding error.</td>
</tr>
<tr>
<td>F02 HWI_NO_SAF_AUTH</td>
<td><strong>Meaning</strong>: The user does not have correct SAF authorization for the request.</td>
</tr>
<tr>
<td></td>
<td><strong>Action</strong>: Check for probable error. Consider one or more of the following possible actions:</td>
</tr>
<tr>
<td></td>
<td>• Define read access authorization to the FACILITY class resource profile HWI.APPLNAME.HWISERV.</td>
</tr>
<tr>
<td></td>
<td>• Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau for CPC connection.</td>
</tr>
<tr>
<td></td>
<td>• Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename for an image connection.</td>
</tr>
<tr>
<td></td>
<td>• Ensure that the referenced FACILITY class profiles are RACLIST-specified.</td>
</tr>
<tr>
<td>F03 HWI_INTERRUPT_STATUS_INV</td>
<td><strong>Meaning</strong>: The calling program is disabled. The system rejects this service request.</td>
</tr>
<tr>
<td></td>
<td><strong>Action</strong>: Check the calling program for a probable coding error.</td>
</tr>
<tr>
<td>F04 HWI_MODE_INV</td>
<td><strong>Meaning</strong>: The calling program is not in task mode. The system rejects this service request.</td>
</tr>
<tr>
<td></td>
<td><strong>Action</strong>: Check the calling program for a probable error.</td>
</tr>
<tr>
<td>F05 HWI_LOCKS_HELD</td>
<td><strong>Meaning</strong>: The calling program is holding one or more locks. The system rejects this service request.</td>
</tr>
<tr>
<td></td>
<td><strong>Action</strong>: Check the calling program for a probable coding error.</td>
</tr>
<tr>
<td>F06 HWI_UNSUPPORTED_RELEASE</td>
<td><strong>Meaning</strong>: The system level does not support this service. The system rejects this service request.</td>
</tr>
<tr>
<td></td>
<td><strong>Action</strong>: Remove the calling program from the system, and install it on a system that supports BCPii services. Then run the calling program again.</td>
</tr>
</tbody>
</table>
Return Code in Hexadecimal Equate

Symbol | Meaning and Action
--- | ---
F07 HWI_UNSUPPORTED_ENVIRONMENT | **Meaning:** The system does not support execution of the service from the current environment (for example, calling a BCPii service from within a BCPii ENF exit routine).
**Action:** Issue the BCPii service from a different execution environment.

FFF HWI_UNEXPECTED_ERROR | **Meaning:** System error. The service that was called encountered an unexpected error. The system rejects the service call.
**Action:** Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center.

**Example**

In the pseudocode example, the caller issues a call to register to be notified when the command response events and status change events occur.

```plaintext
Declare (ReturnCode, EventAction, EventExitMode) Fixed(31);
Declare ConnectToken Isa(HWI_CONNTOKEN_TYPE);
Declare EventIDs Isa(HWI_EVENTIDS_TYPE);
Declare (EventExitAddr, EventExitParm) Ptr(31);
Declare DiagArea Isa(HWI_DIAGAREA_TYPE);
Declare EventExit Entry External;

EventAction = HWI_EVENT_ADD;
Hwi_EventID_EyeCatcher = HWI_EVENTID_TEXT;
Hwi_Event_CmdResp = on;
Hwi_Event_StatusChg = on;
Hwi_Event_Reserved = 0;
EventExitMode = HWI_EVENT_TASK;
EventExitAddr = ADDR(EventExit);
EventExitParm = 0;

CALL HWIEVENT (ReturnCode, ConnectToken, EventAction, EventIDs,
EventExitMode, EventExitAddr, EventExitParm, DiagArea);
```

A REXX programming example for the HWIEVENT service:

```rexx
myAction = HWI_EVENT_ADD
myEventIds. = 0 /*Initialize all EventIds to 0 */
myEventIds.Hwi_Event_CmdResp = 1
myEventIds.Hwi_Event_StatusChg = 1
myEventIds.Hwi_Event_ActProfChg = 1

myMode = HWI_EVENT_TASK
myEventExitAddr = 0F123456 /* char rep of 4 byte hex address */
myEventExitParm = 0

address bcpii
"hwievent RetCode myConnectToken myEventAction myEventIds. myEventExitMode
myEventExitAddr myEventExitParm myDiag."

If (RC <> 0) | (Retcode <> 0) Then
  Do
    Say 'Service failed with REXX RC = 'RC' and API Retcode = 'Retcode'.
    If (RC=Hwi_REXXParmSyntaxError | Retcode=0) Then
      Do
        Say ' Diag_index=' myDiag.DIAG_INDEX
        Say ' Diag_key=' myDiag.DIAG_KEY
      End
  End
```

Chapter 19. Base Control Program internal interface (BCPii) 325
HWILIST — Retrieve HMC and BCPii configuration-related information

Call the HWILIST service to retrieve hardware management console (HMC) and BCPii configuration-related information. Depending on which information is requested, the data returned by this service can be used on subsequent BCPii service calls to take the following actions:

- Connect to a central processor complex (CPC), image (LPAR), capacity record (CAPREC), reset activation profile, image activation profile, or load activation profile using the HWICONN API.
- Register for the proper events (HWIEVENT) using the HWIEVENT API.
- Connect to the local CPC or image.
- Connect to a user-defined image group.

Note: A returned CPC name does not guarantee that an application will be able to connect to that particular resource using the HWICONN API. Connecting to a CPC involves setup issues such as setting up connectivity to a support element and defining the necessary BCPii community name on both the support element and the security product. For more information about the steps that need to be completed before connectivity to a particular CPC is complete, see “Setting up connectivity to the support element” on page 258 and “Community name defined in the security product for each CPC” on page 263.

Description

Environment

The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>One of the following: PKM allowing key 0-7, supervisor state, or APF-Authorized</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary or access register (AR)</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard MVS linkage conventions are used</td>
</tr>
</tbody>
</table>

Programming requirements

See “Syntax, linkage and programming considerations” on page 268 for details about how to call BCPii services in the various programming languages.

REXX programming considerations for the HWILIST service

All information for the HWILIST service applies for REXX requests except:

- An answer area stem variable (for example, AnswerArea) replaces AnswerArea_Ptr.
• AnswerArea.0 replaces NumOfDataItemsReturned.
• AnswerArea.i will contain the i-th list value on return. For a list type of HWI_LIST_EVENTS, AnswerArea.i will contain the i-th event bit value on return.
• AnswerAreaLen is not returned.

Restrictions
BCPii does not allow HWILIST to be issued from within a BCPii ENF exit routine.

BCPii does not allow HWILIST with a ListType of HWI_LIST_EVENTS to be issued by a REXX exec running in the TSO/E REXX or ISV-provided REXX environments.

Authorization
The client application must have access to consult the local CPC. This is granted by allowing the application at least read access to the SAF-protected FACILITY class resource HWI.APPLNAME.HWISERV.

For a ListType of HWI_LIST_CPCS, when BCPii is creating the list of CPC network addresses, only those CPC network addresses that the application has at least read access to are listed. The HWI.TARGET.netid.nau FACILITY class resource is consulted to determine this.

For a ListType of HWI_LIST_IMAGES, when BCPii is creating the list of image (LPAR) names, only those image names that the application has at least read access to are listed. The HWI.TARGET.netid.nau.imagename FACILITY class resource is consulted to determine this.

For a ListType of HWI_LIST_CAPRECS, when BCPii is creating the list of capacity records, only those capacity records that the application has at least read access to are listed. The HWI.CAPREC.netid.nau.caprecid FACILITY class resource is consulted to determine this.

For a ListType of HWI_LIST_EVENTS, an application must have at least read access to the SAF-protected FACILITY class resource HWI.TARGET.netid.nau for a CPC connection; or at least read access to the SAF-protected FACILITY class resource HWI.TARGET.netid.nau.imagename for an image connection.

For a ListType of HWI_LIST_LOCALCPC, an application must have at least read access to the HWI.TARGET.netid.nau FACILITY class resource profile where netid.nau represents the local CPC network address.

For a ListType of HWI_LIST_LOCALIMAGE, an application must have at least read access to the HWI.TARGET.netid.nau.imagename FACILITY class resource profile where netid.nau represents the local CPC network address and imagename represents the local image (LPAR) name.

For a ListType of HWI_LIST_RESET_ACTPROF, HWI_LIST_IMAGE_ACTPROF, or HWI_LIST_LOAD_ACTPROF, when BCPii is creating the list of activation profiles names, an application needs to have at least read access to the HWI.TARGET.netid.nau FACILITY class resource for the CPC to which the activation profiles apply.

For a ListType of HWI_LIST_IMAGEGROUPS, an application must have at least read access to the HWI.TARGET.netid.nau FACILITY class resource for the CPC on which image groups may be defined.
Note: BCPII requires the FACILITY class to be RACLST-specified.

**Syntax**
Write the call as shown in the syntax diagram. You must code all parameters on the CALL statement in the order shown.

<table>
<thead>
<tr>
<th>Non-REXX parameters</th>
<th>REXX parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL HWILIST(</td>
<td>address bcpi &quot;hwilist</td>
</tr>
<tr>
<td>ReturnCode,</td>
<td>ReturnCode</td>
</tr>
<tr>
<td>ConnectToken,</td>
<td>ConnectToken</td>
</tr>
<tr>
<td>ListType,</td>
<td>ListType</td>
</tr>
<tr>
<td>NumOfDataItemsReturned,</td>
<td>AnswerArea_Ptr,</td>
</tr>
<tr>
<td>AnswerArea_Ptr,</td>
<td>AnswerArea.</td>
</tr>
<tr>
<td>AnswerAreaLen,</td>
<td></td>
</tr>
<tr>
<td>DiagArea);</td>
<td>DiagArea.”</td>
</tr>
</tbody>
</table>

**Parameters**
The parameters are explained as follows:

**ReturnType**
Returned parameter
- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

ReturnType contains the return code from the service.

**ConnectToken**
Supplied parameter
- Type: Character string
- Length: 16 bytes

ConnectToken represents a logical connection between the application and a CPC, image, or other entity. The ConnectToken is an output parameter on the HWICONN service call.

In most cases, the ConnectToken specified must have originated from a HWICONN service call that was issued from the same address space as this service call. For BCPII REXX execs running under TSO/E or ISV-provided REXX environments, the ConnectToken specified must have originated from a HWICONN service call that was issued from the same task.

If the ListType is HWI_LIST_CPCS, HWI_LIST_LOCALCPC, or HWI_LIST_LOCALIMAGE, this parameter is not relevant and is ignored.

If the ListType is HWI_LIST_IMAGES, this request must either be directed to a specific CPC or to a specific user-defined image group. Therefore, a connect token that represents an already active HWI CPC connection or user-defined image group must be specified.

If the ListType is HWI_LIST_CAPRECS, any of the activation profile (APROF) list types, or HWI_LIST_IMAGEGROUPS, this request must be directed to a specific CPC. Therefore, a connect token that represents an already active HWI CPC connection must be specified.

For a ListType of HWI_LIST_EVENTS, the connect token must represent an already active HWI CPC or image connection, depending on which events are to be listed. If a list of CPC events is required, the connect token must represent an active CPC connection. Likewise, if a list of image events is required, the connect token must represent an active image connection.
**ListType**

Supplied parameter
- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

ListType specifies the type of request for the service.

<table>
<thead>
<tr>
<th>Constant in Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (1) <strong>HWI_LIST_CPCS</strong></td>
<td>Requests a list of CPCs that can be accessed.</td>
</tr>
<tr>
<td>2 (2) <strong>HWI_LIST_IMAGES</strong></td>
<td>Requests a list of image names that can be accessed on the CPC or within the user-defined image group specified.</td>
</tr>
<tr>
<td>3 (3) <strong>HWI_LIST_EVENTS</strong></td>
<td>Requests a list of previously subscribed events. <strong>Note:</strong> This ListType is not supported for REXX execs running in the TSO/E or ISV-provided REXX environments.</td>
</tr>
<tr>
<td>4 (4) <strong>HWI_LIST_CAPRECS</strong></td>
<td>Requests a list of capacity record ID names that can be accessed.</td>
</tr>
<tr>
<td>5 (5) <strong>HWI_LIST_LOCALCPC</strong></td>
<td>Requests the name of the local CPC on which the caller is currently executing.</td>
</tr>
<tr>
<td>6 (6) <strong>HWI_LIST_LOCALIMAGE</strong></td>
<td>Requests the name of the local image (LPAR) on which the HWILIST caller is currently executing.</td>
</tr>
<tr>
<td>7 (7) <strong>HWI_LIST_RESET_ACTPROF</strong></td>
<td>Requests a list of the currently defined reset activation profiles.</td>
</tr>
<tr>
<td>8 (8) <strong>HWI_LIST_IMAGE_ACTPROF</strong></td>
<td>Requests a list of the currently defined image activation profiles.</td>
</tr>
<tr>
<td>9 (9) <strong>HWI_LIST_LOAD_ACTPROF</strong></td>
<td>Requests a list of the currently defined load activation profiles.</td>
</tr>
<tr>
<td>10 (A) <strong>HWI_LIST_IMAGEGROUPS</strong></td>
<td>Requests a list of the currently defined user-defined image groups. <strong>Note:</strong> This ListType is only available when targeting a z10 or higher CPC.</td>
</tr>
</tbody>
</table>

**NumofDataItemsReturned (non-REXX)**

Returned parameter
- Type: Integer
HWILIST

- Length: 4 bytes

NumofDataItemsReturned contains the number of data items returned in the answer area.

**AnswerArea_Ptr (non-REXX)**

**AnswerArea. (REXX)**

Supplied parameter

- Type: Pointer (non-REXX), stem variable (REXX)
- Length: 4 bytes (non-REXX)

**Non-REXX:**

AnswerArea_Ptr specifies the address of the answer area where the requested data is returned.

**REXX:**

A list of the requested objects is returned in an array form of \(x.n\) where \(x\) is the user-defined AnswerArea stem variable and \(n\) is the \(n\)-th element in the stem array.

The AnswerArea.0 stem variable counter holds the number of items returned.

The ListType specified determines the format of the returned data.

<table>
<thead>
<tr>
<th>ListType</th>
<th>Data to be returned (non-REXX)</th>
<th>Data to be returned (REXX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_LIST_CPCS</td>
<td>A string comprised of a list of blank-separated concatenated 17-character CPC network addresses. Each network address is in the form of a 1- through 8-character netid, followed by a period, and followed by a 1- through 8-character network addressable unit (NAU) name. The network address is padded with trailing blanks if the total string length of the network address is less than 17 characters. Example: net1.cpc01.</td>
<td>A stem array list of CPC network addresses. Each network address is in the form of a 1- through 8-character netid, followed by a period, and followed by a 1- through 8-character network addressable unit (NAU) name. Example: net1.cpc01.</td>
</tr>
<tr>
<td>HWI_LIST_IMAGES</td>
<td>A string comprised of a list of blank-separated concatenated 8-character image names padded with trailing blanks.</td>
<td>A stem array list of image names.</td>
</tr>
<tr>
<td>HWI_LIST_EVENTS</td>
<td>A 128-bit string. The first 96 bits (12 bytes) is an eye-catcher value of HWIEVENTBLCK. The last 32 bits represents events already registered for notification. These events were registered by previous HWIEVENT ADD service calls. The returned event indicators are specific to the ConnectToken specified. These indicators are mapped by the type structure HWI_EVENTIDS_TYPE from the BCPii services interface declaration file. If a particular indicator is on, that event is active for this connection. For example, if (x) is the AnswerArea stem variable, the returned Boolean data indicates the event registration status. (x).Hwi_Event_CmdResp = 1 (on) (x).Hwi_Event_StatusChg = 0 (off) (x).Hwi_Event_PowerChange = 0 (off) Note: This ListType is not supported for REXX execs running in the TSO/E or ISV-provided REXX environments.</td>
<td>A stem array list of Boolean values of the EventIDs, which are represented by the EventIDs tail labels defined in HWICIREX.</td>
</tr>
<tr>
<td>HWI_LIST_CAPRECS</td>
<td>A string comprised of a list of blank-separated concatenated 8-character CAPREC names padded with trailing blanks.</td>
<td>A stem array list of CAPREC names.</td>
</tr>
</tbody>
</table>
### HWILIST

<table>
<thead>
<tr>
<th>ListType</th>
<th>Data to be returned (non-REXX)</th>
<th>Data to be returned (REXX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_LIST_LOCALCPC</td>
<td>A 17-character string representing the CPC network address of the local CPC. The network address is in the form of a 1- to 8-character netid, followed by a period, followed by a 1- to 8-character network addressable unit (NAU) name. The network address is padded with trailing blanks.</td>
<td>The CPC network address of the local CPC is returned in the first and only element in the stem array.</td>
</tr>
<tr>
<td></td>
<td>The network address is in the form of a 1-through 8-character netid, followed by a period, and followed by a 1-through 8-character network addressable unit (NAU) name.</td>
<td>The network address is in the form of a 1-through 8-character netid, followed by a period, and followed by a 1-through 8-character network addressable unit (NAU) name.</td>
</tr>
<tr>
<td>HWI_LIST_LOCALIMAGE</td>
<td>An 8-character string representing the image name of the local image (LPAR) padded with trailing blanks.</td>
<td>The image name of the local image (LPAR) is returned in the first and only element in the stem array.</td>
</tr>
<tr>
<td>HWI_LIST_RESET_ACTPROF</td>
<td>A string comprised of a list of concatenated 16-character reset activation profile names padded with trailing blanks.</td>
<td>A stem array list of reset activation profile names.</td>
</tr>
<tr>
<td>HWI_LIST_IMAGE_ACTPROF</td>
<td>A string comprised of a list of concatenated 16-character image activation profile names padded with trailing blanks.</td>
<td>A stem array list of image activation profile names.</td>
</tr>
<tr>
<td>HWI_LIST_LOAD_ACTPROF</td>
<td>A string comprised of a list of concatenated 16-character load activation profile names padded with trailing blanks.</td>
<td>A stem array list of load activation profile names.</td>
</tr>
<tr>
<td>HWI_LIST_IMAGEGROUPS</td>
<td>A null-terminated string of null-separated user-defined image group names.</td>
<td>A stem array list of user-defined image group names.</td>
</tr>
</tbody>
</table>

**AnswerAreaLen (non-REXX)**

- Supplied parameter
- **Type:** Integer
- **Length:** 4 bytes

AnswerAreaLen specifies the length in bytes of the AnswerArea pointed to by the AnswerArea_Ptr. The amount of storage required by the application at the AnswerArea_Ptr location depends primarily on two factors:

1. The ListType specified
2. The number of data items expected to be returned

For example, if a ListType of HWI_LIST_CPCS is specified and the current HMC LAN has 7 CPCs connected to it, at least 17 bytes x 7 CPCs + the number of blank spaces among the CPCs = 119 + 6 = 125 bytes of data are required for the AnswerArea.

**DiagArea (non-REXX)**

- **DiagArea. (REXX)**
  - Returned parameter
  - **Type:** Character string (non-REXX), stem variable (REXX)
  - **Length:** 32 bytes (non-REXX)

DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

**Note:** For all environmental errors (with return code X'F00' and higher), the DiagArea might not be filled in, and the data returned in the area should be ignored.
### Field Name
(non-REXX) / Tail name constant of the user-defined DiagArea stem (REXX)

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type (non-REXX)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code that is returned from the console application API or the BCPii transport layer.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Additional diagnostic information in text format.</td>
</tr>
</tbody>
</table>

See [Appendix A, “BCPii communication error reason codes,” on page 415](#) for a partial list of the descriptive communication transport error return codes and suggested actions.

### ABEND codes
If BCPii is unable to properly access the user-supplied parameter list, the call might result in an abend X'042' with a reason code of X'0005yyyy' because of one of the following reasons:

**Table 65. Reasons for abend X'042', RC X'0005yyyy'**

<table>
<thead>
<tr>
<th>yyyy</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>The parameters passed by the caller are not in the primary address space.</td>
</tr>
<tr>
<td>0001</td>
<td>The parameters passed by the caller are not accessible.</td>
</tr>
<tr>
<td>0002</td>
<td>The number of parameters passed by the caller is not correct.</td>
</tr>
</tbody>
</table>

For other severe BCPii errors encountered during the call, an abend X'042' with a different reason code may result. See [z/OS MVS System Codes](#) for additional information.

### Return codes
When the service returns control to the caller, GPR 15 and ReturnCode contain a hexadecimal return code.

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 HWI_OK</td>
<td>Meaning: Successful completion. Action: None.</td>
</tr>
<tr>
<td>Return Code in Hexadecimal Equate Symbol</td>
<td>Meaning and Action</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>
| 100 HWI_CONNECT_TOKEN_INV                | **Meaning:** Program error. The specified connect token is not valid. This return code indicates one of the following conditions has occurred:  
  • The connect token does not exist. A previous HWICONN service call has never returned the value specified on OutConnectToken.  
  • The connect token does not represent an active connection. The connection specified might have already been disconnected using the HWIDISC service call.  
  • The connect token is not associated with the address space of the caller. The ConnectToken specified is associated with a different address space than the caller of this service call.  
  **Action:** Check for probable coding error. |
| 101 HWI_COMMUNICATION_ERROR             | **Meaning:** A communication error is detected. The hardware management console application API (HWMCA) or the BCPii transport layer has returned with a failing return code.  
  **Action:** See the DiagArea for further diagnostic information. The Diag_CommErr indicates the return code that is returned from HWMCA APIs or the BCPii transport layer.  
  HWMCA API and BCPii transport return codes are provided in [Appendix A, “BCPii communication error reason codes,” on page 415](#). |
| 102 HWI_DIAGAREA_INV                    | **Meaning:** Program error. The DiagArea is not accessible.  
  **Action:** Check for probable coding error. Verify the specified DiagArea is defined as a 32-byte character field. |
| 103 HWI_CONNECT_TOKEN_INACTIVE          | **Meaning:** The specified connect token is no longer valid. The connection has been disconnected, or it is in the progress of being disconnected.  
  **Action:** Check for probable coding error. Verify that the specified connect token is still active. If connectivity to the targeted CPC connection no longer exists, all connections associated with that CPC will no longer have a connect token that can be used. |
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 301 HWI_LISTTYPE_INV                    | **Meaning**: Program error. The requested LISTTYPE specified in the call is not valid. The system rejects the service call. This return code indicates one of the following conditions has occurred:  
  • The ListType specified is not in the acceptable value range of possible list types.  
  • The ListType specified is incompatible with the InConnectToken specified. For example:  
    – The ListType specified applies only to CPC connections, but the ConnectToken specified represents an image connection.  
    – The ListType specified applies only to image connections, but the ConnectToken specified represents a CPC connection.  
  • For ListType HWI_LIST_EVENTS, the ConnectToken must not represent a capacity record because capacity record events do not have events directly associated with capacity records connections. Capacity-related events are associated with a CPC connection.  
**Action**: Check for probable coding error. Validate that the ListType specified is in the valid range of possible values, and that the ListType specified is permitted for the specified connection type. |
| 302 HWI_DATA_EXCEEDED                   | **Meaning**: Program error. The amount of returned data exceeded the size of the answer area. No data or only partial data is returned.  
**Action**: Check for probable coding error. See the DiagArea for further diagnostic information. The Diag_Actual indicates the application-specified length. The Diag_Expected indicates the size required for the AnswerArea. |
| 303 HWI_ANSWERAREA_INACCESSIBLE        | **Meaning**: Program error. The answer area data area is either partially or completely inaccessible by the application and the Base Control Program internal interface (BCPii) address space.  
**Action**: Check for probable coding error. Verify that the AnswerArea_Ptr points to a data area where the answer area is and make sure the data area is accessible. |
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 304 HWI_LIST_NODATA_RETURNED           | **Meaning:** There is no data to be returned or the caller does not have enough access to display the listed values.  
**Action:** Check for probable coding error. Verify that proper access is granted for the request. |
| 305 HWI_LISTTYPE_NOT_SUPPORTED         | **Meaning:** The targeted hardware of the HWILIST request does not support the request attempted by the program.  
**Action:** Verify that the targeted hardware supports the type of request being made. |
| F00 HWI_NOTAVAILABLE                  | **Meaning:** BCPIi services are not available, and the system rejects the service request.  
**Action:** Notify the system programmer to start the BCPIi address space and try the request again. See [Restarting the HWIBCPIi address space](#) on page 267 about how to start the BCPIi address space.  
Programs can also listen to ENF68 to determine when BCPIi services are available. See [z/OS MVS Programming: Authorized Assembler Services Reference EDT-IWG](#) for how to listen for BCPIi activation messages. |
| F01 HWI_AUTH_FAILURE                   | **Meaning:** The caller is PKM8-15 problem state and the program does not reside in an APF-authorized library.  
**Action:** Check the calling program for a probable coding error. |
## Return Code in Hexadecimal Equate

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| F02 HWI_NO_SAF_AUTH | **Meaning:** The user does not have correct SAF authorization for the request.  
**Action:** Check for probable error. Consider one or more of the following possible actions:  
- Define read access authorization to the FACILITY class resource profile HWI.APPLNAME.HWISERV.  
- Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename for HWI_LIST_IMAGES ListType.  
- Define read access authorization to the FACILITY class resource profile HWI.CAPREC.netid.nau.caprec for HWI_LIST_CAPRECS ListType.  
- For a ListType of HWI_LIST_EVENTS, define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau for a CPC connection, and HWI.TARGET.netid.nau.imagename for an image connection.  
- For a ListType of HWI_LIST_LOCALCPC, define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau where netid.nau represents the local CPC network address.  
- For a ListType of HWI_LIST_LOCALIMAGE, define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename where netid.nau represents the local CPC network address and imagename represents the local image (LPAR) name.  
- For the ListType of HWI_LIST_RESET_ACTPROF, HWI_LIST_IMAGE_ACTPROF, HWI_LIST_LOAD_ACTPROF, or HWI_LIST_IMAGEGROUPS, define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau for the CPC where the activation profiles or image groups to be listed are defined.  
- Ensure that the referenced facility class profiles are RACLIST-specified. |
| F03 HWI_INTERRUPT_STATUS_INV | **Meaning:** The calling program is disabled. The system rejects this service request.  
**Action:** Check the calling program for a probable coding error. |
Return Code in Hexadecimal Equate
Symbol | Meaning and Action
---|---
F04 HWI_MODE_INV | **Meaning:** The calling program is not in task mode. The system rejects this service request.
**Action:** Check the calling program for a probable error.

F05 HWI_LOCKS_HELD | **Meaning:** The calling program is holding one or more locks. The system rejects this service request.
**Action:** Check the calling program for a probable coding error.

F06 HWI_UNSUPPORTED_RELEASE | **Meaning:** The system level does not support this service. The system rejects this service request.
**Action:** Remove the calling program from the system, and install it on a system that supports BCPii services. Then run the calling program again.

F07 HWI_UNSUPPORTED_ENVIRONMENT | **Meaning:** The system does not support execution of the service from the current environment (for example, calling a BCPii service from within a BCPii ENF exit routine).
**Action:** Issue the BCPii service from a different execution environment.

FFF HWI_UNEXPECTED_ERROR | **Meaning:** System error. The service that was called encountered an unexpected error. The system rejects the service call.
**Action:** Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center.

**Example**
In the pseudocode example, the caller issues a call to retrieve a list CPCs that can be accessed.

```
ListingType = HWI_LIST_CPCS;
AnswerArea_Ptr = addr(AnswerArea);
AnswerAreaLen = 125;
CALL HWILIST (ReturnCode, ConnectToken, ListType, NumofDataItemsReturned, 
AnswerArea_Ptr, AnswerAreaLen, DiagArea)
```

A REXX programming example for the HWILIST service:
```
myListType = HWI_LIST_IMAGES
address bcpii
   "hwilist RetCode myConnectToken myListType myAnswerArea. myDiag."

If (RC <> 0) | (Retcode <> 0) Then
```
HWIQUERY — BCPIi retrieval of SE/HMC-managed attributes

Call the HWIQUERY service to retrieve information about objects managed by the support element (SE) or hardware management console (HMC) related with central processor complexes (CPCs), CPC images (LPARs), capacity records, different types of activation profiles, or user-defined image groups.

For some connection types (HWI_CPC and HWI_IMAGE in particular), grouping multiple attributes together into a single HWIQUERY service call may result in significantly reduced waiting times rather than querying the same number of attributes one at a time. Whenever possible, an application should consolidate its HWIQUERY service calls to query multiple attributes using the same query request.

Description

Environment
The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>One of the following: PKM allowing key 0-7, supervisor state, or APF-Authorized</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary or access register (AR)</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard MVS linkage conventions are used</td>
</tr>
</tbody>
</table>

Programming requirements
See "Syntax, linkage and programming considerations" on page 268 for details about how to call BCPIi services in the various programming languages.
See "HWIQUERY and HWISET" on page 417 for the summary table of the BCPii
HWIQUERY and HWISET attributes and the objects that can be targeted for each
function.

**REXX programming considerations for the HWIQUERY service**

All information for the HWIQUERY service applies for REXX requests except:

- A query parameter stem variable (for example, QueryParm) replaces
  QueryParm_Ptr.
  - QueryParm.0 replaces NumOfAttributes. QueryParm.0 is required to specify
    the number of attributes to be queried. The maximum number of attributes
    allowed is 64.
  - QueryParm.n.ATTRIBUTEIDENTIFIER must contain the n-th attribute
    identifier to be returned.
  - QueryParm.n.ATTRIBUTEVALUE will contain the n-th attribute value on
    return.
- AttributeValue_Ptr is replaced with AttributeValue.
- AttributeValue Len is not used.
- AttributeValue LenReturned is not used.
- For the PSW (HWI_PSWS) attribute:
  - QueryParm.n.ATTRIBUTEVALUE.0 will contain the number of PSWs returned
    (j).
  - QueryParm.n.ATTRIBUTEVALUE.m.CPUID will contain the m-th CPU
    identifier.
  - QueryParm.n.ATTRIBUTEVALUE.m.PSW will contain the m-th PSW.
- For the supported processor power savings mode (HWI_SUPPPPOWERMODE)
  attribute:
  - QueryParm.n.ATTRIBUTEVALUE.0 will contain the number of supported
    power savings modes returned (m).
  - QueryParm.n.ATTRIBUTEVALUE.m.PSMODE will contain the m-th supported
    power savings mode.
- For the list of IP addresses (HWI_LIST_IP_ADDRESSES) attribute:
  - QueryParm.n.ATTRIBUTEVALUE.0 will contain the number of IP addresses
    returned (j).
  - QueryParm.n.ATTRIBUTEVALUE.m.IPADDR will contain the m-th IP address.

**Restrictions**

BCPii does not allow HWIQUERY to be issued from within a BCPii ENF exit
routine.

**Authorization**

The client application must have access to consult the local CPC. This is granted by
allowing the application at least read access to the SAF-protected FACILITY class
resource HWI.APPLNAME.HWISERV.

Client application must have at least read access to the SAF-protected FACILITY
class HWI.TARGET.netid.nau for any CPC, activation profile, or user-defined image
group queries, or HWI.TARGET.netid.nau.imagename for image queries, or
HWI.CAPREC.netid.nau.caprecid for capacity record queries.

**Note:** BCPii requires the FACILITY class to be RACLST-specified.
HWIQUERY

**Syntax**
Write the call as shown in the syntax diagram. You must code all parameters on the CALL statement in the order shown.

<table>
<thead>
<tr>
<th>Non-REXX parameters</th>
<th>REXX parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL HWIQUERY(</td>
<td>address bcpii &quot;hwiquery</td>
</tr>
<tr>
<td>ReturnCode,</td>
<td>ReturnCode</td>
</tr>
<tr>
<td>ConnectToken,</td>
<td>ConnectToken</td>
</tr>
<tr>
<td>QueryParm_Ptr,</td>
<td>QueryParm.</td>
</tr>
<tr>
<td>NumOfAttributes,</td>
<td></td>
</tr>
<tr>
<td>DiagArea);</td>
<td>DiagArea.”</td>
</tr>
</tbody>
</table>

**Parameters**
The parameters are explained as follows:

**ReturnCode**
Returned parameter
- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

ReturnCode contains the return code from the service.

**ConnectToken**
Supplied parameter
- Type: Character string
- Length: 16 bytes

ConnectToken represents a logical connection between the application and a CPC, image, capacity record, activation profile, or user-defined image group. The ConnectToken is an output parameter on the HWICONN service call.

In most cases, the ConnectToken specified must have originated from a HWICONN service call that was issued from the same address space as this service call. For BCPIi REXX execs running under the TSO/E or ISV-provided REXX environments, the ConnectToken specified must have originated from a HWICONN service call that was issued from the same task.

**QueryParm_Ptr (non-REXX)**
**QueryParm. (REXX)**
Supplied parameter
- Type: Pointer (non-REXX), stem variable (REXX)
- Length: 4 bytes (non-REXX)

**Non-REXX:**
QueryParm_Ptr specifies the address of a user-defined query structure that contains a list of one or more requested attributes to be queried, in the following form: attribute that is required, address of where returned value is to be stored, the length of the storage available to HWIQUERY to store the returned value, and the actual length of the data that will be returned in the data area.

The size of the data area pointed to by this parameter must be 16 bytes multiplied by the NumOfAttributes parameter. For example, if NumOfAttributes is 4, the data area pointed to by this parameter must be at least 64 bytes long (16 x 4).

The storage area that contains each attribute in the QueryParm is shown below:
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>AttributeIdentifier</td>
<td>32-bit unsigned integer</td>
</tr>
<tr>
<td>AttributeValue_Ptr</td>
<td>Pointer</td>
</tr>
<tr>
<td>AttributeValueLen</td>
<td>32-bit unsigned integer</td>
</tr>
<tr>
<td>AttributeValueLenReturned</td>
<td>32-bit unsigned integer</td>
</tr>
</tbody>
</table>

This table is mapped by the data structure Hwi_QueryParm_Type in the data mappings provided for the various programming languages supported. See “Syntax, linkage and programming considerations” on page 268 for more information.

If all of the data can be written into the data area (the AttributeValueLen is greater than or equal to the actual data returned), the AttributeValueLenReturned field contains the actual length of the data written in the storage specified at address AttributeValue_Ptr.

The AttributeValueLenReturned is only used as an output parameter. Any value contained in the field when HWIQUERY is called is ignored.

**REXX:**

QueryParm is a compound (stem) variable which contains one or more requested attributes to be queried and returned.

The compound (stem) variable is specified as follows (where x is the user-defined QueryParm stem variable and n is the n-th attribute for the request):

- **x.0 specifies the number of attributes to be queried.** The maximum number of attributes allowed is 64. (Supplied parameter)
- **x.n.ATTRIBUTEIDENTIFIER specifies the requested attribute.** Set this variable to one of the query attribute constants defined in HWICIREX. (Supplied parameter)
- **x.n.ATTRIBUTEVALUE is the data value to be returned for most attributes.** (Returned parameter)
- **Some single attributes can return multiple objects in a formatted structure.** For those attributes, x.n.ATTRIBUTEVALUE.0 (Returned parameter) is the total number of returned objects. See the query attribute table below for the following attributes that are in a different format. These attributes include: HWI_SUPPPPOWERMODE, HWI_LIST_IP_ADDRESSES and HWI_PSWS.

The following is the list of valid query attributes identifiers. For more information about these attributes, see the following publications:

- System z Application Programming Interfaces (SB10-7030-13)
- System z10 and eServer zSeries Application Programming Interfaces (SB10-7030-09)
- System z9 and eServer zSeries Application Programming Interfaces (SB10-7030-08)
- Publication appropriate to the level of hardware that the HWIQUERY is targeted
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(1)</td>
<td>HWI_NAME Requests to retrieve the name that represents the connect token.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must represent a CPC connection, an image connection, a reset activation profile connection, an image activation profile connection, a load activation profile connection, or an image group connection.</td>
</tr>
<tr>
<td>2</td>
<td>(2)</td>
<td>HWI_ERRSTAT Requests to retrieve whether the status is acceptable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must represent a CPC connection an image connection, or an image group connection.</td>
</tr>
<tr>
<td>3</td>
<td>(3)</td>
<td>HWI_BUSYSTAT Requests to retrieve whether the status is busy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must represent a CPC connection an image connection, or an image group connection.</td>
</tr>
<tr>
<td>4</td>
<td>(4)</td>
<td>HWI_MSGSTAT Requests to retrieve whether hardware messages are present.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must represent a CPC connection an image connection.</td>
</tr>
<tr>
<td>5</td>
<td>(5)</td>
<td>HWI_OPERSTAT Requests to retrieve the current status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token represents a CPC connection an image connection.</td>
</tr>
<tr>
<td>6</td>
<td>(6)</td>
<td>HWI_ACCSTAT Requests to retrieve the acceptable status values.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token represents a CPC connection an image connection.</td>
</tr>
<tr>
<td>7</td>
<td>(7)</td>
<td>HWI_APROF Requests to retrieve the next activation reset profile name.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must represent a CPC connection an image connection.</td>
</tr>
<tr>
<td>8</td>
<td>(8)</td>
<td>HWI_LUAPROF Requests to retrieve the last used activation profile.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must represent a CPC connection an image connection.</td>
</tr>
<tr>
<td>9</td>
<td>(9)</td>
<td>HWI_OBJTYPE Requests to retrieve the object type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Input connection token represents</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Returns</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPC HUMCA_CPC_OBJECT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CPC image HUMCA_CPC_IMAGE_OBJECT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capacity record HUMCA_CAPACITY_RECORD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reset activation profile HUMCA_ACT_PROFILE_RESET</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Image activation profile HUMCA_ACT_PROFILE_IMAGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Load activation profile HUMCA_ACT_PROFILE_LOAD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Image Group HUMCA_CPC_IMAGE_USER_GROUP</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must represent a CPC connection, an image connection, a capacity record connection, a reset activation profile connection, an image activation profile connection, a load activation profile connection, or an image group connection.</td>
</tr>
<tr>
<td>A</td>
<td>(10)</td>
<td>HWI_IMLMODE Requests to retrieve the initial machine load (IML) mode (LPAR).</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must only represent a CPC connection or an image connection.</td>
</tr>
<tr>
<td>Constant in hexadecimal (Decimal)</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>B-16 (11–22)</td>
<td>Reserved for attributes that are common to CPC and image connections unless otherwise noted.</td>
<td></td>
</tr>
<tr>
<td>RESERVED</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 17 (23)                           | Requests to retrieve the internet address (IPv4 format).  
Note: The input connection token must only represent a CPC connection. |
| HWI_IPADDR                        |             |
| 18 (24)                           | Requests to retrieve the SNA address (netid.nau).  
Note: The input connection token must only represent a CPC connection. |
| HWI_SNAADDR                       |             |
| 19 (25)                           | Requests to retrieve the machine model.  
Note: The input connection token must only represent a CPC connection. |
| HWI_MMODEL                        |             |
| 1A (26)                           | Requests to retrieve the machine type.  
Note: The input connection token must only represent a CPC connection. |
| HWI_MTYPE                         |             |
| 1B (27)                           | Requests to retrieve the machine serial.  
Note: The input connection token must only represent a CPC connection. |
| HWI_MSERIAL                       |             |
| 1C (28)                           | Requests to retrieve the CPC serial number.  
Note: The input connection token must only represent a CPC connection. |
| HWI_CPCSERIAL                     |             |
| 1D (29)                           | Requests to retrieve the CPC identifier.  
Note: The input connection token must only represent a CPC connection. |
| HWI_CPCID                         |             |
| 1E (30)                           | Requests to retrieve the name of the application that is holding the reserve (if any).  
Note: The input connection token must only represent a CPC connection. |
| HWI_RESERVEID                     |             |
| 1F (31)                           | Requests to retrieve the service required.  
Note: The input connection token must only represent a CPC connection. |
| HWI_SVCEREQD                      |             |
| 20 (32)                           | Requests to retrieve the CBU installed.  
Note: The input connection token must only represent a CPC connection. |
| HWI_CBUINSTD                      |             |
| 21 (33)                           | Requests to retrieve the CBU enabled.  
Note: The input connection token must only represent a CPC connection. |
<p>| HWI_CBUENABLD                     |             |</p>
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 22 (34)                          | HWI_CBUACTIVE | Requests to retrieve the CBU activated.  
  Note: The input connection token must only represent a CPC connection. |
| 23 (35)                          | HWI_CBUACTDT  | Requests to retrieve the CBU activation date.  
  Note: The input connection token must only represent a CPC connection. |
| 24 (36)                          | HWI_CBUEXPDT  | Requests to retrieve the CBU expiration date.  
  Note: The input connection token must only represent a CPC connection. |
| 25 (37)                          | HWI_CBTESTAR  | Requests to retrieve the CBU tests left (test activations remaining).  
  Note: The input connection token must only represent a CPC connection. |
| 26 (38)                          | HWI_CBUREALAV | Requests to retrieve the CBU real activation available.  
  Note: The input connection token must only represent a CPC connection. |
| 27 (39)                          | HWI_PRUNTYPE  | Requests to retrieve the processor running time type.  
  Note: The input connection token must only represent a CPC connection or a reset activation profile connection. |
| 28 (40)                          | HWI_PRUNTIME  | Requests to retrieve the processor running time.  
  Note: The input connection token must only represent a CPC connection or a reset activation profile connection. |
| 29 (41)                          | HWI_PRUNTSEW  | Requests to retrieve the processor running time slice end wait processing.  
  Note: The input connection token must only represent a CPC connection or a reset activation profile connection. |
| 2A (42)                          | HWI_OOCINST   | Requests to retrieve the on and off capacity on demand installed.  
  Note: The input connection token must only represent a CPC connection. |
| 2B (43)                          | HWI_OOCACT    | Requests to retrieve the on and off capacity on demand currently activated.  
  Note: The input connection token must only represent a CPC connection. |
| 2C (44)                          | HWI_OOCENAB   | Requests to retrieve the on and off capacity on demand enabled.  
  Note: The input connection token must only represent a CPC connection. |
| 2D (45)                          | HWI_OOCADT    | Requests to retrieve the on and off capacity on demand activation date.  
  Note: The input connection token must only represent a CPC connection. |
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2E (46)                           | HWI_PCPCSWM   | Requests to retrieve the permanent CPC software model. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 2F (47)                           | HWI_PPBPSWM   | Requests to retrieve the permanent plus billable processor software model. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 30 (48)                           | HWI_PPTPSWM   | Requests to retrieve the permanent plus (all) temporary processor software model. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 31 (49)                           | HWI_PPCMSU    | Requests to retrieve the permanent CPC millions of service units (MSU) value. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 32 (50)                           | HWI_PPBPMSU   | Requests to retrieve the permanent plus billable processor MSU value. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 33 (51)                           | HWI_PPTPMSU   | Requests to retrieve the permanent plus (all) temporary processor MSU value. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 34 (52)                           | HWI_NUMGPP    | Requests to retrieve the number of general purpose processors. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 35 (53)                           | HWI_NUMSAP    | Requests to retrieve the number of service assist processors. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 36 (54)                           | HWI_NUMIFAP   | Requests to retrieve the number of the integrated facility for applications (IFA) processors. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 37 (55)                           | HWI_NUMIFLP   | Requests to retrieve the number of the integrated facility for Linux (IFL) processors. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 38 (56)                           | HWI_NUMICFP   | Requests to retrieve the number of the internal coupling facility (ICF) processors. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 39 (57)                           | HWI_NUMIIPP   | Requests to retrieve the number of integrated information processors (IIP). This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 3A (58)                          | HWI_NUMFLTYP  | Requests to retrieve the number of defective (faulty) processors. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 3B (59)                          | HWI_NUMSPARE  | Requests to retrieve the number of spare processors. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 3C (60)                          | HWI_NUMPENDP  | Requests to retrieve the number of pending (activation) processors. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 3D (61)                          | HWI_CAPCHGALLWD | Requests to determine if activate/deactivate of capacity are permitted. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 3E (62)                          | HWI_DGRSTAT   | Requests to retrieve degraded status.  
**Note:** The input connection token must only represent a CPC connection. |
| 3F (63)                          | HWI_CURRPOWERMODE | Requests to retrieve the current processor power savings mode active on the targeted CPC. This attribute is only available when targeting a zEnterprise or higher CPC.  
**Note:** The input connection token must only represent a CPC connection. |
| 40 (64)                          | HWI_SUPPPPOWERMODE | Requests to retrieve the supported processor power savings modes available on the targeted CPC. This attribute is only available when targeting a zEnterprise or higher CPC.  
**Non-REXX:** The returned data is mapped as follows:  
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of supported powersave modes</td>
<td>32-bit integer</td>
</tr>
</tbody>
</table>
| For each supported powersave mode, the following is returned:  
Powersave mode 32-bit integer value  
**Note:** The query parameter for this attribute must specify a data area large enough to contain all of the above structure (that is, 32 bits + 32 bits per supported powersave mode returned). For example, if there are 2 supported powersave modes on the targeted CPC, then the structure must be at least 32 + (32 x 2) = 96 bits (12 bytes).  
**REXX:** The returned data is mapped as follows (where x is the user-defined QueryParm stem, n is the n-th requested attribute and m is the m-th returned powersave mode value):  
• x.n.ATTRIBUTEVALUE.0 is the number of supported powersave modes (m).  
• x.n.ATTRIBUTEVALUE.m.PSMODE is the m-th powersave mode value.  
**Note:** The input connection token must only represent a CPC connection. |
<table>
<thead>
<tr>
<th>Constant in hexadecimal</th>
<th>(Decimal)</th>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>(65)</td>
<td>HWL_STPCONFIG</td>
<td>Requests to retrieve the Server Timer Protocol (STP) configuration data. Note: The input connect token must only represent a CPC connection.</td>
</tr>
<tr>
<td>42</td>
<td>(66)</td>
<td>HWL_NUMPGPP</td>
<td>Requests to retrieve the number of pending general purpose processors. Note: The input connect token must only represent a CPC connection.</td>
</tr>
<tr>
<td>43</td>
<td>(67)</td>
<td>HWL_NUMPSAP</td>
<td>Requests to retrieve the number of pending service assist processors. Note: The input connect token must only represent a CPC connection.</td>
</tr>
<tr>
<td>44</td>
<td>(68)</td>
<td>HWL_NUMPAAP</td>
<td>Requests to retrieve the number of pending Application Assist Processor (AAP) processors. Note: The input connect token must only represent a CPC connection.</td>
</tr>
<tr>
<td>45</td>
<td>(69)</td>
<td>HWL_NUMPIFLP</td>
<td>Requests to retrieve the number of pending Integrated Facility for Linux (IFL) processors. Note: The input connect token must only represent a CPC connection.</td>
</tr>
<tr>
<td>46</td>
<td>(70)</td>
<td>HWL_NUMPICFP</td>
<td>Requests to retrieve the number of pending Internal Coupling Facility (ICF) processors. Note: The input connect token must only represent a CPC connection.</td>
</tr>
<tr>
<td>47</td>
<td>(71)</td>
<td>HWL_NUMPIIPP</td>
<td>Requests to retrieve the number of pending Integrated Information (IIP) processors. Note: The input connect token must only represent a CPC connection.</td>
</tr>
<tr>
<td>48</td>
<td>(72)</td>
<td>HWL_POWERMODEALLOWED</td>
<td>Requests to retrieve the processor power savings mode allowed. This attribute is only available when targeting a zEnterprise or higher CPC. HWMCA_TRUE The processor currently allows switching to power savings mode. HWMCA_FALSE The processor currently does not allow switching to power savings mode. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>49</td>
<td>(73)</td>
<td>HWL_VERSION</td>
<td>Requests to retrieve the CPC version number. Note: The input connection token must only represent a CPC connection.</td>
</tr>
<tr>
<td>4A</td>
<td>(74)</td>
<td>HWL_EC_MCL_INFO</td>
<td>Requests to retrieve an XML string that describes the Engineering Change (EC) and Microcode Level (MCL) levels. Note: The input connection token must only represent a CPC connection.</td>
</tr>
</tbody>
</table>

**Attention:** The data returned by the support element can be quite large. Consider using a larger data area when requesting this attribute.
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 4B (75)                          | **HWI_LIST_IP_ADDRESSES** | Requests to retrieve all the IP addresses (in either IPv4 or IPv6 format, or both) used for the targeted CPC.  
**Non-REXX:**  
The returned data is mapped as follows:  
Field Name | Field Type  
----------|-----------  
Number of IP addresses | 32-bit unsigned integer  
IP address value | 39-character value padded with blanks  

**Note:** The query parameter for this attribute must specify a data area large enough to contain all of the above structure (that is, a 4-byte length field plus a 39-byte field for each IP address returned). For example, if there are 3 IP addresses returned, the AttributeValueLen specified for this attribute must be at least \((4 + (39 \times 3)) = 121\) bytes.  
**REXX:**  
The returned data is mapped as follows (where \(x\) is the user-defined QueryParm stem, \(n\) is the \(n\)-th requested attribute and \(m\) is the \(m\)-th returned IP address value):  
- \(x.n\).ATTRIBUTEVALUE.0 is the number of IP addresses \((m)\).  
- \(x.n\).ATTRIBUTEVALUE.m.IPADDR is the \(m\)-th IP address value.  
**Note:** The input connection token must only represent a CPC connection. |
| 4C (76)                          | **HWI_AUTO_SWITCH_ENABLED** | Requests to retrieve a value used to determine if automatic switching between primary and alternate support elements is enabled.  
A 4-byte integer type value is returned:  
**HWMCA_TRUE**  
Automatic switching is enabled.  
**HWMCA_FALSE**  
Automatic switching is disabled.  
**Note:** The input connection token must only represent a CPC connection. |
| 4D-68 (77-104)                   | **RESERVED** | Reserved for CPC attributes unless otherwise noted. |
| 69 (105)                         | **HWI_CPCNAME** | Requests to retrieve the parent (CPC) name.  
**Note:** The input connection token must only represent an image connection. |
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6A (106)</td>
<td>HWI_OSNAME</td>
<td>Requests to retrieve the SW operating system name. The values returned on the HWI_OSNAME attribute are not owned by z/OS BCPii and are subject to change. The possible values returned by the various operating systems at the time of this publication include:</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>HWI_OSTYPE value: MVS</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The HWI_OSNAME value returned is the SYSNAME parameter as defined in IEASYSxx parmlib member for the targeted image.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>HWI_OSTYPE value: VM</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The HWI_OSNAME value returned is the system identifier or system name as defined in the SYSTMID field in the SYSCM (System Common Area) control block.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>HWI_OSTYPE value: LINUX</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The HWI_OSNAME value returned is N/A.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>HWI_OSTYPE value: VSE</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The HWI_OSNAME value returned is the VSE system name.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>HWI_OSTYPE value: Z TPF EE</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The HWI_OSNAME value returned is the id value representing the targeted image's CPU designation in the z/TPF complex.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must only represent an image connection.</td>
</tr>
<tr>
<td>6B (107)</td>
<td>HWI_OSTYPE</td>
<td>Requests to retrieve the SW operating system type. The values returned on the HWI_OSTYPE attribute are not owned by z/OS BCPii and are subject to change. Possible values include MVS, VM, LINUX, VSE, and Z TPF EE.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Note:</strong> The input connection token must only represent an image connection.</td>
</tr>
<tr>
<td>Constant in hexadecimal</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>6C (108)</td>
<td>Requests to retrieve the SW operating system level. The values returned on the HWI_OSLEVEL attribute are not owned by z/OS BCPi and are subject to change. The possible values returned by the various operating systems at the time of this publication include:</td>
<td></td>
</tr>
<tr>
<td>HWI_OSTYPE value: MVS</td>
<td>The HWI_OSLEVEL value is mapped by the CVTOSLVL field of the CVT control block.</td>
<td></td>
</tr>
<tr>
<td>HWI_OSTYPE value: VM</td>
<td>The HWI_OSLEVEL value is mapped as follows:</td>
<td></td>
</tr>
<tr>
<td>• 4-bit release #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 4-bit modification level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit version #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 16-bit service level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit MVS guest count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit LINUX guest count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit VSE guest count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit Solaris guest count</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_OSTYPE value: LINUX</td>
<td>The HWI_OSLEVEL value is mapped as follows, in hexadecimal:</td>
<td></td>
</tr>
<tr>
<td>• 40 bits N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit major kernel revision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit major release</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit minor release</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_OSTYPE value: VSE</td>
<td>The HWI_OSLEVEL value is mapped as follows:</td>
<td></td>
</tr>
<tr>
<td>• 32-bit VSE/AF release level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 32-bit latest service level (if available)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_OSTYPE value: Z TPF EE</td>
<td>The HWI_OSLEVEL value is mapped as follows:</td>
<td></td>
</tr>
<tr>
<td>• 16-bit version #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 8-bit PUT level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For MVS, FFFFFFFFE7F0000 implies that the target is running z/OS V1R13 because the CVTZOS_V1R13 bit is the last supported release flag that is on.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For VM, 4005100200320000 implies that the target is running z/VM Release 4, Modification Level 0, Version 5, Service Level 1002, MVS guest count 0, Linux guest count 32, VSE guest count 0, and Solaris guest count 0.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For LINUX, 0000000000020620 implies that the target is running z/LINUX major kernel revision 2, major release 6, and minor release 32.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For VSE, 0830000000000000 implies that the target is running at the VSE/AF 8.3 release level and no service level is available.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For Z TPF EE, 0101070000000000 implies that the target is running z/TPF version 1.1, PUT level 7.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Note: The input connection token must represent an image connection.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6D (109)</td>
<td>Requests to retrieve the SW sysplex name (z/OS only).</td>
<td></td>
</tr>
<tr>
<td>Note: The input connection token must only represent an image connection.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant in hexadecimal</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------</td>
<td></td>
</tr>
</tbody>
</table>
| 6E (110)                | Requests to retrieve the LPAR cluster name.  
  *Note:* The input connection token must only represent an *image connection.* |
| HWI_CLUSTER             | Requests to retrieve the LPAR cluster name.  
  *Note:* The input connection token must only represent an *image connection.* |
| 6F (111)                | Requests to retrieve the partition ID. If the connection token represents an *image connection*, the image partition ID is returned; if the connection token represents an *image activation profile connection*, the image activation profile partition ID is returned.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| HWI_PARTITIONID         | Requests to retrieve the partition ID. If the connection token represents an *image connection*, the image partition ID is returned; if the connection token represents an *image activation profile connection*, the image activation profile partition ID is returned.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| 70 (112)                | Requests to retrieve the current defined capacity.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| HWI_DEFCAP              | Requests to retrieve the current defined capacity.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| 71 (113)                | Requests to retrieve the shared general processor initial processing weight (SGPIPW).  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| HWI_SGPIPW              | Requests to retrieve the SGPIPW to be capped or not capped.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| 72 (114)                | Requests to retrieve the SGPIPW to be capped or not capped.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| HWI_SGPIPWWCAP          | Requests to retrieve the minimum SGPPW value.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| 73 (115)                | Requests to retrieve the minimum SGPPW value.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| HWI_SGPPWMIN            | Requests to retrieve the maximum SGPPW value.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| 74 (116)                | Requests to retrieve the maximum SGPPW value.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| HWI_SGPPWMAX            | Requests to retrieve the current SGPPW value.  
  *Note:* The input connection token must only represent an *image connection.* |
| 75 (117)                | Requests to retrieve the current SGPPW value.  
  *Note:* The input connection token must only represent an *image connection.* |
| HWI_SGPPW               | Requests to retrieve the SGPPW to be capped or not capped.  
  *Note:* The input connection token must only represent an *image connection.* |
| 76 (118)                | Requests to retrieve the SGPPW to be capped or not capped.  
  *Note:* The input connection token must only represent an *image connection.* |
| HWI_SGPPWCAP            | Requests to retrieve whether WLM is allowed to change processing weight-related attributes.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| 77 (119)                | Requests to retrieve whether WLM is allowed to change processing weight-related attributes.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| HWI_WLM                 | Requests to retrieve the integrated facility for applications initial processing weight (IFAIPW).  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| 78 (120)                | Requests to retrieve the integrated facility for applications initial processing weight (IFAIPW).  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| HWI_IFAIPW              | Requests to retrieve the IFAIPW to be capped or not capped.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
| 79 (121)                | Requests to retrieve the IFAIPW to be capped or not capped.  
  *Note:* The input connection token must only represent an *image connection* or an *image activation profile connection.* |
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Description</th>
<th>Equate symbol</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>7A (122) HWI_IFAPWMIN</td>
<td>Requests to retrieve the minimum IFAPW value.</td>
<td>Requests to retrieve the minimum IFAPW value.</td>
<td>The input connection token must only represent an image connection or an image activation profile connection.</td>
</tr>
<tr>
<td>7B (123) HWI_IFAPWMAX</td>
<td>Requests to retrieve the maximum IFAPW value.</td>
<td>Requests to retrieve the maximum IFAPW value.</td>
<td>The input connection token must only represent an image connection or an image activation profile connection.</td>
</tr>
<tr>
<td>7C (124) HWI_IFAPW</td>
<td>Requests to retrieve the current IFAPW value.</td>
<td>Requests to retrieve the current IFAPW value.</td>
<td>The input connection token must only represent an image connection.</td>
</tr>
<tr>
<td>7D (125) HWI_IFAPWCAP</td>
<td>Requests to retrieve the IFAPW to be currently capped or not capped.</td>
<td>Requests to retrieve the IFAPW to be currently capped or not capped.</td>
<td>The input connection token must only represent an image connection.</td>
</tr>
<tr>
<td>7E (126) HWI_IFLPW</td>
<td>Requests to retrieve the integrated facility for Linux initial processing weight.</td>
<td>Requests to retrieve the integrated facility for Linux initial processing weight.</td>
<td>The input connection token must only represent an image connection or an image activation profile connection.</td>
</tr>
<tr>
<td>7F (127) HWI_IFLPWCAP</td>
<td>Requests to retrieve the IFLPW to be capped or not capped.</td>
<td>Requests to retrieve the IFLPW to be capped or not capped.</td>
<td>The input connection token must only represent an image connection or an image activation profile connection.</td>
</tr>
<tr>
<td>80 (128) HWI_IFLPWMIN</td>
<td>Requests to retrieve the minimum IFLPW value.</td>
<td>Requests to retrieve the minimum IFLPW value.</td>
<td>The input connection token must only represent an image connection or an image activation profile connection.</td>
</tr>
<tr>
<td>81 (129) HWI_IFLPWMAX</td>
<td>Requests to retrieve the maximum IFLPW value.</td>
<td>Requests to retrieve the maximum IFLPW value.</td>
<td>The input connection token must only represent an image connection or an image activation profile connection.</td>
</tr>
<tr>
<td>82 (130) HWI_IFLPW</td>
<td>Requests to retrieve current IFLPW value.</td>
<td>Requests to retrieve current IFLPW value.</td>
<td>The input connection token must only represent an image connection.</td>
</tr>
<tr>
<td>83 (131) HWI_IFLPWCAP</td>
<td>Requests to retrieve the IFLPW to be capped or not capped.</td>
<td>Requests to retrieve the IFLPW to be capped or not capped.</td>
<td>The input connection token must only represent an image connection.</td>
</tr>
<tr>
<td>84 (132) HWI_ICFIPW</td>
<td>Requests to retrieve the internal coupling facility initial processing weight (ICFIPW).</td>
<td>Requests to retrieve the internal coupling facility initial processing weight (ICFIPW).</td>
<td>The input connection token must only represent an image connection (Coupling Facility images only) or an image activation profile connection.</td>
</tr>
<tr>
<td>85 (133) HWI_ICFIPWCAP</td>
<td>Requests to retrieve the ICFIPW be capped or not capped.</td>
<td>Requests to retrieve the ICFIPW be capped or not capped.</td>
<td>The input connection token must only represent an image connection (Coupling Facility images only) or an image activation profile connection.</td>
</tr>
<tr>
<td>Constant in hexadecimal (Decimal)</td>
<td>Equate symbol</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--------------</td>
<td>-------------</td>
<td></td>
</tr>
</tbody>
</table>
| 86 (134)                        | HWI_ICFPWMIN | Requests to retrieve the minimum ICFPW value.  
**Note:** The input connection token must only represent an image connection (Coupling Facility images only) or an image activation profile connection. |
| 87 (135)                        | HWI_ICFPWMAX | Requests to retrieve the maximum ICFPW value.  
**Note:** The input connection token must only represent an image connection (Coupling Facility images only) or an image activation profile connection. |
| 88 (136)                        | HWI_ICFPW   | Requests to retrieve the current ICFPW value.  
**Note:** The input connection token must only represent an image connection (Coupling Facility images only). |
| 89 (137)                        | HWI_ICFPWCAP | Requests to retrieve the ICFPW to be capped or not capped.  
**Note:** The input connection token must only represent an image connection (Coupling Facility images only). |
| 8A (138)                        | HWI_IIPPW   | Requests to retrieve the integrated information processors initial processing weight (IIPIPW).  
**Note:** The input connection token must only represent an image connection or an image activation profile connection. |
| 8B (139)                        | HWI_IIPPWCAP | Requests to retrieve the IIPIPW be capped or not capped.  
**Note:** The input connection token must only represent an image connection or an image activation profile connection. |
| 8C (140)                        | HWI_IIPPWMIN | Requests to retrieve the minimum IIPPW value.  
**Note:** The input connection token must only represent an image connection or an image activation profile connection. |
| 8D (141)                        | HWI_IIPPWMAX | Requests to retrieve the maximum IIPPW value.  
**Note:** The input connection token must only represent an image connection or an image activation profile connection. |
| 8E (142)                        | HWI_IIPPW   | Requests to retrieve the current IIPPW value.  
**Note:** The input connection token must only represent an image connection. |
| 8F (143)                        | HWI_IIPPWCAP | Requests to retrieve the IIPPW to be capped or not capped.  
**Note:** The input connection token must only represent an image connection. |
| 90 (144)                        | HWI_IPLTOKEN | Requests to retrieve the IPL token associated with the current IPL of the image targeted.  
**Note:** The input connection token must only represent an image connection. |
### Constant in hexadecimal (Decimal)

<table>
<thead>
<tr>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>91 (145)</td>
<td>Requests to retrieve the program status word (PSW) for each of the central processors (CP) associated with this image.</td>
</tr>
</tbody>
</table>

**Non-REXX:**

The returned data is mapped as follows:

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of CPs</td>
<td>32-bit unsigned integer</td>
</tr>
</tbody>
</table>

For each CP, the following is returned:

<table>
<thead>
<tr>
<th>CPUID</th>
<th>32-bit unsigned integer</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSW</td>
<td>128-bit unsigned integer</td>
</tr>
</tbody>
</table>

**Note:** The query parameter for this attribute must specify a data area large enough to contain all of the above structure (that is 32 bits + 160 bits per CP). For example, if there are 4 CPs on the targeted image, the AttributeValueLen specified for this attribute must be 32 + (160 x 4) = 672 bits (84 bytes).

**REXX:**

The returned data is mapped as follows (where \( x \) is the user-defined QueryParm stem, \( n \) is the \( n \)-th requested attribute and \( m \) is the \( m \)-th returned CPUID or PSW value):

- \( x.n.ATTRIBUTEVALUE.0 \) is the number of CPs \((m)\).
- \( x.n.ATTRIBUTEVALUE.m.CPUID \) is the \( m \)-th CPUID value.
- \( x.n.ATTRIBUTEVALUE.m.PSW \) is the \( m \)-th PSW value.

**Note:** The input connection token must represent an *image connection*.

<table>
<thead>
<tr>
<th>92 (146)</th>
<th>Requests to change or set the workload unit capacity for the group profile associated with an image.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Note:</strong></td>
<td>1. The input connection token must only represent an <em>image connection</em>.</td>
</tr>
<tr>
<td></td>
<td>2. This attribute requires that the target image be:</td>
</tr>
<tr>
<td></td>
<td>* On a z196 (zEnterprise) or higher CPC.</td>
</tr>
<tr>
<td></td>
<td>* A member of a LPAR (defined capacity) group.</td>
</tr>
<tr>
<td></td>
<td>If both the above requirements are not met, the HWIQUERY fails with RC=X'406' (HWI_QUERY_ATTRIBUTE_NOT_SUPPORTED).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>93-B6 (147-182)</th>
<th>Additional attributes and reserved numbers for attributes that are for image connections only.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B7</strong> (183)</td>
<td>Requests to retrieve the record ID.</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>The input connection token must only represent a <em>capacity record connection</em>.</td>
</tr>
<tr>
<td><strong>B8</strong> (184)</td>
<td>Requests to retrieve the record type.</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>The input connection token must only represent a <em>capacity record connection</em>.</td>
</tr>
<tr>
<td><strong>B9</strong> (185)</td>
<td>Requests to retrieve the record activation status.</td>
</tr>
<tr>
<td><strong>Note:</strong></td>
<td>The input connection token must only represent a <em>capacity record connection</em>.</td>
</tr>
</tbody>
</table>

---

**HWIQUERY**

**354** z/OS V2R1.0 MVS Callable Services for HLL
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA (186)</td>
<td>Requests to retrieve the record activation date.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must only represent a capacity record connection.</td>
</tr>
<tr>
<td>HWL_ACTDATE</td>
<td></td>
</tr>
<tr>
<td>BB (187)</td>
<td>Requests to retrieve the record expiration date.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must only represent a capacity record connection.</td>
</tr>
<tr>
<td>HWL_EXPIRE</td>
<td></td>
</tr>
<tr>
<td>BC (188)</td>
<td>Requests to retrieve the record activation expiration date.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must only represent a capacity record connection.</td>
</tr>
<tr>
<td>HWL_ACTEXP</td>
<td></td>
</tr>
<tr>
<td>BD (189)</td>
<td>Requests to retrieve the maximum real activation days.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must only represent a capacity record connection.</td>
</tr>
<tr>
<td>HWL_MAXRADS</td>
<td></td>
</tr>
<tr>
<td>BE (190)</td>
<td>Requests to retrieve the maximum test activation days.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must only represent a capacity record connection.</td>
</tr>
<tr>
<td>HWL_MAXTADS</td>
<td></td>
</tr>
<tr>
<td>BF (191)</td>
<td>Requests to retrieve the remaining real activation days.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must only represent a capacity record connection.</td>
</tr>
<tr>
<td>HWL_REMRADS</td>
<td></td>
</tr>
<tr>
<td>C0 (192)</td>
<td>Requests to retrieve the remaining test activation days.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must only represent a capacity record connection.</td>
</tr>
<tr>
<td>HWL_REMTADS</td>
<td></td>
</tr>
<tr>
<td>C1 (193)</td>
<td>Request to retrieve all aspects of a capacity record in XML format.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must only represent a capacity record connection.</td>
</tr>
<tr>
<td>HWL_IOCDS</td>
<td></td>
</tr>
<tr>
<td>C3-C8 (195-200)</td>
<td>Reserved for capacity record attributes.</td>
</tr>
<tr>
<td>RESERVED</td>
<td></td>
</tr>
<tr>
<td>C9 (201)</td>
<td>Requests to retrieve the IOCDS.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must represent a reset activation profile.</td>
</tr>
<tr>
<td>HWL_IOCDS</td>
<td></td>
</tr>
<tr>
<td>CA (202)</td>
<td>Requests to retrieve the IPL address.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must represent an image activation profile or a load activation profile.</td>
</tr>
<tr>
<td>HWL_IPL_ADDRESS</td>
<td></td>
</tr>
<tr>
<td>CB (203)</td>
<td>Requests to retrieve the IPL parameter.</td>
</tr>
<tr>
<td></td>
<td>Note: The input connection token must represent an image activation profile or a load activation profile.</td>
</tr>
<tr>
<td>Constant in hexadecimal (Decimal)</td>
<td>Equate symbol</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>CC</td>
<td>(204)</td>
</tr>
<tr>
<td>CD</td>
<td>(205)</td>
</tr>
<tr>
<td>CE</td>
<td>(206)</td>
</tr>
<tr>
<td>CF</td>
<td>(207)</td>
</tr>
<tr>
<td>D0</td>
<td>(208)</td>
</tr>
<tr>
<td>D1</td>
<td>(209)</td>
</tr>
<tr>
<td>D2</td>
<td>(210)</td>
</tr>
<tr>
<td>D3</td>
<td>(211)</td>
</tr>
<tr>
<td>D4</td>
<td>(212)</td>
</tr>
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<td>D5</td>
<td>(213)</td>
</tr>
<tr>
<td>D6</td>
<td>(214)</td>
</tr>
<tr>
<td>D7</td>
<td>(215)</td>
</tr>
<tr>
<td>Constant in hexadecimal (Decimal)</td>
<td>Equate symbol</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>D8 (216)</td>
<td>HWI_NUM_GPP</td>
</tr>
<tr>
<td>D9 (217)</td>
<td>HWI_NUM_RESGPP</td>
</tr>
<tr>
<td>DA (218)</td>
<td>HWI_NUM_IFA</td>
</tr>
<tr>
<td>DB (219)</td>
<td>HWI_NUM_RESIFA</td>
</tr>
<tr>
<td>DC (220)</td>
<td>HWI_NUM_IFL</td>
</tr>
<tr>
<td>DD (221)</td>
<td>HWI_NUM_RESIFL</td>
</tr>
<tr>
<td>DE (222)</td>
<td>HWI_NUM_ICF</td>
</tr>
<tr>
<td>DF (223)</td>
<td>HWI_NUM_RESICF</td>
</tr>
<tr>
<td>E0 (224)</td>
<td>HWI_NUM_ZIIP</td>
</tr>
<tr>
<td>E1 (225)</td>
<td>HWI_NUM_RESZIIP</td>
</tr>
<tr>
<td>E2 (226)</td>
<td>HWI_NUM_SHARED_GPP</td>
</tr>
<tr>
<td>E3 (227)</td>
<td>HWI_NUM_RES_SHARED_GPP</td>
</tr>
<tr>
<td>Constant in hexadecimal (Decimal)</td>
<td>Equate symbol</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------</td>
</tr>
</tbody>
</table>
| E4 (228)                         | HWI_NUM_SHARED_IFA | Requests to retrieve the number of shared integrated facility for applications (IFA) processors to be used for the CPC image object activated with this profile.  
  *Note:* The input connection token must represent an *image activation profile*. |
| E5 (229)                         | HWI_NUM_RES_SHARED_IFA | Requests to retrieve the number of reserved shared integrated facility for applications (IFA) processors to be used for the CPC image object activated with this profile.  
  *Note:* The input connection token must represent an *image activation profile*. |
| E6 (230)                         | HWI_NUM_SHARED_IFL  | Requests to retrieve the number of shared integrated facility for Linux (IFL) processors to be used for the CPC image object activated with this profile.  
  *Note:* The input connection token must represent an *image activation profile*. |
| E7 (231)                         | HWI_NUM_RES_SHARED_IFL | Requests to retrieve the number of reserved shared integrated facility for Linux (IFL) processors to be used for the CPC image object activated with this profile.  
  *Note:* The input connection token must represent an *image activation profile*. |
| E8 (232)                         | HWI_NUM_SHARED_ICF  | Requests to retrieve the number of shared internal coupling facility (ICF) processors to be used for the CPC image object activated with this profile.  
  *Note:* The input connection token must represent an *image activation profile*. |
| E9 (233)                         | HWI_NUM_RES_SHARED_ICF | Requests to retrieve the number of reserved shared internal coupling facility (ICF) processors to be used for the CPC image object activated with this profile.  
  *Note:* The input connection token must represent an *image activation profile*. |
| EA (234)                         | HWI_NUM_SHARED_ZIIP  | Requests to retrieve the number of shared System z Integrated Information Processors (zIIPs) to be used for the CPC image object activated with this profile.  
  *Note:* The input connection token must represent an *image activation profile*. |
| EB (235)                         | HWI_NUM_RES_SHARED_ZIIP | Requests to retrieve the number of reserved shared System z Integrated Information Processors (zIIPs) to be used for the CPC image object activated with this profile.  
  *Note:* The input connection token must represent an *image activation profile*. |
| EC (236)                         | HWI_BASIC_CPU_AUTH_COUNT_CNTL  | Requests to retrieve the enablement value of the Basic CPU counter facility for the CPC image. This attribute is only available when targeting a z10 or higher CPC.  
  *Note:* The input connection token must represent an *image activation profile*. |
| ED (237)                         | HWI_PROBSTATE_CPU_AUTH_COUNT_CNTL  | Requests to retrieve the enablement value of the Problem state CPU counter facility for the CPC image. This attribute is only available when targeting a z10 or higher CPC.  
  *Note:* The input connection token must represent an *image activation profile*. |
| EE (238)                         | HWI_CRYPTOACTIVITY_CPU_AUTH_COUNT_CNTL  | Requests to retrieve the enablement value of the crypto activity CPU counter facility for the CPC image. This attribute is only available when targeting a z10 or higher CPC.  
  *Note:* The input connection token must represent an *image activation profile*. |
<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF (239) HWI_EXTENDED_CPU_AUTH_COUNT_CNTL</td>
<td>Requests to retrieve the enablement value of the extended CPU counter facility for the CPC image. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>F0 (240) HWI_COPROCESSOR_CPU_AUTH_COUNT_CNTL</td>
<td>Requests to retrieve the enablement value of the coprocessor group CPU counter facility for the CPC image. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>F1 (241) HWI_BASIC_CPU_SAMPLING_AUTH_CNTL</td>
<td>Requests to retrieve the enablement value of the basic CP CPU sampling facility for the CPC image. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>F2 (242) HWI_APROF_STORE_STATUS.AUTH_CNTL</td>
<td>Requests to retrieve the store status function value. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent a load activation profile.</td>
</tr>
<tr>
<td>F3 (243) HWI_APROF_LOADTYPE</td>
<td>Requests to retrieve the type of load being requested. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent a load activation profile.</td>
</tr>
<tr>
<td>F4 (244) HWI_PROFILE_DESCRIPTION</td>
<td>Requests to retrieve the activation profile description. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>F5 (245) HWI_PROFILE_PARTITION</td>
<td>Requests to retrieve the partition identifier for the activation profile. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>F6 (246) HWI_OPERATING_MODE</td>
<td>Requests to retrieve the operating mode value for the activation profile. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>F7 (247) HWI_CLOCK_TYPE</td>
<td>Requests to retrieve the clock type assignment (time source setting) for the activation profile. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>F8 (248) HWI_TIME_OFFSET_DAYS</td>
<td>Requests to retrieve the time offset days (the number of days currently set as the offset from the external time source’s time of day) for the activation profile. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
</tbody>
</table>
## HWIQUERY

<table>
<thead>
<tr>
<th>Constant in hexadecimal (Decimal)</th>
<th>Equate symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F9  (249)</td>
<td>HWI_TIME_OFFSET_HOURS</td>
<td>Requests to retrieve the time offset hours (the number of hours currently set as the offset from the external time source's time of day) for the activation profile. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em>.</td>
</tr>
<tr>
<td>FA  (250)</td>
<td>HWI_TIME_OFFSET_MINUTES</td>
<td>Requests to retrieve the time offset minutes (the number of minutes currently set as the offset from the external time source's time of day) for the activation profile. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em>.</td>
</tr>
<tr>
<td>FB  (251)</td>
<td>HWI_TIME_OFFSET_INCREASE</td>
<td>Requests to retrieve the time offset increase or decrease value for the activation profile. The time offset, as specified in days, hours, and minutes, is increased or decreased from GMT. TRUE means that the time offset is east of GMT. FALSE means that the time offset is west of GMT. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em>.</td>
</tr>
<tr>
<td>FC  (252)</td>
<td>HWI_LICCC_VALIDATION_ENABLED</td>
<td>Requests to retrieve whether the activation profile must conform to the current Licensed Internal Code Configuration Control (LICCC) configuration. This attribute is only available when targeting a zEnterprise or higher CPC. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em>.</td>
</tr>
<tr>
<td>FD  (253)</td>
<td>HWI_GLOBAL_PERFORMANCE_DATA_CONTROL</td>
<td>Requests to retrieve whether the logical partition can be used to view the processing unit activity data for all other LPARs activated on the same CPC. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em>.</td>
</tr>
<tr>
<td>FE  (254)</td>
<td>HWI_IO_CONFIGURATION_CONTROL</td>
<td>Requests to retrieve whether the logical partition can be used to read and write any Input/Output Configuration Data Set (IOCDS) in the configuration. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em>.</td>
</tr>
<tr>
<td>FF  (255)</td>
<td>HWI_CROSS_PARTITION_AUTHORITY</td>
<td>Requests to retrieve whether the logical partition can be used to issue control program instructions that reset or deactivate other LPARs. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em>.</td>
</tr>
<tr>
<td>100  (256)</td>
<td>HWI_LOGICAL_PARTITION_ISOLATION</td>
<td>Requests to retrieve whether reconfigurable channel paths assigned to the logical partition are reserved for its exclusive use. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em>.</td>
</tr>
<tr>
<td>101-109  (257-265)</td>
<td>RESERVED</td>
<td>Reserved for activation profile attributes.</td>
</tr>
</tbody>
</table>
**NumOfAttributes (non-REXX)**

Supplied parameter
- Type: Integer
- Length: 4 bytes

NumOfAttributes specifies the number of attributes to be queried. The maximum number of attributes allowed is 64.

**DiagArea (non-REXX)**

DiagArea. (REXX)

Returned parameter
- Type: Character string (non-REXX), stem variable (REXX)
- Length: 32 bytes (non-REXX)

DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

**Note:** For all environmental errors (with return code X'F00' and higher), the DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name (non-REXX) / Tail name constant of the user-defined DiagArea stem (REXX)</th>
<th>Field Type (non-REXX)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code that is returned from the console application API or the BCPii transport layer.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Additional diagnostic information in text format.</td>
</tr>
</tbody>
</table>

See Appendix A, “BCPii communication error reason codes,” on page 415 for a partial list of the descriptive communication transport error return codes and suggested actions.

**ABEND codes**

If BCPii is unable to properly access the user-supplied parameter list, the call might result in an abend X'042' with a reason code of X'0006yyyy' because of one of the following reasons:

<table>
<thead>
<tr>
<th>yyyy</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>The parameters passed by the caller are not in the primary address space.</td>
</tr>
<tr>
<td>0001</td>
<td>The parameters passed by the caller are not accessible.</td>
</tr>
<tr>
<td>0002</td>
<td>The number of parameters passed by the caller is not correct.</td>
</tr>
</tbody>
</table>

For other severe BCPii errors encountered during the call, an abend X'042' with a different reason code may result. See z/OS MVS System Codes for additional information.
## Return codes
When the service returns control to the caller, GPR 15 and ReturnCode contain a hexadecimal return code.

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 HWI_OK</td>
<td><strong>Meaning:</strong> Successful completion.</td>
</tr>
<tr>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
</tbody>
</table>
| 100 HWI_CONNECT_TOKEN_INV                | **Meaning:** Program error. The specified connect token is not valid. This return code indicates that one of the following conditions has occurred:  
  • The connect token does not exist. A previous HWICONN service call has never returned the value specified on OutConnectToken.  
  • The connect token does not represent an active connection. The connection specified might have already been disconnected using the HWIDISC service call.  
  • The connect token is not associated with the address space of the caller. The ConnectToken specified is associated with a different address space than the caller of this service call. |
|                                          | **Action:** Check for probable coding error. |
| 101 HWI_COMMUNICATION_ERROR              | **Meaning:** A communication error is detected. The hardware management console application API (HWMCA) or the BCPii transport layer has returned with a failing return code.  
  **Action:** See the DiagArea for further diagnostic information. The Diag_CommErr indicates the return code that is returned from HWMCA APIs or the BCPii transport layer. In some cases, the Diag_Index and Diag_Key may contain additional details.  
  HWMCA API and BCPii transport return codes are provided in [Appendix A, “BCPii communication error reason codes,” on page 415](#). |
<p>| 102 HWI_DIAGAREA_INV                      | <strong>Meaning:</strong> Program error. The DiagArea is not accessible. |
|                                          | <strong>Action:</strong> Check for probable coding error. Verify that the specified DiagArea is defined as a 32-byte character field. |
| 103 HWI_CONNECT_TOKEN_INACTIVE           | <strong>Meaning:</strong> The specified connect token is no longer valid. The connection has been disconnected or it is in the progress of being disconnected. |
|                                          | <strong>Action:</strong> Check for probable coding error. Verify that the specified connect token is still active. If connectivity to the targeted CPC connection no longer exists, all connections associated with that CPC will no longer have a connect token that can be used. |</p>
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 401 HWI_QUERYPARM_ATTRIB_INV             | **Meaning:** Program error. One of the requested attribute identifiers in the QueryParm is not valid. The system rejects the service call. This return code indicates that one of the following conditions has occurred:  
  - The Query attribute identifier specified is not in the acceptable value range of possible attributes.  
  - The specified Query attribute identifier has been provided with an incompatible connection type. For example, the attribute identifier applies only to CPC connections, but the ConnectToken specified represents an image connection, a capacity record connection, or any of the activation profile connections.  

**Action:** Check for probable coding error. Validate that the Query attribute specified is in the valid range of possible values. Validate that the Query attribute specified is permitted for the specified connection type.  
See the DiagArea for further diagnostic information:  
  - The Diag_Index field specifies the index of the element in the attribute array that is in error.  
  - The Diag_Key contains the attribute identifier specified.  
  - The Diag_Text contains "Invalid Attr" if the attribute is one whose value cannot be queried. If the attribute cannot be queried for the specified connection type, the Diag_Text contains "Mismatch." |
| 402 HWI_QUERYPARM_INACCESSIBLE           | **Meaning:** Program error. The QueryParm data area is either partially or completely inaccessible by the application, the Base Control Program internal interface (BCPii) address space, or both.  

**Action:** Check for probable coding error. Consider the following possibilities:  
  - The QueryParm length could be too small. The size of QueryParm must be at least the product of the NumofAttributes parameter and the length of the data area mapping for each attribute (16 bytes).  
  - The NumofAttributes value can be larger than the number of parameters actually passed. |
| 403 HWI_QUERYPARM_ATTRIBRETTADDR_INACCESSIBLE | **Meaning:** Program error. Storage that is pointed to by one or more of the attribute value pointers in the QueryParm is not accessible by the application. The system is not able to return data for this attribute identifier. Partial data might have already been returned.  

**Action:** Check for probable coding error. See the DiagArea for further diagnostic information. The Diag_Index field specifies the array index that contained the inaccessible AttributeValuePtr. The Diag_Key contains the erroneous attribute identifier. |
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal</th>
<th>Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 404                        | HWI_QUERYPARM_ATTRIB_LENGTH_INV | **Meaning:** Program error. One of the attribute lengths specified is too small. There is not enough space to contain all of the returned data for this particular attribute. The system returns partial data, filling in the attribute data area for the length specified.  
**Action:** Check for probable coding error. See the DiagArea for further diagnostic information. The Diag_Index field specifies the array index which contained the partially filled-in value. The Diag_Key is the attribute identifier constant that causes the error. The Diag_Actual indicates the application-specified length. The Diag_Expected indicates the size required for the returned data. |
| 405                        | HWI_QUERY_NUMOFATTRIB_INV | **Meaning:** Program error. The NumOfAttributes specified on the call is not valid. The NumOfAttributes value must be in the range of 1 to 64.  
**Action:** Check for probable error. Verify that the NumOfAttributes specified is greater than zero and less than or equal to 64. |
| 406                        | HWI_QUERY_ATTRIBUTE_NOT_SUPPORTED | **Meaning:** The targeted hardware of the HWIQUERY request does not recognize the attribute attempted to be retrieved.  
**Action:** Verify that the targeted hardware is at a level that supports the type of attribute being queried. |
| 407                        | HWI_QUERY_TARGET_DEACTIVATED | **Meaning:** A query attribute could not be retrieved because the targeted object is deactivated.  
**Action:** Verify that the targeted object is activated. Activate the object before attempting to retrieve this same attribute again. |
| 408                        | HWI_QUERY_ATTRIB_TEMP_NOT_AVAILABLE | **Meaning:** One or more query attributes could not be retrieved because the support element (SE) is temporarily unavailable.  
**Action:** Try this request again at a later time. If the problem persists, contact the IBM Support Center. |
| F00                        | HWI_NOT_AVAILABLE | **Meaning:** BCPii services are not available, and the system rejects the service request.  
**Action:** Notify the system programmer to start the BCPii address space and try the request again. See z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXG for how to restart the HWIBCPii address space.  
Programs can also listen to ENF68 to determine when BCPii services are available. See z/OS MVS Programming: Authorized Assembler Services Reference EDT-IXG for how to listen for BCPii activation messages. |
| F01                        | HWI_AUTH_FAILURE | **Meaning:** The caller is PKM8-15 problem state and the program does not reside in an APF-authorized library.  
**Action:** Check the calling program for a probable coding error. |
<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| F02 HWI_NO_SAF_AUTH                    | **Meaning:** The user does not have correct SAF authorization for the request.  
**Action:** Check for probable error. Consider one or more of the following possible actions:  
• Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau for CPC, activation profile, or user-defined image group connections.  
• Define read access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename for an image connections.  
• Define read access authorization to the FACILITY class resource profile HWI.CAPREC.netid.nau.caprecid for a capacity record connection.  
• Ensure that the referenced facility class profile is RACLIST-specified. |
| F03 HWI_INTERRUPT_STATUS_INV           | **Meaning:** The calling program is disabled. The system rejects this service request.  
**Action:** Check the calling program for a probable coding error. |
| F04 HWI_MODE_INV                       | **Meaning:** The calling program is not in task mode. The system rejects this service request.  
**Action:** Check the calling program for a probable error. |
| F05 HWI_LOCKS_HELD                    | **Meaning:** The calling program is holding one or more locks. The system rejects this service request.  
**Action:** Check the calling program for a probable coding error. |
| F06 HWI_UNSUPPORTED_RELEASE            | **Meaning:** The system level does not support this service. The system rejects this service request.  
**Action:** Remove the calling program from the system, and install it on a system that supports BCPIi services. Then run the calling program again. |
| F07 HWI_UNSUPPORTED_ENVIRONMENT         | **Meaning:** The system does not support execution of the service from the current environment (for example, calling a BCPIi service from within a BCPIi ENF exit routine).  
**Action:** Issue the BCPIi service from a different execution environment. |
| FFF HWI_UNEXPECTED_ERROR               | **Meaning:** System error. The service that was called encountered an unexpected error. The system rejects the service call.  
**Action:** Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center. |

**Example**

In the pseudocode example, the caller issues a call to retrieve the CPC name and the Current CPC status of a CPC:
HWIQUERY

QueryParm_Ptr = ADDR(QueryParm);
NumberOfAttributes = 2;
QueryParm(1).AttributeIdentifier = HWI_NAME;
QueryParm(1).AttributeValue_Ptr = Addr(Value1);
QueryParm(1).AttributeValueLen = length of value1;
QueryParm(2).AttributeIdentifier = HWI_OPERSTAT;
QueryParm(2).AttributeValue_Ptr = Addr(Value2);
QueryParm(2).AttributeValueLen = 4;
CALL HWIQUERY (ReturnCode, ConnectToken, QueryParm_Ptr,
   NumOfAttributes, DiagArea)

A REXX programming example for the HWIQUERY service:

myQueryParm.0 = 4 /* Set number of attributes */
myQueryParm.n.ATTRIBUTEIDENTIFIER = HWI_NAME
myQueryParm.n.ATTRIBUTEIDENTIFIER = HWI_LUAPROF
myQueryParm.n.ATTRIBUTEIDENTIFIER = HWI_MSERIAL
myQueryParm.n.ATTRIBUTEIDENTIFIER = HWI_IPADDR

address bcpii "hwiquery RetCode myConnectToken myQueryParm. myDiag."

If (RC <> 0) | (Retcode <> 0) Then
   Do
      Say 'Service failed with REXX RC = 'RC' and API Retcode = 'Retcode'.'
      If (RC=Hwi_REXPParmSyntaxError | Retcode<>0) Then
         Do
            Say ' Diag_index=' myDiag.DIAG_INDEX
            Say ' Diag_key=' myDiag.DIAG_KEY
            Say ' Diag_actual=' myDiag.DIAG_ACTUAL
            Say ' Diag_expected=' myDiag.DIAG_EXPECTED
            Say ' Diag_commerr=' myDiag.DIAG_COMMERR
            Say ' Diag_text=' myDiag.DIAG_TEXT
         End
      Else
         Do n=1 to myQueryParm.0
            Say ' myQueryParm.'n'.ATTRIBUTEVALUE = 'myQueryParm.n.ATTRIBUTEVALUE
         End
   Else
      Do n=1 to myQueryParm.0
         Say ' myQueryParm.'n'.ATTRIBUTEVALUE = 'myQueryParm.n.ATTRIBUTEVALUE
      End

HWISET — BCPii set SE/HMC-managed attributes

Call the HWISET service to change or set data for Hardware Management Console
(HMC)-managed objects associated with Central Processor Complexes (CPCs), CPC
images (LPARs), or activation profiles.

Description

Environment

The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization</td>
<td>PKM allowing key 0-7, or supervisor state</td>
</tr>
<tr>
<td>Dispatchable unit mode</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode</td>
<td>Primary or access register (AR)</td>
</tr>
<tr>
<td>Interrupt status</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
</tbody>
</table>
**HWISET**

**Requirement Details**

**Linkage:**
Standard MVS linkage conventions are used

**Programming requirements**

See "Syntax, linkage and programming considerations" on page 268 for details about how to call BCPii services in the various programming languages.

See "HWIQUERY and HWISET" on page 417 for the summary table of the BCPii HWIQUERY and HWISET attributes and the objects that can be targeted for each function.

**REXX programming considerations for the HWISET service**

All information for the HWISET service applies for REXX requests except:

- SetTypeValue replaces SetTypeValue_Ptr. The actual value to be set, represented in character form, is passed instead of a pointer.
- The SetTypeValueLen input parm is not used.

**Restrictions**

BCPii does not allow HWISET to be issued from within a BCPii ENF exit routine.

**Authorization**

The client application must have at least read access to the SAF-protected FACILITY class resource HWI.APPLNAME.HWISERV. This class resource grants the application access to consult to the local CPC.

In addition, the client application must have at least update access to the SAF-protected FACILITY class resource profile HWI.TARGET.\texttt{netid.nau} for setting CPC-related or activation profile-related values, or HWI.TARGET.\texttt{netid.nau.imagename} for setting image-related values.

**Note:** BCPii requires the FACILITY class to be RAClIST-specified.

**Syntax**

Write the call as shown in the syntax diagram. You must code all parameters on the CALL statement in the order shown.

<table>
<thead>
<tr>
<th>Non-REXX parameters</th>
<th>REXX parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL HWISET(</td>
<td>address bcpii &quot;hwiset</td>
</tr>
<tr>
<td>ReturnCode,</td>
<td>ReturnCode</td>
</tr>
<tr>
<td>ConnectToken,</td>
<td>ConnectToken</td>
</tr>
<tr>
<td>SetType,</td>
<td>SetType</td>
</tr>
<tr>
<td>SetTypeValue_Ptr,</td>
<td>SetTypeValue</td>
</tr>
<tr>
<td>SetTypeValueLen,</td>
<td></td>
</tr>
<tr>
<td>DiagArea);</td>
<td>DiagArea.&quot;</td>
</tr>
</tbody>
</table>

**Parameters**

The parameters are explained as follows:

**ReturnCode**

Returned parameter

- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

ReturnCode contains the return code from the service.
**ConnectToken**

Supplied parameter
- Type: Character string
- Length: 16 bytes

ConnectToken represents a logical connection between the application and a CPC, image, or activation profile. The ConnectToken is an output parameter on the HWICONN service call.

In most cases, the ConnectToken specified must have originated from a HWICONN service call that was issued from the same address space as this service call. For BCPIi REXX execs running under the TSO/E or ISV-provided REXX environments, the ConnectToken specified must have originated from a HWICONN service call that was issued from the same task.

**SetType**

Supplied parameter
- Type: Integer (non-REXX), character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

SetType specifies the type of set request.

The following table is the list of valid set types. See the following documentation for more information:
- *System z Application Programming Interfaces* (SB10-7030-13)
- *System z10 and eServer zSeries Application Programming Interfaces* (SB10-7030-09)
- *System z9 and eServer zSeries Application Programming Interfaces* (SB10-7030-08)
- Publication appropriate to the level of hardware that the HWISET is targeted.

<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal)</th>
<th>Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 6                                 | (6)           | HWI_ACCSTAT | Requests to change or set the acceptable CPC status values.  
**Note:** The input connection token represents a CPC connection or an image connection. |
| 7                                 | (7)           | HWI_APROF   | Requests to change or set the next activation reset profile name.  
**Note:** The input connection token represents a CPC connection or an image connection. |
| 27                                | (39)          | HWI_PRUNTYPE | Requests to change or set the processor running time type.  
**Note:** The input connection token represents a CPC connection or a reset activation profile connection. |
| 28                                | (40)          | HWI_PRUNTIME | Requests to change or set the processor running time type.  
**Note:** The input connection token must only represent a CPC connection or a reset activation profile connection. |
| 29                                | (41)          | HWI_PRUNTSEW | Requests to change or set the processor running time slice end wait processing.  
**Note:** The input connection token must only represent a CPC connection or a reset activation profile connection. |
<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 70 (112) HWI_DEF_CAP                           | Requests to change or set the current defined capacity.  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 71 (113) HWI_SGPI_PW                           | Requests to change or set the shared general processor initial processing weight (SGPIPW).  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 72 (114) HWI_SGPI_PW_CAP                       | Requests to change or set the SGPIPW to be capped or not capped.  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 73 (115) HWI_SGPPW_MIN                         | Requests to change or set the minimum SGPPW value.  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 74 (116) HWI_SGPPW_MAX                         | Requests to change or set the maximum SGPPW value.  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 77 (119) HWI_WLM                               | Requests to change or set whether WLM is allowed to change SGPPW values.  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 78 (120) HWI_IFA_PW                            | Requests to change or set the integrated facility for applications initial processing weight (IFAIPW).  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 79 (121) HWI_IFA_PW_CAP                        | Requests to change or set the IFAIPW to be capped or not capped.  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 7A (122) HWI_IFA_PW_MIN                        | Requests to change or set the minimum IFAPW value.  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 7B (123) HWI_IFA_PW_MAX                        | Requests to change or set the maximum IFAPW value.  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
| 7E (126) HWI_IFL_PW                            | Requests to change or set the integrated facility for Linux initial processing weight (IFLIPW).  
Note: The input connection token must only represent an image connection or an image activation profile connection. |
<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 7F (127) HWI_IFLIPWCAP | Requests to change or set the IFLIPW to be capped or not capped.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 80 (128) HWI_IFLPWMIN | Requests to change or set the minimum IFLPW value.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 81 (129) HWI_IFLPWMAX | Requests to change or set the maximum IFLPW value.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 84 (132) HWI_ICFIPW | Requests to change or set the internal coupling facility initial processing weight (ICFIPW).  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 85 (133) HWI_ICFIPWCAP | Requests to change or set the ICFIPW be capped or not capped.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 86 (134) HWI_ICFPWMIN | Requests to change or set the minimum ICFPW value.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 87 (135) HWI_ICFPWMAX | Requests to change or set the maximum ICFPW value.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 8A (138) HWI_IPIPW | Requests to change or set the integrated information processors initial processing weight (IIPPW).  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 8B (139) HWI_IPIPWCAP | Requests to change or set the IIPPW be capped or not capped.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 8C (140) HWI_IIPPWMIN | Requests to change or set the minimum IPPW value.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
| 8D (141) HWI_IIPPWMAX | Requests to change or set the maximum IPPW value.  
*Note:* The input connection token must only represent an image connection or an image activation profile connection. |
<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| 92 (146) HWI_GROUP_PROFILE_CAPACITY | Requests to change or set the workload unit capacity for the group profile associated with an image. **Note:**  
1. The input connection token must only represent an *image connection*.  
2. This attribute requires the target image be:  
   • On a z196 (zEnterprise) or higher CPC.  
   • A member of a LPAR (defined capacity) group.  
   If both the above requirements are not met, the HWISET fails with RC=X'101' (HWI_COMMUNICATON_ERROR), with the DiagCommErr value set to X'15' (21) (HWMCA_DE_SNMP_ERROR). |
<p>| C9 (201) HWI_IOCDS | Requests to change or set the IOCDS. <strong>Note:</strong> The input connection token must represent a <em>reset activation profile</em>. |
| CA (202) HWI_IPL_ADDRESS | Requests to change or set the IPL address. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em> or a <em>load activation profile</em>. |
| CB (203) HWI_IPL_PARM | Requests to change or set the IPL parameter. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em> or a <em>load activation profile</em>. |
| CC (204) HWI_IPL_TYPE | Requests to change or set the IPL type for the activation profile. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em> or a <em>load activation profile</em>. |
| CD (205) HWI_WW_PORTNAME | Requests to change or set the worldwide port name for the activation profile. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em> or a <em>load activation profile</em>. |
| CE (206) HWI_BOOT_PGM_SELECTOR | Requests to change or set the boot program selector for the activation profile. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em> or a <em>load activation profile</em>. |
| CF (207) HWI_LU_NUM | Requests to change or set the logical unit number value for the activation profile. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em> or a <em>load activation profile</em>. |
| D0 (208) HWI_BOOTREC_BLK_ADDR | Requests to change or set the boot record logical block address for the activation profile. <strong>Note:</strong> The input connection token must represent an <em>image activation profile</em> or a <em>load activation profile</em>. |</p>
<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| D1 (209) HWI_OPSYS_LOADPARM                   | Requests to change or set the operating system specific load parameter.  
**Note:** The input connection token must represent an *image activation profile* or a *load activation profile.* |
| D2 (210) HWI_GROUP_PROF_NAME                  | Requests to change or set the name of the group capacity profile that is to be used for the CPC image or image object activated with this profile.  
**Note:** The input connection token must represent an *image activation profile.* |
| D3 (211) HWI_LOAD_AT_ACTIVATION               | Requests to change or set the indicator if the CPC image object activated with this profile should be loaded (IPLed) at the end of the activation.  
**Note:** The input connection token must represent an *image activation profile.* |
| D4 (212) HWI_CENTRAL_STOR                    | Requests to change or set the initial amount of central storage (in megabytes) to be used for the CPC image object activated with this profile.  
**Note:** The input connection token must represent an *image activation profile.* |
| D5 (213) HWI_RES_CENTRAL_STOR                | Requests to change or set the reserved amount of central storage (in megabytes) to be used for the CPC image object activated with this profile.  
**Note:** The input connection token must represent an *image activation profile.* |
| D6 (214) HWI_EXPANDED_STOR                   | Requests to change or set the initial amount of expanded storage (in megabytes) to be used for the CPC image object activated with this profile.  
**Note:** The input connection token must represent an *image activation profile.* |
| D7 (215) HWI_RES_EXPANDED_STOR               | Requests to change or set the reserved amount of expanded storage (in megabytes) to be used for the CPC image object activated with this profile.  
**Note:** The input connection token must represent an *image activation profile.* |
| D8 (216) HWI_NUM_GPP                         | Requests to change or set the number of dedicated general purpose processors to be used for the CPC image object activated with this profile.  
**Note:** The input connection token must represent an *image activation profile.* |
| D9 (217) HWI_NUM_RESGPP                      | Requests to change or set the number of reserved dedicated general purpose processors to be used for the CPC image object activated with this profile.  
**Note:** The input connection token must represent an *image activation profile.* |
| DA (218) HWI_NUM_IFA                         | Requests to change or set the number of dedicated integrated facility for applications (IFA) processors to be used for the CPC image object activated with this profile.  
**Note:** The input connection token must represent an *image activation profile.* |
<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| DB (219) HWI_NUM_RESIFA | Requests to change or set the number of reserved dedicated integrated facility for applications (IFA) processors to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| DC (220) HWI_NUM_IFL | Requests to change or set the number of dedicated integrated facility for Linux (IFL) processors to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| DD (221) HWI_NUM_RESIFL | Requests to change or set the number of reserved dedicated integrated facility for Linux (IFL) processors to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| DE (222) HWI_NUM_ICF | Requests to change or set the number of dedicated internal coupling facility (ICF) processors to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| DF (223) HWI_NUM_RESICF | Requests to change or set the number of reserved dedicated internal coupling facility (ICF) processors to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| E0 (224) HWI_NUM_ZIIP | Requests to change or set the number of dedicated System z Integrated Information Processors (zIIPs) to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| E1 (225) HWI_NUM_RESZIIP | Requests to change or set the number of reserved System z Integrated Information Processors (zIIPs) to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| E2 (226) HWI_NUM_SHARED_GPP | Requests to change or set the number of shared general purpose processors to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| E3 (227) HWI_NUM_RES_SHARED_GPP | Requests to change or set the number of reserved shared general purpose processors to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
| E4 (228) HWI_NUM_SHARED_IFA | Requests to change or set the number of shared integrated facility for applications (IFA) processors to be used for the CPC image object activated with this profile.  
*Note:* The input connection token must represent an *image activation profile.* |
<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E5 (229) HWI_NUM_RES_SHARED_IFA</td>
<td>Requests to change or set the number of reserved shared integrated facility for applications (IFA) processors to be used for the CPC image object activated with this profile. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>E6 (230) HWI_NUM_SHARED_IFL</td>
<td>Requests to change or set the number of shared integrated facility for Linux (IFL) processors to be used for the CPC image object activated with this profile. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>E7 (231) HWI_NUM_RES_SHARED_IFL</td>
<td>Requests to change or set the number of reserved shared integrated facility for Linux (IFL) processors to be used for the CPC image object activated with this profile. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>E8 (232) HWI_NUM_SHARED_ICF</td>
<td>Requests to change or set the number of shared internal coupling facility (ICF) processors to be used for the CPC image object activated with this profile. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>E9 (233) HWI_NUM_RES_SHARED_ICF</td>
<td>Requests to change or set the number of reserved shared internal coupling facility (ICF) processors to be used for the CPC image object activated with this profile. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>EA (234) HWI_NUM_SHARED_ZIIP</td>
<td>Requests to change or set the number of shared System z Integrated Information Processors (zIIPs) to be used for the CPC image object activated with this profile. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>EB (235) HWI_NUM_RES_SHARED_ZIIP</td>
<td>Requests to change or set the number of reserved shared System z Integrated Information Processors (zIIPs) to be used for the CPC image object activated with this profile. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>EC (236) HWI_BASIC_CPU_AUTH_COUNT_CNTL</td>
<td>Requests to change or set the enablement value of the basic CPU counter facility for the CPC image object activated with this profile. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>ED (237) HWI_PROBSTATE_CPU_AUTH_COUNT_CNTL</td>
<td>Requests to change or set the enablement value of the Problem state CPU counter facility for the CPC image object activated with this profile. This attribute is only available when targeting a z10 or higher CPC. <strong>Note:</strong> The input connection token must represent an image activation profile.</td>
</tr>
</tbody>
</table>
## Constant in: Hexadecimal (Decimal) Equate Symbol | Description
---|---
EE (238) | HWI_CRYPTOACTIVITY_CPU _AUTH_COUNT_CNTL
Requests to change of set the enablement value of the crypto activity CPU counter facility for the CPC image object activated with this profile. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent an image activation profile.

EF (239) | HWI_EXTENDED_CPU _AUTH_COUNT_CNTL
Requests to change or set the enablement value of the extended CPU counter facility for the CPC image object activated with this profile. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent an image activation profile.

F0 (240) | HWI_COPROCESSOR_CPU _AUTH_COUNT_CNTL
Requests to change or set the enablement value of the coprocessor group CPU counter facility for the CPC image object activated with this profile. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent an image activation profile.

F1 (241) | HWI_BASIC_CPU_SAMPLING _AUTH_CNTL
Requests to change or set the enablement value of the basic CP CPU sampling facility for the CPC image object activated with this profile. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent an image activation profile.

F2 (242) | HWI_APROF_STORE_STATUS
Requests to change or set the store status function value. This value is only valid if HWI_APROF_LOADTYPE is set to normal. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent a load activation profile.

F3 (243) | HWI_APROF_LOADTYPE
Requests to change or set the type of load being requested. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent a load activation profile.

F4 (244) | HWI_PROFILE_DESCRIPTION
Requests to change or set the activation profile description. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent an image activation profile.

F5 (245) | HWI_PROFILE_PARTITION_ID
Requests to change or set the partition identifier for the activation profile. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent an image activation profile.

F6 (246) | HWI_OPERATING_MODE
Requests to change or set the operating mode value for the activation profile. This attribute is only available when targeting a z10 or higher CPC.
**Note:** The input connection token must represent an image activation profile.
### HWISET

<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
</table>
| F7 (247) HWI_CLOCK_TYPE | Requests to change or set the clock type assignment (time source setting) for the activation profile. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must represent an image activation profile. |
| F8 (248) HWI_TIME_OFFSET_DAYS | Requests to change or set the time offset days (the number of days currently set as the offset from the external time source's time of day) for the activation profile. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must represent an image activation profile. |
| F9 (249) HWI_TIME_OFFSET_HOURS | Requests to change or set the time offset hours (the number of hours currently set as the offset from the external time source's time of day) for the activation profile. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must represent an image activation profile. |
| FA (250) HWI_TIME_OFFSET_MINUTES | Requests to change or set the time offset minutes (the number of minutes currently set as the offset from the external time source's time of day) for the activation profile. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must represent an image activation profile. |
| FB (251) HWI_TIME_OFFSET_INCREASE | Requests to change or set the time offset increase or decrease value for the activation profile. The time offset, as specified in days, hours, and minutes, is increased or decreased from GMT. TRUE means that the time offset is east of GMT. FALSE means that the time offset is west of GMT. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must represent an image activation profile. |
| FC (252) HWI_LICCC_VALIDATION_ENABLED | Requests to change or set whether the activation profile must conform to the current Licensed Internal Code Configuration Control (LICCC) configuration. This attribute is only available when targeting a zEnterprise or higher CPC.  
**Note:** The input connection token must represent an image activation profile. |
| FD (253) HWI_GLOBAL_PERFORMANCE_DATA_CONTROL | Requests to change or set whether the logical partition can be used to view the processing unit activity data for all other LPARs activated on the same CPC. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must represent an image activation profile. |
| FE (254) HWI_IO_CONFIGURATION_CONTROL | Requests to change or set whether the logical partition can be used to read and write any Input/Output Configuration Data Set (IOCDS) in the configuration. This attribute is only available when targeting a z10 or higher CPC.  
**Note:** The input connection token must represent an image activation profile. |
### HWISET

<table>
<thead>
<tr>
<th>Constant in: Hexadecimal (Decimal) Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 (256) HWI_LOGICAL_PARTITION_ISOLATION</td>
<td>Requests to change or set whether reconfigurable channel paths assigned to the logical partition are reserved for its exclusive use. This attribute is only available when targeting a z10 or higher CPC. Note: The input connection token must represent an image activation profile.</td>
</tr>
<tr>
<td>101-109 (257–264) RESERVED</td>
<td>Reserved for activation profile attributes.</td>
</tr>
</tbody>
</table>

**SetTypeValue_Ptr (non-REXX)**

**SetTypeValue (REXX)**

Supplied parameter

- Type: Pointer (non-REXX), character or character representation of an integer (REXX)
- Length: 4 bytes (non-REXX)

**Non-REXX:**

SetTypeValue_Ptr specifies address of the value to be set or changed.

**REXX:**

SetTypeValue specifies the value to be set or changed.

The particular SetType determines what data value must be specified. See the chart below as well as the following documentation for more information:

- System z Application Programming Interfaces (SB10-7030-13)
- System z10 and eServer zSeries Application Programming Interfaces (SB10-7030-09)
- System z9 and eServer zSeries Application Programming Interfaces (SB10-7030-08)
## HWISET

<table>
<thead>
<tr>
<th>SetTypes</th>
<th>Values to be specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(6)</td>
<td>For CPC connections, bit values can be set to:</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_OPERATING</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_NOT_OPERATING</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_NO_POWER</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_EXCEPTIONS</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_STATUS_CHECK</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_SERVICE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_LINKNOTACTIVE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_POWERSAVE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_SERVICE_REQ</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_DEGRADED</td>
</tr>
<tr>
<td>(7)</td>
<td>For image connections, bit values can be set to:</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_OPERATING</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_NOT_OPERATING</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_NOT_ACTIVATED</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_EXCEPTIONS</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS_STATUS_CHECK</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_STATUS POWERSAVE</td>
</tr>
<tr>
<td>(7)</td>
<td>A 16-character activation profile name padded with trailing blanks.</td>
</tr>
<tr>
<td>(39)</td>
<td>HWI_APROF</td>
</tr>
<tr>
<td>(40)</td>
<td>HWI_PRUNTYPE A 4-byte integer type value.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_DETERMINED_SYSTEM</strong></td>
</tr>
<tr>
<td></td>
<td>The processor running is dynamically determined by the system.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_DETERMINED_USER</strong></td>
</tr>
<tr>
<td></td>
<td>The processor running time is set to a constant value.</td>
</tr>
<tr>
<td>(41)</td>
<td>HWI_PRUNTSEW A 4-byte integer type value.</td>
</tr>
<tr>
<td></td>
<td>A value between 1 to 100 for the user defined processor running time.</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> This value can only be set if the processor running time type (HWI_PRUNTYPE) is set to HWMCA_DETERMINED_USER.</td>
</tr>
<tr>
<td>(41)</td>
<td>HWI_PRUNTSEW A 4-byte integer type value.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_TRUE</strong></td>
</tr>
<tr>
<td></td>
<td>Indicates that an image should lose its share of running time when it enters a wait state.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_FALSE</strong></td>
</tr>
<tr>
<td></td>
<td>Indicates that an image should not lose its share of running time when it enters a wait state.</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> This value can only be set if the processor running time type (HWI_PRUNTYPE) is set to HWMCA_DETERMINED_USER.</td>
</tr>
<tr>
<td>SetTypes</td>
<td>Values to be specified</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>70</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(112) HWI_DEFCAP</td>
<td>A value represents the amount of defined capacity specified for the logical partition. A value of 0 indicates that no defined capacity is specified for the logical partition.</td>
</tr>
<tr>
<td>71</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(113) HWI_SGPIPW</td>
<td>A value from 1 - 999 defines the relative amount of shared general purpose processor resources allocated to the CPC image object. A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated general purpose processor. Note: The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated general purpose processor.</td>
</tr>
<tr>
<td>72</td>
<td>A 4-byte integer type value. This indicates that the initial general purpose processor processing weight for the CPC image object is capped or not capped.</td>
</tr>
<tr>
<td>(114) HWI_SGPIPWCAP</td>
<td>HWMCA_TRUE Capped</td>
</tr>
<tr>
<td></td>
<td>HWMCA_FALSE Not capped</td>
</tr>
<tr>
<td>73</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(115) HWI_SGPPWMIN</td>
<td>A value from 1 - 999 and less than or equal to the initial processing weight defines the minimum relative amount of shared general purpose processor resources allocated to the CPC image object. A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated general purpose processor. Note: The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated general purpose processor.</td>
</tr>
<tr>
<td>74</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(116) HWI_SGPPWMAX</td>
<td>A value from 1 - 999 and greater than or equal to the initial processing weight defines the maximum relative amount of shared general purpose processor resources allocated to the CPC image object. A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated general purpose processor. Note: The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated general purpose processor.</td>
</tr>
<tr>
<td>SetTypes</td>
<td>Values to be specified</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------</td>
</tr>
<tr>
<td>77</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(119)</td>
<td>This indicates whether the Workload Manager is allowed to change processor weight-related attributes.</td>
</tr>
<tr>
<td>HWL_WLM</td>
<td>• HWMCA_TRUE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_FALSE</td>
</tr>
<tr>
<td></td>
<td>HWL_WLM must be set to HWMCA_TRUE before any of the settings for the specialized IFA, IFL, ICF, or IIP engines can be modified.</td>
</tr>
<tr>
<td>78</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(120)</td>
<td>A value from 1 - 999 defines the relative amount of shared integrated facility for applications (IFA) processor resources allocated to the CPC image object.</td>
</tr>
<tr>
<td></td>
<td>A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated integrated facility for applications (IFA) processor.</td>
</tr>
<tr>
<td></td>
<td>Note: The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated integrated facility for applications (IFA) processor.</td>
</tr>
<tr>
<td>79</td>
<td>A 4-byte integer type value. This indicates whether the initial processing weight for integrated facility for applications (IFA) processors is a limit or a target.</td>
</tr>
<tr>
<td>(121)</td>
<td>HWMCA_TRUE</td>
</tr>
<tr>
<td></td>
<td>Capped</td>
</tr>
<tr>
<td></td>
<td>HWMCA_FALSE</td>
</tr>
<tr>
<td></td>
<td>Not capped</td>
</tr>
<tr>
<td>7A</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(122)</td>
<td>A value from 1 - 999 defines the minimum relative amount of shared integrated facility for applications (IFA) processor resources allocated to the CPC image object.</td>
</tr>
<tr>
<td></td>
<td>A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated integrated facility for applications (IFA) processor.</td>
</tr>
<tr>
<td></td>
<td>Note: The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated integrated facility for applications (IFA) processor.</td>
</tr>
<tr>
<td>SetTypes</td>
<td>Values to be specified</td>
</tr>
<tr>
<td>-------------------</td>
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</tr>
<tr>
<td>7B (123)</td>
<td>HWI_IFAPWMAX</td>
</tr>
<tr>
<td>7E (126)</td>
<td>HWI_IFLIPW</td>
</tr>
<tr>
<td>7F (127)</td>
<td>HWI_IFLIPWCAP</td>
</tr>
<tr>
<td>80 (128)</td>
<td>HWI_IFLPWMIN</td>
</tr>
<tr>
<td>HWISET</td>
<td></td>
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<tr>
<td>---</td>
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</tr>
<tr>
<td><strong>SetTypes</strong></td>
<td><strong>Values to be specified</strong></td>
</tr>
<tr>
<td>81</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(129) HWI_IFLPWMAX</td>
<td>A value from 1 - 999 defines the maximum relative amount of shared integrated facility for Linux (IFL) processor resources allocated to the CPC image object. A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated integrated facility for Linux (IFL) processor. <strong>Note:</strong> The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated integrated facility for Linux (IFL) processor.</td>
</tr>
<tr>
<td>84</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(132) HWI_ICFIPW</td>
<td>A value from 1 - 999 defines the relative amount of shared internal coupling facility (ICF) processor resources allocated to the CPC image object. A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated internal coupling facility (ICF) processor. <strong>Note:</strong> The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated internal coupling facility (ICF) processor.</td>
</tr>
<tr>
<td>85</td>
<td>A 4-byte integer type value. This indicates whether the initial processing weight for internal coupling facility (ICF) processors is a limit or a target.</td>
</tr>
<tr>
<td>(133) HWI_ICFIPWCAP</td>
<td>HWMCA_TRUE Capped</td>
</tr>
<tr>
<td></td>
<td>HWMCA_FALSE Not capped</td>
</tr>
<tr>
<td>86</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(134) HWI_ICFPWMIN</td>
<td>A value from 1 - 999 defines the minimum relative amount of shared internal coupling facility (ICF) processor resources allocated to the CPC image object. A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated internal coupling facility (ICF) processor. <strong>Note:</strong> The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated internal coupling facility (ICF) processor.</td>
</tr>
<tr>
<td>HWISET</td>
<td>Chapter 19. Base Control Program internal interface (BCPi)</td>
</tr>
<tr>
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<tr>
<td><strong>SetTypes</strong></td>
<td><strong>Values to be specified</strong></td>
</tr>
<tr>
<td>87</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td></td>
<td>A value from 1 - 999 defines the maximum relative amount of shared internal coupling facility (ICF) processor resources allocated to the CPC image object.</td>
</tr>
<tr>
<td></td>
<td>A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated internal coupling facility (ICF) processor.</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong>: The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated internal coupling facility (ICF) processor.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>8A</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td></td>
<td>A value from 1 - 999 defines the relative amount of shared integrated information processors (IIP) resources allocated to the CPC image object.</td>
</tr>
<tr>
<td></td>
<td>A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated integrated information processor (IIP).</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong>: The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated integrated information processor (IIP).</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>8B</td>
<td>A 4-byte integer type value. This indicates whether the initial processing weight for integrated information processors (IIP) is a limit or a target.</td>
</tr>
<tr>
<td></td>
<td><strong>HWI_IIPPW</strong></td>
</tr>
<tr>
<td></td>
<td><strong>HWI_IIPPWCAP</strong></td>
</tr>
<tr>
<td></td>
<td><strong>HWI_IIPPWMIN</strong></td>
</tr>
<tr>
<td></td>
<td><strong>HWI_SET</strong></td>
</tr>
<tr>
<td>8B</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td></td>
<td>A value from 1 - 999 defines the minimum relative amount of shared integrated information processors (IIP) resources allocated to the CPC image object.</td>
</tr>
<tr>
<td></td>
<td>A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated integrated information processor (IIP).</td>
</tr>
<tr>
<td></td>
<td><strong>Note</strong>: The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated integrated information processor (IIP).</td>
</tr>
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</table>
### HWISET

<table>
<thead>
<tr>
<th>SetTypes</th>
<th>Values to be specified</th>
</tr>
</thead>
<tbody>
<tr>
<td>8D</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(141)</td>
<td>A value from 1 - 999 defines the maximum relative amount of shared integrated information processors (IIP) resources allocated to the CPC image object.</td>
</tr>
<tr>
<td>HWI_IPPWMAX</td>
<td>A value of 0 indicates that CPC image does not represent a logical partition or the CPC image does not represent a logical partition with at least one not dedicated integrated information processor (IIP).</td>
</tr>
<tr>
<td></td>
<td><strong>Note:</strong> The setting of this attribute is only valid for CPC image objects that represent a logical partition with at least one not dedicated integrated information processor (IIP).</td>
</tr>
<tr>
<td>92</td>
<td>A 4-byte integer value to represent the workload unit capacity for the group profile associated with an image.</td>
</tr>
<tr>
<td>(146)</td>
<td></td>
</tr>
<tr>
<td>HWI_GROUP_PROFILE_CAPACITY</td>
<td></td>
</tr>
<tr>
<td>C9</td>
<td>A character string representing the IOCDS.</td>
</tr>
<tr>
<td>(201)</td>
<td>A value of an empty string indicates that the reset activation profile will use the currently active IOCDS.</td>
</tr>
<tr>
<td>HWI_IOCDS</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td>A character string representing the IPL address.</td>
</tr>
<tr>
<td>(202)</td>
<td><strong>Note:</strong> A value of an empty string indicates that the image activation profile uses the next IPL address set by HCD.</td>
</tr>
<tr>
<td>HWI_IPL_ADDRESS</td>
<td></td>
</tr>
<tr>
<td>CB</td>
<td>A character string representing the IPL parameter.</td>
</tr>
<tr>
<td>(203)</td>
<td><strong>Note:</strong> A value of an empty string indicates that the image activation profile uses the next IPL parameter set by HCD.</td>
</tr>
<tr>
<td>HWI_IPL_PARM</td>
<td></td>
</tr>
<tr>
<td>CC</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(204)</td>
<td><strong>HWMC_A_IPLTYPE_STANDARD</strong></td>
</tr>
<tr>
<td></td>
<td>Indicates that the image activation profile is used to perform a standard load.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMC_A_IPLTYPE_SCSI</strong></td>
</tr>
<tr>
<td></td>
<td>Indicates that the image activation profile is used to perform a SCSI load.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMC_A_IPLTYPE_SCSIDUMP</strong></td>
</tr>
<tr>
<td></td>
<td>Indicates that the image activation profile is used to perform a SCSI dump.</td>
</tr>
<tr>
<td>CD</td>
<td>A character string representing the worldwide port name.</td>
</tr>
<tr>
<td>(205)</td>
<td></td>
</tr>
<tr>
<td>HWI_WW_PORTNAME</td>
<td></td>
</tr>
<tr>
<td>CE</td>
<td>A 4-byte integer type value representing the boot program selector value.</td>
</tr>
<tr>
<td>(206)</td>
<td></td>
</tr>
<tr>
<td>HWI_BOOT_PGM_SELECTOR</td>
<td></td>
</tr>
<tr>
<td>SetTypes</td>
<td>Values to be specified</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>CF</td>
<td>A character string representing the logical unit number.</td>
</tr>
<tr>
<td>(207)</td>
<td></td>
</tr>
<tr>
<td>HWI_LU_NUM</td>
<td></td>
</tr>
<tr>
<td>D0</td>
<td>A character string representing the boot record logical block address.</td>
</tr>
<tr>
<td>(208)</td>
<td></td>
</tr>
<tr>
<td>HWI_BOOTREC_BLK_ADDR</td>
<td></td>
</tr>
<tr>
<td>D1</td>
<td>A character string representing the operating system specific load parameters.</td>
</tr>
<tr>
<td>(209)</td>
<td></td>
</tr>
<tr>
<td>HWI_OPSYS_LOADPARM</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>A character string that represents the name of a group capacity profile.</td>
</tr>
<tr>
<td>(210)</td>
<td></td>
</tr>
<tr>
<td>HWI_GROUP_PROF_NAME</td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>A 4-byte integer type value.</td>
</tr>
<tr>
<td>(211)</td>
<td></td>
</tr>
<tr>
<td>HWI_LOAD_AT_ACTIVATION</td>
<td>This indicates whether a load should be done at the end of activation.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_TRUE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_FALSE</td>
</tr>
<tr>
<td>D4</td>
<td>A 4-byte integer type value to represent the initial amount of central storage (in megabytes) to be used for the CPC image.</td>
</tr>
<tr>
<td>(212)</td>
<td></td>
</tr>
<tr>
<td>HWI_CENTRAL_STOR</td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>A 4-byte integer type value to represent the reserved amount of central storage (in megabytes) to be used for the CPC image.</td>
</tr>
<tr>
<td>(213)</td>
<td></td>
</tr>
<tr>
<td>HWI_RES_CENTRAL_STOR</td>
<td></td>
</tr>
<tr>
<td>D6</td>
<td>A 4-byte integer type value to represent the initial amount of expanded storage (in megabytes) to be used for the CPC image.</td>
</tr>
<tr>
<td>(214)</td>
<td></td>
</tr>
<tr>
<td>HWI_EXPANDED_STOR</td>
<td></td>
</tr>
<tr>
<td>D7</td>
<td>A 4-byte integer type value to represent the reserved amount of expanded storage (in megabytes) to be used for the CPC image.</td>
</tr>
<tr>
<td>(215)</td>
<td></td>
</tr>
<tr>
<td>HWI_RES_EXPANDED_STOR</td>
<td></td>
</tr>
<tr>
<td>D8</td>
<td>A 4-byte integer type value to represent the number of dedicated general purpose processors to be used for the CPC image.</td>
</tr>
<tr>
<td>(216)</td>
<td></td>
</tr>
<tr>
<td>HWI_NUM_GPP</td>
<td></td>
</tr>
<tr>
<td>D9</td>
<td>A 4-byte integer type value to represent the number of reserved dedicated general purpose processors to be used for the CPC image.</td>
</tr>
<tr>
<td>(217)</td>
<td></td>
</tr>
<tr>
<td>HWI_NUM_RESGPP</td>
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</tr>
<tr>
<td>SetTypes</td>
<td>Values to be specified</td>
</tr>
<tr>
<td>------------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DA (218)</td>
<td>A 4-byte integer value to represent the number of dedicated integrated facility for applications (IFA) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_IFA</td>
<td></td>
</tr>
<tr>
<td>DB (219)</td>
<td>A 4-byte integer value to represent the number of reserved dedicated integrated facility for applications (IFA) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_RESIFA</td>
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</tr>
<tr>
<td>DC (220)</td>
<td>A 4-byte integer value to represent the number of dedicated integrated facility for Linux (IFL) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_IFL</td>
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<tr>
<td>DD (221)</td>
<td>A 4-byte integer value to represent the number of reserved dedicated integrated facility for Linux (IFL) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_RESIFL</td>
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</tr>
<tr>
<td>DE (222)</td>
<td>A 4-byte integer value to represent the number of dedicated internal coupling facility (ICF) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_ICF</td>
<td></td>
</tr>
<tr>
<td>DF (223)</td>
<td>A 4-byte integer value to represent the number of reserved dedicated internal coupling facility (ICF) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_RESICF</td>
<td></td>
</tr>
<tr>
<td>E0 (224)</td>
<td>A 4-byte integer value to represent the number of dedicated System z Integrated Information Processors (zIIPs) to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_ZIIP</td>
<td></td>
</tr>
<tr>
<td>E1 (225)</td>
<td>A 4-byte integer value to represent the number of reserved dedicated System z Integrated Information Processors (zIIPs) to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_RESZIIP</td>
<td></td>
</tr>
<tr>
<td>E2 (226)</td>
<td>A 4-byte integer type value to represent the number of shared general purpose processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_SHARED_GPP</td>
<td></td>
</tr>
<tr>
<td>E3 (227)</td>
<td>A 4-byte integer type value to represent the number of reserved shared general purpose processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_RES_SHARED_GPP</td>
<td></td>
</tr>
<tr>
<td>E4 (228)</td>
<td>A 4-byte integer value to represent the number of shared integrated facility for applications (IFA) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>HWI_NUM_SHARED_IFA</td>
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</tr>
<tr>
<td>SetTypes</td>
<td>Values to be specified</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>E5 (229)</td>
<td>HWI_NUM_RES_SHARED_IFA A 4-byte integer value to represent the number of reserved shared integrated facility for applications (IFA) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>E6 (230)</td>
<td>HWI_NUM_SHARED_IFL A 4-byte integer value to represent the number of shared integrated facility for Linux (IFL) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>E7 (231)</td>
<td>HWI_NUM_RES_SHARED_IFL A 4-byte integer value to represent the number of reserved shared integrated facility for Linux (IFL) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>E8 (232)</td>
<td>HWI_NUM_SHARED_IFL A 4-byte integer value to represent the number of shared internal coupling facility (ICF) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>E9 (233)</td>
<td>HWI_NUM_RES_SHARED_IFL A 4-byte integer value to represent the number of reserved shared internal coupling facility (ICF) processors to be used for the CPC image.</td>
</tr>
<tr>
<td>EA (234)</td>
<td>HWI_NUM_SHARED_ZIIP A 4-byte integer value to represent the number of shared System z Integrated Information Processors (zIIPs) to be used for the CPC image.</td>
</tr>
<tr>
<td>EB (235)</td>
<td>HWI_NUM_RES_SHARED_ZIIP A 4-byte integer value to represent the number of reserved shared System z Integrated Information Processors (zIIPs) to be used for the CPC image.</td>
</tr>
<tr>
<td>EC (236)</td>
<td>HWI_BASIC_CPU_AUTH_COUNT_CNTL A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_TRUE</strong></td>
</tr>
<tr>
<td></td>
<td>The authorization control is enabled.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_FALSE</strong></td>
</tr>
<tr>
<td></td>
<td>The authorization control is disabled.</td>
</tr>
<tr>
<td>ED (237)</td>
<td>HWI_PROBSTATE_CPU_AUTH_COUNT_CNTL A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_TRUE</strong></td>
</tr>
<tr>
<td></td>
<td>The authorization control is enabled.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_FALSE</strong></td>
</tr>
<tr>
<td></td>
<td>The authorization control is disabled.</td>
</tr>
<tr>
<td>EE (238)</td>
<td>HWI_CRYPTOACTIVITY_CPU_AUTH_COUNT_CNTL A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_TRUE</strong></td>
</tr>
<tr>
<td></td>
<td>The authorization control is enabled.</td>
</tr>
<tr>
<td></td>
<td><strong>HWMCA_FALSE</strong></td>
</tr>
<tr>
<td></td>
<td>The authorization control is disabled.</td>
</tr>
<tr>
<td>SetTypes</td>
<td>Values to be specified</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------</td>
</tr>
<tr>
<td>EF</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>(239) HWI_EXTENDED_CPU_AUTH_COUNT_CNTL</td>
<td>HWMCA_TRUE The authorization control is enabled.</td>
</tr>
<tr>
<td></td>
<td>HWMCA_FALSE The authorization control is disabled.</td>
</tr>
<tr>
<td>F0</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>(240) HWI_COPROCESSOR_CPU_AUTH_COUNT_CNTL</td>
<td>HWMCA_TRUE The authorization control is enabled.</td>
</tr>
<tr>
<td></td>
<td>HWMCA_FALSE The authorization control is disabled.</td>
</tr>
<tr>
<td>F1</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>(241) HWI_BASIC_CPU_SAMPLING_AUTH_CNTL</td>
<td>HWMCA_TRUE The authorization control is enabled.</td>
</tr>
<tr>
<td></td>
<td>HWMCA_FALSE The authorization control is disabled.</td>
</tr>
<tr>
<td>F2</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>(242) HWI_APROF_STORE_STATUS</td>
<td>HWMCA_TRUE Store status is selected. Only allowed if HWI_APROF_LOADTYPE is set to HWMCA_LOADTYPE_NORMAL.</td>
</tr>
<tr>
<td></td>
<td>HWMCA_FALSE Store status is not selected.</td>
</tr>
<tr>
<td>F3</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>(243) HWI_APROF_LOADTYPE</td>
<td>HWMCA_LOADTYPE_NORMAL The Loadtype is set to normal.</td>
</tr>
<tr>
<td></td>
<td>HWMCA_LOADTYPE_CLEAR The Loadtype is set to clear.</td>
</tr>
<tr>
<td>F4</td>
<td>A 50-character activation profile description. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>(244) HWI_PROFILE_DESCRIPTION</td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>A 4-byte integer type decimal value ranging from 0 to 63. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>(245) HWI_PROFILE_PARTITION_ID</td>
<td></td>
</tr>
<tr>
<td>SetTypes</td>
<td>Values to be specified</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>F6 (246) HWI_OPERATING_MODE</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_ESA390_OPERATING_MODE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_ESA390TPF_OPERATING_MODE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_CF_OPERATING_MODE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_LINUX_OPERATING_MODE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_FMEX_OPERATING_MODE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_HMEX_OPERATING_MODE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_HMAS_OPERATING_MODE</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_ZVM_OPERATING_MODE</td>
</tr>
<tr>
<td>F7 (247) HWI_CLOCK_TYPE</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_CLOCK_TYPE_STANDARD</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_CLOCK_TYPE_LPAR</td>
</tr>
<tr>
<td>F8 (248) HWI_TIME_OFFSET_DAYS</td>
<td>A 4-byte integer type decimal value ranging from 0 - 999. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>F9 (249) HWI_TIME_OFFSET_HOURS</td>
<td>A 4-byte integer type decimal value ranging from 0 - 23. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>FA (250) HWI_TIME_OFFSET_MINUTES</td>
<td>A 4-byte integer type decimal value. Possible values are 0, 15, 30 or 45. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td>FB (251) HWI_TIME_OFFSET_INCREASE</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_TRUE</td>
</tr>
<tr>
<td></td>
<td>The local time zone is east of GMT.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_FALSE</td>
</tr>
<tr>
<td></td>
<td>The local time zone is west of GMT.</td>
</tr>
<tr>
<td>FC (252) HWI_LICCC_VALIDATION_ENABLED</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a zEnterprise or higher CPC.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_TRUE</td>
</tr>
<tr>
<td></td>
<td>Activation profile must conform to the current LICCC configuration.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_FALSE</td>
</tr>
<tr>
<td></td>
<td>Activation profile is not required to conform to the current LICCC configuration.</td>
</tr>
<tr>
<td>FD (253) HWI_GLOBAL_PERFORMANCE_DATA_CONTROL</td>
<td>A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_TRUE</td>
</tr>
<tr>
<td></td>
<td>Global performance data control is enabled.</td>
</tr>
<tr>
<td></td>
<td>• HWMCA_FALSE</td>
</tr>
<tr>
<td></td>
<td>Global performance data control is disabled.</td>
</tr>
</tbody>
</table>
HWISET

SetTypes | Values to be specified
---|---
FE (254) | A 4-byte integer type value. This attribute is only available when targeting a z10 or higher CPC.
   
   **HWMCA_TRUE**
   
   I/O configuration control is enabled.
   
   **HWMCA_FALSE**
   
   I/O configuration control is disabled.

   
   HWI_IO_CONFIGURATION _CONTROL

   
   100 (256)

   
   **HWMCA_TRUE**
   
   Logical partition isolation control is enabled.
   
   **HWMCA_FALSE**
   
   Logical partition isolation control is disabled.

   
   HWI_LOGICAL_PARTITION _ISOLATION

SetTypeValueLen (non-REXX)

Supplied parameter

- Type: Integer
- Length: 4 bytes

SetTypeValueLen specifies the length in bytes of the SetTypeValue pointed to by the SetTypeValue_Ptr parameter.

DiagArea (non-REXX)

DiagArea (REXX)

Returned parameter

- Type: Character string (non-REXX), stem variable (REXX)
- Length: 32 bytes (non-REXX)

DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

Note: For all environmental errors (with return code X'F00' and higher), the DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name (non-REXX) / Tail name constant of the user-defined DiagArea stem (REXX)</th>
<th>Field Type (non-REXX)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code that is returned from the Console Application API or the BCP/Ii transport layer.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Reserved.</td>
</tr>
</tbody>
</table>
See Appendix A, “BCPii communication error reason codes,” on page 415 for a partial list of the descriptive communication transport error return codes and suggested actions.

**ABEND codes**
If BCPii is unable to properly access the user-supplied parameter list, the call might result in an abend X'042' with a reason code of X'0007yyyy' because of one of the following reasons:

<table>
<thead>
<tr>
<th>yyyy</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>The parameters passed by the caller are not in the primary address space.</td>
</tr>
<tr>
<td>0001</td>
<td>The parameters passed by the caller are not accessible.</td>
</tr>
<tr>
<td>0002</td>
<td>The number of parameters passed by the caller is not correct.</td>
</tr>
</tbody>
</table>

For other severe BCPii errors encountered during the call, an abend X'042' with a different reason code may result. See [z/OS MVS System Codes](#) for additional information.

**Return codes**
When the service returns control to the caller, GPR 15 and ReturnCode contain a hexadecimal return code.

<table>
<thead>
<tr>
<th>Return Code in: Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 0 HWI_OK                                 | **Meaning**: Successful completion.  
**Action**: None. |
| 100 HWI_CONNECT_TOKEN_INV                | **Meaning**: Program error. The specified connect token is not valid. This return code indicates one of the following conditions has occurred:  
• The connect token does not exist. A previous HWICONN service call has never returned the value specified on OutConnectToken.  
• The connect token does not represent an active connection. The connection specified might have already been disconnected using the HWIDISC service call.  
• The connect token is not associated with the address space of the caller. The ConnectToken specified is associated with a different address space than the caller of this service call.  
**Action**: Check for probable coding error. |
<table>
<thead>
<tr>
<th>Return Code Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 101 HWI_COMMUNICATION_ERROR | **Meaning**: A communication error is detected. The hardware management console application API (HWMCA) or the BCPii Transport layer has returned with a failing return code.  
**Action**: Check for probable coding error. See the DiagArea for further diagnostic information. The Diag_CommErr indicates the return code that is returned from HWMCA APIs or the BCPii Transport layer.  
HWMCA API and BCPii transport return codes are provided in Appendix A, “BCPii communication error reason codes,” on page 415. |
| 102 HWI_DIAGAREA_INV | **Meaning**: Program error. The DiagArea is not accessible.  
**Action**: Check for probable coding error. Verify the specified DiagArea is defined as a 32-byte character field. |
| 103 HWI_CONNECT_TOKEN_INACTIVE | **Meaning**: The specified connect token is no longer valid. The connection has been disconnected or it is in the progress of being disconnected.  
**Action**: Check for probable coding error. Verify that the specified connect token is still active. If connectivity to the targeted CPC connection no longer exists, all connections associated with that CPC will no longer have a connect token that can be used. |
<table>
<thead>
<tr>
<th>Return Code in: Hexadecimal Equate</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| **501 HWI_SETTYPE_INV**           | **Meaning:** Program error. The requested SetType specified in the call is not valid for the ConnectToken specified. The system rejects the service call. This return code indicates one of the following conditions has occurred:  
* The SetType specified is not in the acceptable value range of attributes that can be set.  
* The specified SetType has been provided with an incompatible connection type. For example, the attribute identifier applies only to CPC connections, but the ConnectToken specified represents an image connection, or any of the activation profile connections.  
**Action:** Check for probable coding error. Validate that the SetType specified is in the valid range of possible values. Validate that the SetType specified is permitted for the specified connection type.  
See the DiagArea for further diagnostic information.  
* The Diag_Key contains the value of the attribute in question.  
* The Diag_Text contain “Bad Set Attr” if the value of the attribute cannot be set; the Diag_Text contains “Mismatch” if the attribute cannot be set for the specified connection type. |
| **502 HWI_SETTYPE_VALUE_INV**     | **Meaning:** Program error. The requested SetTypeValue to be set or changed is not valid. The system rejects the service call.  
**Action:** Check for probable coding error. Validate that the value to which an attribute is being set is appropriate for that attribute. |
| **503 HWI_SETTYPE_VALUE_LEN_INV** | **Meaning:** Program error. The SetTypeValueLen specified is not valid. The SetTypeValueLen must be equal to or greater than the minimum required length for the set type value.  
**Action:** Check for probable coding error. Validate that the SetTypeValueLen specified is equal to or greater than the minimum required length for the set type value. |
<table>
<thead>
<tr>
<th>Return Code in: Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 504 HWI_SETTYPE_VALUE _INACCESSIBLE      | **Meaning**: Program error. The set type value data area is either partially or completely inaccessible by the application, or BCPii, or both.  
**Action**: Check for probable coding error. Verify the SetTypeValue_Ptr points to a data area where the set type value is, and make sure that the data area is accessible. |
| 506 HWI_SET_ATTRIBUTE_NOT_SUPPORTED      | **Meaning**: The targeted hardware of the HWISET request does not recognize the attribute that the user is attempting to set.  
**Action**: Verify that the targeted hardware is at a level that supports the type of attribute being set. |
| F00 HWI_NOT_AVAILABLE                    | **Meaning**: HWI is not available, and the system rejects the service request.  
**Action**: Start HWI and try the request again. |
| F01 HWI_AUTH_FAILURE                     | **Meaning**: The caller is PKM8-15 problem state.  
**Action**: Check the calling program for a probable coding error. |
| F02 HWI_NO_SAF_AUTH                      | **Meaning**: The user does not have correct SAF authorization for the request.  
**Action**: Check for probable error. Consider one or more of the following possible actions:  
- Define read access authorization to the FACILITY class resource profile HWI.APPLNAME.HWISERV.  
- Define update access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau for a CPC connection.  
- Define update access authorization to the FACILITY class resource profile HWI.TARGET.netid.nau.imagename for an image connection.  
- Ensure that the referenced Facility Class Profile is RACLIST-specified. |
| F03 HWI_INTERRUPT_STATUS_INV             | **Meaning**: The calling program is disabled. The system rejects this service request.  
**Action**: Check the calling program for a probable coding error. |
| F04 HWI_MODE_INV                         | **Meaning**: The calling program is not in Task mode, which is the required mode. The system rejects this service request.  
**Action**: Check the calling program for a probable error. |
### HWISET

<table>
<thead>
<tr>
<th>Return Code in: Hexadecimal Equate</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| F05 HWI_LOCKS_HELD                | **Meaning:** The calling program is holding one or more locks. The system rejects this service request.  
**Action:** Check the calling program for a probable coding error. |
| F06 HWI_UNSUPPORTED_RELEASE       | **Meaning:** The system level does not support this service. The system rejects this service request.  
**Action:** Remove the calling program from the system, and install it on a system that supports HWI. Then rerun the calling program. |
| F07 HWI_UNSUPPORTED_ENVIRONMENT    | **Meaning:** The system does not support execution of the service from the current environment (for example, calling a BCPii service from within a BCPii ENF exit routine).  
**Action:** Issue the BCPii service from a different execution environment. |
| FFF HWI_UNEXPECTED_ERROR          | **Meaning:** System error. The service that was called encountered an unexpected error. The system rejects the service call.  
**Action:** Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center. In many cases, a dump has been taken by BCPii to attempt the collection of the necessary information to diagnose the error. If so, provide this dump to the IBM support team. |

### Example

In the pseudocode example, the caller issues a call to change or set the CPC status for a CPC.

```plaintext
.. 
SetType = HWI_ACCSTAT;  
SetTypeValue = HWMCA_STATUS_OPERATING;  
SetTypeValue_Ptr = addr(SetTypeValue);  
SetTypeValueLen = Length(SetTypeValue);  
CALL HWISET (ReturnCode, ConnectToken, SetType, SetTypeValue_Ptr,  
            SetTypeValueLen, DiagArea)  
.. 
```

A REXX programming example for the HWISET service:

```plaintext
mySetType = HWI_ACCSTAT  /* AccStat attribute */  
mySetTypeValue = HWMCA_STATUS_EXCEPTIONS  
address bcpii  
"hwiset RetCode myConnectToken mySetType mySetTypeValue myDiag."  

If (RC <> 0) | (Retcode <> 0) Then  
   Do 
```

Chapter 19. Base Control Program internal interface (BCPi) 395
HWIBEGINEVENTDELIVERY — Begin delivery of BCPii event notifications

Call the HWIBeginEventDelivery service to allow a C application running in the z/OS UNIX System Services environment to begin delivery of event notifications. This service must be issued before the HWIManageEvents service.

Description

Environment
The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>None</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard C linkage conventions are used</td>
</tr>
</tbody>
</table>

Programming requirements
The file hwicmu.s contains the sidedeck needed to link the program to the DLL.

z/OS UNIX C language callers must include the header file HWICIC.

Restrictions
None.

Authorization
Read access to the SAF profile CEA.CONNECT in the SERVAUTH class is required.

Syntax
Write the call as shown on the syntax diagram. You must code all parameters in the order shown.
**HWIBeginEventDelivery**

**CALL statement**

```c
int HWIBeginEventDelivery
{
  *DiagArea
  ,ConnectToken
  ,**DeliveryToken
}
```

**Parameters**

The parameters are explained as follows:

* **DiagArea**
  
  Returned parameter
  
  - Type: character string
  - Length: 32 bytes

  *DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the *DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

Note: For all environmental errors (with return code X'F00' and higher), the *DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code from the failing operation.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Additional diagnostic information in text format.</td>
</tr>
</tbody>
</table>

See [Appendix A, “BCPii communication error reason codes,” on page 415](#) for a partial list of the descriptive communication transport error return codes and suggested actions.

* **ConnectToken**
  
  Supplied parameter
  
  - Type: character string
  - Length: 16 bytes

  ConnectToken specifies the value returned from an HWICONN service call.

* **DeliveryToken**
  
  Returned parameter
  
  - Type: character string
  - Length: 8 bytes

  **DeliveryToken specifies the variable to contain the address of the token that represents the event notification connection on future service calls.**
### ABEND codes
None.

### Return codes
When the service completes, one of the following values is returned to the caller:

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal</th>
<th>Equate</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000000 HWIUSS_RC_OK</td>
<td></td>
<td><strong>Meaning:</strong> Successful completion.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> None.</td>
</tr>
<tr>
<td>00001001 HWIUSS_RC_UNAVAILABLE</td>
<td></td>
<td><strong>Meaning:</strong> This error is returned for one of the following reasons, which is written to the diag_commerr field of the DiagArea:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• CEA (Common Event Adapter) communication is unavailable. (reason x'100')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Write access to a socket is denied. (reason x'103')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Services are failing in the CEA Server. (reason x'111')</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> The request is rejected. Confirm that the CEA address space has been started and try the request again.</td>
</tr>
<tr>
<td>00001002 HWIUSS_RC_NO_AUTH</td>
<td></td>
<td><strong>Meaning:</strong> The program is not authorized to access CEA services.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> The request is rejected. Determine if the program needs access to CEA services. If so, grant the required access to the proper resources and try this request again. See <a href="#">“Setting up event notification for BCPii z/OS UNIX applications” on page 264</a> for further information.</td>
</tr>
<tr>
<td>00001003 HWIUSS_RC_MAX_CLIENTS</td>
<td></td>
<td><strong>Meaning:</strong> The maximum number of CEA clients has been reached.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> The request is rejected. Determine if other CEA clients can be stopped. If so, try this request again.</td>
</tr>
<tr>
<td>00001007 HWIUSS_RC_SAF_NOTDEF_CONNECT</td>
<td></td>
<td><strong>Meaning:</strong> The SAF profile CEA.CONNECT is not defined.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> The request is rejected. Add the CEA.CONNECT profile to the SERVAUTH class and try this request again.</td>
</tr>
<tr>
<td>00001008 HWIUSS_RC_COMM_FAILURE</td>
<td></td>
<td><strong>Meaning:</strong> An error occurred in z/OS UNIX socket processing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Action:</strong> The request is rejected. Verify that the file system is properly configured for z/OS UNIX sockets and try this request again.</td>
</tr>
</tbody>
</table>
HWIBeginEventDelivery

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWIUSS_RC_CEA_INTERNAL_ERROR 00001009</td>
<td>Meaning: An internal CEA processing error has occurred.</td>
</tr>
<tr>
<td></td>
<td>Action: The request is rejected. Consult the DiagArea for the details about this error. If the error persists, contact the IBM Support Center.</td>
</tr>
<tr>
<td>HWIUSS_RC_INPUT_PTR_IS_NULL 0000100A</td>
<td>Meaning: A null input pointer was found.</td>
</tr>
<tr>
<td></td>
<td>Action: The request is rejected. Pass a valid pointer to the API and try this request again.</td>
</tr>
<tr>
<td>HWIUSS_RC_UNEXPECTED_ERROR FFFFFFFF</td>
<td>Meaning: An unexpected error has occurred.</td>
</tr>
<tr>
<td></td>
<td>Action: The request is rejected. Consult the DiagArea for more specifics regarding the error. Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center.</td>
</tr>
</tbody>
</table>

Example

In the C code example, the caller issues a call to register for event delivery.

```c
HWI_CONN_TOKEN_TYPE hwitoken;
HWI_DIAGAREA_TYPE DiagArea;
HWI_DELIVERY_TOKEN_TYPE *DeliveryToken;
int localRC;

localRC = HWIBeginEventDelivery(&DiagArea, hwitoken, DeliveryToken)
```

HWIEndEventDelivery — End delivery of BCPii event notifications

Call the HWIEndEventDelivery service to allow a C application running in the z/OS UNIX System Services environment to end delivery of event notifications. This service unregisters the registration made by the HWIBeginEventDelivery service.

Description

Environment

The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>None</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard C linkage conventions are used</td>
</tr>
</tbody>
</table>
**Programming requirements**

The file hwicmuss.x contains the sidedeck needed to link the program to the DLL.

z/OS UNIX C language callers must include the header file HWICIC.

**Restrictions**

None.

**Authorization**

Read access to the SAF profile CEA.CONNECT in the SERVAUTH class is required.

**Syntax**

Write the call as shown on the syntax diagram. You must code all parameters in the order shown.

```
CALL statement  Parameters
int  HWIEndEventDelivery (   
  *DiagArea   
  ,*DeliveryToken   
)
```

**Parameters**

The parameters are explained as follows:

**+DiagArea**

Returned parameter

- Type: character string
- Length: 32 bytes

*DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the *DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

**Note:** For all environmental errors (with return code XF00' and higher), the *DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code from the failing operation.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Additional diagnostic information in text format.</td>
</tr>
</tbody>
</table>

See [Appendix A, “BCPii communication error reason codes,” on page 415](#) for a partial list of the descriptive communication transport error return codes and suggested actions.

**+DeliveryToken**

Supplied parameter
DeliveryToken specifies the event notification connection created by a previous HWIBeginEventDelivery call.

ABEND codes
None.

Return codes
When the service completes, one of the following values is returned to the caller:

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| HWIUSS_RC_OK | **Meaning**: Successful completion.  
**Action**: None. |
| HWIUSS_RC_UNAVAILABLE | **Meaning**: This error is returned for one of the following reasons, which is written to the diag_commerr field of the DiagArea:  
- CEA (Common Event Adapter) communication is unavailable. (reason x'100')  
- Write access to a socket is denied. (reason x'103')  
- Services are failing in the CEA Server. (reason x'111')  
**Action**: The request is rejected. Confirm that the CEA address space has been started and try the request again. |
| HWIUSS_RC_BAD_DELIVERYTOKEN | **Meaning**: The provided delivery token is not valid.  
**Action**: The request is rejected. This is a probable coding error. |
| HWIUSS_RC_COMM_FAILURE | **Meaning**: An error occurred in z/OS UNIX socket processing.  
**Action**: The request is rejected. Verify that the file system is properly configured for z/OS UNIX sockets and try this request again. |
| HWIUSS_RC_CEA_INTERNAL_ERROR | **Meaning**: An internal CEA processing error has occurred.  
**Action**: The request is rejected. Consult the DiagArea for the details about this error. If the error persists, contact the IBM Support Center. |
| HWIUSS_RC_INPUT_PTR_IS_NULL | **Meaning**: A null input pointer was found.  
**Action**: The request is rejected. Pass a valid pointer to the API and try this request again. |
HWIEndEventDelivery

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0FFFFFFF HWIUSS_RC_UNEXPECTED_ERROR</td>
<td>Meaning: An unexpected error has occurred.</td>
</tr>
<tr>
<td></td>
<td>Action: The request is rejected. Consult the DiagArea for more specifics regarding the error. Search problem reporting databases for a fix for the problem. If no fix exists, contact the IBM Support Center.</td>
</tr>
</tbody>
</table>

Example
In the C code example, the caller issues a call to unregister for event delivery.

```c
HWI_DIAGAREA_TYPE DiagArea;
HWI_DELIVERYTOKEN_TYPE *DeliveryToken;
int LocalRC;

LocalRC = HWIEndEventDelivery(&DiagArea, DeliveryToken)
```

HWIManageEvents — Manage the list of BCPii events

Call the HWIManageEvents service to allow a C application running in the z/OS UNIX System Services environment to manage the list of events for which the application is to be notified. The HWIBeginEventDelivery service must have been called before the HWIManageEvents service being called because the appropriate delivery token returned from the HWIBeginEventDelivery service is required as input.

Description

Environment
The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>One of the following: PKM allowing key 0-7, supervisor state, or APF-Authorized</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>Any PASN, any HASN, any SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard C linkage conventions are used</td>
</tr>
</tbody>
</table>

Programming requirements
The file hwicmuss.x contains the sidedeck needed to link the program to the DLL.

z/OS UNIX C language callers must include the header file HWICIC.

Restrictions
None.
Authorization

The client application must have access to consult the local CPC. This is granted by allowing the application at least read access to the SAF-protected FACILITY class resource HWI.APPLNAME.HWISERV.

Read access is required to the profile CEA.SUBSCRIBE.ENF_0068qqqqqqqq in the SERVAUTH class, where qqqqqqqqq is the specific hexadecimal event qualifier pattern. See the ENF 68 documentation contained in the ENFREQ chapter of [MVS Programming: Authorized Assembler Services Reference EDT-IXG](#) for further information about how to specify this event qualifier.

The client application must have at least read access to the SAF-protected FACILITY class resource HWL.TARGET.netid.nau for a ConnectToken representing a CPC connection, or HWI.TARGET.netid.nau.imagename for a ConnectToken representing an image connection.

**Note:** BCPIi requires the FACILITY class to be RACLIST-specified.

Syntax

Write the call as shown on the syntax diagram. You must code all parameters in the order shown.

```
CALL statement
int HWIManageEvents
Parameters
 ( *
  *DiagArea
  ,*DeliveryToken
  ,ConnectToken
  ,EventAction
  ,EventIDs
 )
```

Parameters

The parameters are explained as follows:

*DiagArea

Returned parameter

- Type: character string
- Length: 32 bytes

*DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the *DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

**Note:** For all environmental errors (with return code XF00' and higher), the *DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
</tbody>
</table>
See Appendix A, “BCPii communication error reason codes,” on page 415 for a partial list of the descriptive communication transport error return codes and suggested actions.

**DeliveryToken**  
Supplied parameter  
- Type: character string  
- Length: 8 bytes  
*D*eliveryToken specifies the event notification connection, as returned by a previous HWIBeginEventDelivery call.

**ConnectToken**  
Supplied parameter  
- Type: character string  
- Length: 16 bytes  
ConnectToken specifies a logical connection between the application and a CPC or an image. The ConnectToken is an output parameter on the HWICONN service call.  
The ConnectToken specified must have originated from a HWICONN service call that was issued from the same address space as this service call.

**EventAction**  
Supplied parameter  
- Type: integer  
- Length: 4 bytes  
EventAction specifies the type of action for the service. See the EventAction parameter of “HWIEVENT — Register or unregister for BCPii events” on page 314 for the exact syntax.

**EventIDs**  
Supplied parameter  
- Type: integer  
- Length: 128 bit (16 bytes)  
EventIDs specifies the events to be added or deleted. See the EventIDs parameter of “HWIEVENT — Register or unregister for BCPii events” on page 314 for the exact syntax.

IBM recommends that an application should at least add the Hwi_Event_BCPIIStatus event if other events are going to be added by the application. The only way to listen for BCPii events in the z/OS UNIX System Services environment is to issue a blocking call to the HwiGetEvent service. If BCPii stops and the Hwi_Event_BCPIIStatus has not been added, the application has no way of knowing of this termination and may hang indefinitely. By at least listening to this event, an application can be aware of BCPii terminations and take the appropriate action.
ABEND codes

If BCPii is unable to properly access the user-supplied parameter list, the call might result in an abend X'042' with a reason code of X'0004yyyy' because of one of the following reasons:

Table 68. Reasons for abend X'042', RC X'0004yyyy'

<table>
<thead>
<tr>
<th>yyyy</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>The parameters passed by the caller are not in the primary address space.</td>
</tr>
<tr>
<td>0001</td>
<td>The parameters passed by the caller are not accessible.</td>
</tr>
<tr>
<td>0002</td>
<td>The number of parameters passed by the caller is not correct.</td>
</tr>
</tbody>
</table>

For other severe BCPii errors encountered during the call, an abend X'042' with a different reason code may result. See [z/OS MVS System Codes](#) for additional information.

Return codes

When the service completes, one of the following values is returned to the caller:

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000000 HWIUSS_RC_OK</td>
<td>Meaning: Successful completion.</td>
</tr>
<tr>
<td></td>
<td>Action: None.</td>
</tr>
<tr>
<td>00001000 HWIUSS_RC_HWIEVENT_FAILURE</td>
<td>Meaning: The resultant HWIEVENT service call failed.</td>
</tr>
<tr>
<td></td>
<td>Action: The request is rejected. The DiagArea contains the failure data. Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center.</td>
</tr>
<tr>
<td>00001001 HWIUSS_RC_UNAVAILABLE</td>
<td>Meaning: This error is returned for one of the following reasons, which is written to the diag_commerr field of the DiagArea:</td>
</tr>
<tr>
<td></td>
<td>• CEA (Common Event Adapter) communication is unavailable. (reason x'100')</td>
</tr>
<tr>
<td></td>
<td>• Write access to a socket is denied. (reason x'103')</td>
</tr>
<tr>
<td></td>
<td>• Services are failing in the CEA Server. (reason x'111')</td>
</tr>
<tr>
<td></td>
<td>Action: The request is rejected. Confirm that the CEA address space has been started and try the request again.</td>
</tr>
<tr>
<td>Return Code in Hexadecimal Equate Symbol</td>
<td>Meaning and Action</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>--------------------</td>
</tr>
</tbody>
</table>
| 00001002 HWIUSS_RC_NO_AUTH             | Meaning: This error is returned for one of the following reasons, which is written to the diag_commerr field of the DiagArea:  
  - The program is not authorized to access CEA services. (reason x'102')  
  - The program is not authorized to monitor the requested event. (reason x'10E')  
  Action: The request is rejected. Determine whether the program needs access to CEA services. If so, grant the required access to the proper resources and try this request again. See "Setting up event notification for BCPii z/OS UNIX applications" on page 264 for further information. |
| 00001004 HWIUSS_RC_BAD_DELIVERYTOKEN   | Meaning: The provided delivery token is not valid.  
  Action: The request is rejected. This is a probable coding error. |
| 00001006 HWIUSS_RC_SAF_NOTDEF_EVENT    | Meaning: The SAF profile CEA.SUBSCRIBE.ENF_0068* is not defined.  
  Action: The request is rejected. Add the proper CEA.SUBSCRIBE.ENF_0068* profile to the SERVAUTH class and try this request again. |
| 00001008 HWIUSS_RC_COMM_FAILURE        | Meaning: An error occurred in z/OS UNIX socket processing.  
  Action: The request is rejected. Verify that the file system is properly configured for z/OS UNIX sockets and try this request again. |
| 00001009 HWIUSS_RC_CEA_INTERNAL_ERROR  | Meaning: An internal CEA processing error has occurred.  
  Action: The request is rejected. Consult the DiagArea for the details about this error. If the error persists, contact the IBM Support Center. |
| 0000100A HWIUSS_RC_INPUT_PTR_IS_NULL   | Meaning: A null input pointer was found.  
  Action: The request is rejected. Pass a valid pointer to the API and try this request again. |
| 0FFFFFFF HWIUSS_RC_UNEXPECTED_ERROR    | Meaning: An unexpected error has occurred.  
  Action: The request is rejected. Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center. |

**Example**

In the C code example, the caller issues a call to register to be notified when the command response events and status change events occur.
HWIManageEvents

HWI_DIAGAREA_TYPE DiagArea;
HWI_DELIVERYTOKEN_TYPE *DeliveryToken;
HWI_CONNTOKEN_TYPE ConnectToken;
HWI_EVENTIDS_TYPE EventIDs;
int localRC;

memset ((void*)&eventIDs, 0x00, sizeof (eventIDs));
memcpy (eventIDs.Hwi_EventID_EyeCatcher,
    HWI_EVENTID_TEXT,
    sizeof (eventIDs.Hwi_EventID_EyeCatcher));
EventIDs.Hwi_Event_CmdResp = 1;
EventIDs.Hwi_Event_StatusChg = 1;
localRC = HWIManageEvents(&DiagArea, DeliveryToken, ConnectToken,
    HWI_EVENT_ADD, EventIDs)

HWIGetEvent — Retrieve outstanding BCPii event notifications

Call the HWIGetEvent service to allow a C application running in the z/OS UNIX System Services environment to retrieve outstanding BCPii event notifications.

Description

Environment
The requirements for the callers are:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum authorization:</td>
<td>None</td>
</tr>
<tr>
<td>Dispatchable unit mode:</td>
<td>Task</td>
</tr>
<tr>
<td>Cross memory mode:</td>
<td>PASN=HASN=SASN</td>
</tr>
<tr>
<td>AMODE:</td>
<td>31-bit</td>
</tr>
<tr>
<td>ASC mode:</td>
<td>Primary</td>
</tr>
<tr>
<td>Interrupt status:</td>
<td>Enabled for I/O and external interrupts</td>
</tr>
<tr>
<td>Locks:</td>
<td>No locks held</td>
</tr>
<tr>
<td>Control parameters:</td>
<td>Control parameters must be in the primary address space and addressable by the caller</td>
</tr>
<tr>
<td>Linkage:</td>
<td>Standard C linkage conventions are used</td>
</tr>
</tbody>
</table>

Programming requirements
The file hwicmuss.x contains the sidedeck needed to link the program to the DLL.

z/OS UNIX C language callers must include the header file HWICIC.

Restrictions
None.

Authorization
None.

Syntax
Write the call as shown on the syntax diagram. You must code all parameters in the order shown.
HWIGetEvent

CALL statement

int HWIGetEvent

Parameters

<table>
<thead>
<tr>
<th>DiagArea</th>
<th>Returned parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: character string</td>
<td></td>
</tr>
<tr>
<td>Length: 32 bytes</td>
<td></td>
</tr>
</tbody>
</table>

*DiagArea contains diagnostic data to help determine the cause of a failure from the service. For many return codes, the *DiagArea can contain further information to help determine the cause of the failure. See the descriptions of different return codes for a partial list of data returned in this area.

Note: For all environmental errors (with return code X’F00’ and higher), the *DiagArea might not be filled in, and the data returned in the area should be ignored.

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Field Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diag_Index</td>
<td>32-bit integer</td>
<td>The array index to the parameter field that causes the error.</td>
</tr>
<tr>
<td>Diag_Key</td>
<td>32-bit integer</td>
<td>The constant value represents the field that causes the error.</td>
</tr>
<tr>
<td>Diag_Actual</td>
<td>32-bit integer</td>
<td>The incorrect actual value specified.</td>
</tr>
<tr>
<td>Diag_Expected</td>
<td>32-bit integer</td>
<td>The expected value to be used.</td>
</tr>
<tr>
<td>Diag_CommErr</td>
<td>32-bit integer</td>
<td>The returned code from the failing operation.</td>
</tr>
<tr>
<td>Diag_Text</td>
<td>Character (12)</td>
<td>Additional diagnostic information in text format.</td>
</tr>
</tbody>
</table>

See Appendix A, “BCPii communication error reason codes,” on page 415 for a partial list of the descriptive communication transport error return codes and suggested actions.

*DeliveryToken

Supplied parameter

Type: character string

Length: 8 bytes

*DeliveryToken specifies the event notification connection, as returned by a previous HWIBeginEventDelivery call.

*Buffer

Supplied parameter
HWIGetEvent

- Type: character string
- Length: up to 4096 bytes

*Buffer specifies the address of the storage where the ENF68 event data is to be returned. This data is mapped by the HWIENF68 structure in the HWICIC header file.

BufferSize
Supplied parameter
- Type: integer
- Length: 4 bytes

BufferSize specifies the size of the *Buffer storage area.

Constant HWIUSS_MAX_GETBUFFER_SIZE can be used to allocate a buffer large enough to hold the maximum size of ENF68 data returned.

Timeout
Supplied parameter
- Type: integer
- Length: 4 bytes

Timeout specifies the amount of time, in seconds, for which the service should wait for an event to occur.

<table>
<thead>
<tr>
<th>Constant in Hexadecimal</th>
<th>Equate Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 HWIUSS_TIMEOUT_NOWAIT</td>
<td></td>
<td>Do not wait for an event to occur if one is not ready for delivery.</td>
</tr>
<tr>
<td>FFFFFFFFF</td>
<td>HWIUSS_TIMEOUT_INFINITE</td>
<td>Do not return until an event has occurred.</td>
</tr>
<tr>
<td>Any other non-negative number</td>
<td></td>
<td>Wait for the specified number of seconds.</td>
</tr>
</tbody>
</table>

Note: If the Hwi_Event_BCPIStatus event is not registered by the application and the BCPii address space goes down, this service will not be completed if HWIUSS_TIMEOUT_INFINITE was specified. If a numeric value was specified, the service will wake up but neither event data nor indicator that BCPii is not available will be returned. IBM recommends that an application specifies the Hwi_Event_BCPIStatus event on the HwiManageEvents service call if the HwiGetEvent service is used. When the HwiGetEvent service returns control to the application, an inspection of which event was received will allow the application to react appropriately when BCPii stops.

*BytesNeeded
Returned parameter
- Type: integer
- Length: 4 bytes

*BytesNeeded specifies the variable to contain the number of bytes used in the output buffer to contain the returned event data. If the buffer is not large enough to contain all the event data, this variable contains the amount of storage required to receive all the event data.

ABEND codes
None.
**Return codes**

When the service completes, one of the following values is returned to the caller:

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal Equate Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
</table>
| 00000000 HWIUS SS_RC_OK                | **Meaning:** Successful completion.  
**Action:** None. |
| 00000001 HWIUS SS_RC_PARTIAL_DATA      | **Meaning:** The provided buffer was not large enough to contain all the event data.  
**Action:** The request is successful. To receive all the event data, buffer the size of which is at least BytesNeeded must be provided. |
| 00000002 HWIUS SS_RC_EVENTS_LOST       | **Meaning:** At least one event was not returned because the program has not been retrieving events timely.  
**Action:** The request is successful. To receive all events, the program must make this service call more often or reduce the number of events requested. |
| 00000003 HWIUS SS_RC_TIMEOUT           | **Meaning:** No events have occurred in the requested time interval.  
**Action:** The request is successful. |
| 00000100 HWIUS SS_RC_UNAVAILABLE       | **Meaning:** This error is returned for one of the following reasons, which is written to the diag_commerr field of the DiagArea:  
- CEA (Common Event Adapter) communication is unavailable. (reason x’100’)  
- Write access to a socket is denied. (reason x’103’)  
- Services are failing in the CEA Server. (reason x’111’)  
**Action:** The request is rejected. Confirm that the CEA address space has been started and try the request again. |
| 00001004 HWIUS SS_RC_BAD_DELIVERYTOKEN | **Meaning:** The provided delivery token is not valid.  
**Action:** The request is rejected. This is a probable coding error. |
| 00001005 HWIUS SS_RC_SMALL_BUFFER      | **Meaning:** The provided buffer is not large enough to contain the event data.  
**Action:** The request is rejected. This is a probable coding error. Provide a larger buffer and try the request again. |
## Return Code in Hexadecimal Equate

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning and Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00001008 HWIUSS_RC_COMM_FAILURE</td>
<td><strong>Meaning</strong>: An error occurred in z/OS UNIX socket processing.&lt;br&gt;<strong>Action</strong>: The request is rejected. Verify that the file system is properly configured for z/OS UNIX sockets and try this request again.</td>
</tr>
<tr>
<td>00001009 HWIUSS_RC_CEA_INTERNAL_ERROR</td>
<td><strong>Meaning</strong>: An internal CEA processing error has occurred.&lt;br&gt;<strong>Action</strong>: The request is rejected. Consult the DiagArea for the details about this error. If the error persists, contact the IBM Support Center.</td>
</tr>
<tr>
<td>0000100A HWIUSS_RC_INPUT_PTR_IS_NULL</td>
<td><strong>Meaning</strong>: A null input pointer was found.&lt;br&gt;<strong>Action</strong>: The request is rejected. Pass a valid pointer to the API and try this request again.</td>
</tr>
<tr>
<td>FFFFFFFF HWIUSS_RC_UNEXPECTED_ERROR</td>
<td><strong>Meaning</strong>: An unexpected error has occurred.&lt;br&gt;<strong>Action</strong>: The request is rejected. Search problem reporting data bases for a fix for the problem. If no fix exists, contact the IBM Support Center.</td>
</tr>
</tbody>
</table>

### Example

In the C code example, the caller issues a call to retrieve any outstanding event data, waiting forever until an event occurs.

```c
HWI_DIAGAREA_TYPE DiagArea;
HWI_DELIVERYTOKEN_TYPE DeliveryToken;
char *Buffer[HWIUSS_MAX_GETBUFFER_SIZE];
int BufSize = HWIUSS_MAX_GETBUFFER_SIZE;
int Timeout = HWIUSS_TIMEOUT_INFINITE;
int BytesReturned;
int localRC;

localRC = HWIGetEvent(&DiagArea, DeliveryToken, &Buffer, BufSize,
Timout, &BytesReturned)
```
HWIGetEvent
Part 9. Appendixes
Appendix A. BCPii communication error reason codes

All BCPii API invocations can experience a communication failure when communicating between the BCPii address space and the support element of the targeted Central Processor Complex (CPC). The calling program receives the HWI_COMMUNICATION_ERROR (101 hexadecimal, 257 decimal) return code when this occurs. One of the output parameters from each service is a Diagnostic Area (referred to as the DiagArea). For the HWI_COMMUNICATION_ERROR return code, a field in this DiagArea that is called Diag_Commerr contains a more descriptive return code from the BCPii communications transport to help pinpoint the cause of the failure.

Below is a partial list of the descriptive communication transport error return codes, along with a suggested action to take.

<table>
<thead>
<tr>
<th>Return Code in Hexadecimal (in decimal)</th>
<th>Description / Suggested Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-63 (0-99)</td>
<td>These return codes are documented in Appendix C (API Return Codes) in the System z Application Programming Interfaces publication (SB10-7030).</td>
</tr>
<tr>
<td>64-76 (100-118)</td>
<td>An internal error has likely occurred inside the BCPii transport code. Contact the IBM Support Center.</td>
</tr>
<tr>
<td>77 (119)</td>
<td>The BCPii transport rejected the particular request. Activate CTRACE with CTRACE option “ALL” and reissue the request. If the request failed again, turn off CTRACE, collect the SVCDUMP, and contact the IBM Support Center.</td>
</tr>
<tr>
<td>78-CF (120-207)</td>
<td>An internal error has likely occurred inside the BCPii transport code. Contact the IBM Support Center.</td>
</tr>
<tr>
<td>D0 (208)</td>
<td>The support element rejected the particular request. Activate CTRACE with CTRACE option “ALL” and reissue the request. If the request failed again, turn off CTRACE, collect the SVCDUMP, and contact the IBM Support Center.</td>
</tr>
<tr>
<td>D1-D3 (209-211)</td>
<td>An internal error has likely occurred inside the BCPii transport code. Contact the IBM Support Center.</td>
</tr>
<tr>
<td>D4 (212)</td>
<td>The support element rejected communication from BCPii, likely because the Cross partition authority was not granted on this support element.</td>
</tr>
<tr>
<td>E0 (224)</td>
<td>No response was received from the support element, after waiting for a considerable amount of time. BCPii times out the request. Check if connectivity to the support element is still there.</td>
</tr>
<tr>
<td>Greater than E0 (&gt;224)</td>
<td>An internal error has likely occurred inside the BCPii transport code. Contact the IBM Support Center.</td>
</tr>
</tbody>
</table>
BCPii Communication Error Reason Codes
Appendix B. BCPii summary tables

The following summary tables show the objects that can be targeted for the BCPii functions:

- “HWIQUERY and HWISET”
- “HWICMD” on page 428
- “HWIEVENT” on page 430

For complete details of the BCPii APIs, see Chapter 19, “Base Control Program internal interface (BCPii),” on page 257.

HWIQUERY and HWISET

This table shows the BCPii HWIQUERY and HWISET attributes and the objects that can be targeted for each function. Note: The HWMCA attribute suffix refers to the ‘HWMCA Object Attribute ID suffix’ documented in System z Application Programming Interfaces (SB10-7030-13).

Table 69. HWIQUERY and HWISET attributes

<table>
<thead>
<tr>
<th>Attribute constant</th>
<th>Description</th>
<th>Starting z/OS release</th>
<th>Settable using HWISET</th>
<th>CPC</th>
<th>Image</th>
<th>CapRec</th>
<th>Reset AProf</th>
<th>Image AProf</th>
<th>Load AProf</th>
<th>User-defined Image Group</th>
<th>HWMCA attribute suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_NAME</td>
<td>Name</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>HWI_ERRSTAT</td>
<td>Status error (Y/N)</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<td>X</td>
<td>7.0</td>
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<tr>
<td>HWI_BUSYSTAT</td>
<td>Busy status (Y/N)</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
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<td></td>
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<tr>
<td>HWI_MSGSTAT</td>
<td>Messages present (Y/N)</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
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<td>9.0</td>
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<tr>
<td>HWI_OPERSTAT</td>
<td>Current status</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
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<td></td>
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<td>10.0</td>
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<tr>
<td>HWI_ACCSTAT</td>
<td>Acceptable status values</td>
<td>V1R10</td>
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<td></td>
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<td></td>
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<td>11.0</td>
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<tr>
<td>HWI_APROF</td>
<td>Next reset activation profile name</td>
<td>V1R10</td>
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<td>X</td>
<td>X</td>
<td></td>
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<td></td>
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<td>13.0</td>
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<tr>
<td>HWI_LUAPROF</td>
<td>Last used activation profile name</td>
<td>V1R10</td>
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<tr>
<td>HWI_OBJTYPE</td>
<td>Object type</td>
<td>V1R10</td>
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<td>X</td>
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<td>HWI_IMLMODE</td>
<td>IML mode</td>
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<tr>
<td>HWI_IPADDR</td>
<td>Internet address (IPv4 format)</td>
<td>V1R10</td>
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<td>15.0</td>
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<tr>
<td>Attribute constant equate symbol with hexadecimal and (decimal) values</td>
<td>Description</td>
<td>Starting z/OS release</td>
<td>Settable using HWISET</td>
<td>CPC</td>
<td>Image</td>
<td>CapRec</td>
<td>Reset AProf</td>
<td>Image AProf</td>
<td>Load AProf</td>
<td>User-defined Image Group</td>
<td>HWMCA attribute suffix</td>
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<td>HWL_SNAADDR 18 (24)</td>
<td>SNA address (netid.nau)</td>
<td>V1R10</td>
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<td>HWL_MMODEL 19 (25)</td>
<td>Machine model</td>
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<td>HWL_MTYPE 1A (26)</td>
<td>Machine type</td>
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<td>HWL_MSERIAL 1B (27)</td>
<td>Machine serial</td>
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<td>HWL_CPCSERIAL 1C (28)</td>
<td>CPC serial number</td>
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<td>HWL_CPCID 1D (29)</td>
<td>CPC identifier</td>
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<td>HWL_reserveID 1E (30)</td>
<td>Name of application holding reserve</td>
<td>V1R10</td>
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<td>HWL_SVCEREQD 1F (31)</td>
<td>Service required (Y/N)</td>
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<td>HWL_CBUNSTD 20 (32)</td>
<td>CBU installed (Y/N)</td>
<td>V1R10</td>
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<td>HWL_CBUENABLD 21 (33)</td>
<td>CBU enabled (Y/N)</td>
<td>V1R10</td>
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<tr>
<td>HWL_CBUACTIVE 22 (34)</td>
<td>CBU activated (Y/N)</td>
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<tr>
<td>HWL_CBUACTDT 23 (35)</td>
<td>CBU activation date</td>
<td>V1R10</td>
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<tr>
<td>HWL_CBUEXPDT 24 (36)</td>
<td>CBU expiration date</td>
<td>V1R10</td>
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</tr>
<tr>
<td>HWL_CBUTESTAR 25 (37)</td>
<td>CBU test activations remaining</td>
<td>V1R10</td>
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</tr>
<tr>
<td>HWL_CBUREALAV 26 (38)</td>
<td>Real CBU activation available (Y/N)</td>
<td>V1R10</td>
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</tr>
<tr>
<td>HWL_PRUNTYPE 27 (39)</td>
<td>Processor running time type</td>
<td>V1R10</td>
<td>X</td>
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<td></td>
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</tr>
<tr>
<td>HWL_PRUNTIME 28 (40)</td>
<td>Processor running time</td>
<td>V1R10</td>
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<td>X</td>
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</tr>
<tr>
<td>HWL_PRUNTSEW 29 (41)</td>
<td>Processor loses its running time slice when in wait state (Y/N)</td>
<td>V1R10</td>
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<td>X</td>
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</tr>
<tr>
<td>HWL_OOCINST 2A (42)</td>
<td>On/Off on Demand installed (Y/N)</td>
<td>V1R10</td>
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</tr>
<tr>
<td>HWL_OOCACT 2B (43)</td>
<td>On/Off on Demand activated (Y/N)</td>
<td>V1R10</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
## HWIQUERY and HWISET attributes

Table 69. HWIQUERY and HWISET attributes (continued)

<table>
<thead>
<tr>
<th>Attribute constant</th>
<th>Description</th>
<th>Starting z/OS release</th>
<th>Settable using HWISET</th>
<th>CPC</th>
<th>Image</th>
<th>CapRec</th>
<th>Reset AProf</th>
<th>Image AProf</th>
<th>Load AProf</th>
<th>User-defined Image Group</th>
<th>HWMCA attribute suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_OOCENAB</td>
<td>On/Off on Demand enabled (Y/N)</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>HWI_OOCADT</td>
<td>On/Off on Demand activation date</td>
<td>V1R10</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>HWI_PCPCSWM</td>
<td>Permanent CPC software model</td>
<td>V1R10</td>
<td>X</td>
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<tr>
<td>HWI_PBPSPSWM</td>
<td>Permanent plus billable processor software model</td>
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<tr>
<td>HWI_PPTPSWM</td>
<td>Permanent plus (all) temporary processor software model</td>
<td>V1R10</td>
<td>X</td>
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<tr>
<td>HWI_PCTCMSU</td>
<td>CPC millions of service units (MSU) value</td>
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<tr>
<td>HWI_PBPMSU</td>
<td>Permanent plus billable processor MSU value</td>
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<tr>
<td>HWI_PPTPMSU</td>
<td>Permanent plus (all) temporary processor MSU value</td>
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<td>HWI_NUMGPP</td>
<td>Number of general purpose processors</td>
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</tr>
<tr>
<td>HWI_NUMSAP</td>
<td>Number of service assist processors</td>
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## HWIQUERY and HWISET attributes

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<th>CapRec</th>
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<th>Image AProf</th>
<th>Load AProf</th>
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### HWIQUERY and HWISET attributes (continued)

| Attribute constant equate symbol with hexadecimal and (decimal) values | Description | Starting z/OS release | Settable using HWISET | CPC | Image | CapRec | Reset | APProf | Image | APProf | Load | APProf | User-defined Image Group | HWMCA attribute suffix |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HWI_CPCNAME 69 (105) | Parent (CPC) name | V1R10 | X | | | | | | | | | | | 2.0 |
| HWI_OSNAME 6A (106) | Operating system name | V1R10 | X | | | | | | | | | | | 3.0 |
| HWI_OSTYPE 6B (107) | SW operating system type (MVS, VM, LINUX, VSE, Z/TPF EE) | V1R10 | X | | | | | | | | | | | 4.0 |
| HWI_OSLEVEL 6C (108) | SW operating system level | V1R10 | X | | | | | | | | | | | 5.0 |
| HWI_SYSPLEX 6D (109) | SW sysplex name | V1R10 | X | | | | | | | | | | | 6.0 |
| HWI_CLUSTER 6E (110) | LPAR cluster name | V1R10 | X | | | | | | | | | | | 49.0 |
| HWI_PARTITIONID 6F (111) | Partition ID | V1R10 | X | X | | | | | | | | | | 51.0 |
| HWI_DEF_CAP 70 (112) | Current defined | V1R10 | X | X | X | | | | | | | | | | 43.0 |
| HWI_SGPIP_PW 71 (113) | Shared general processor initial processing weight | V1R10 | X | X | X | | | | | | | | | | 30.0 |
| HWI_SGPIP_PW_CAP 72 (114) | SGPIP PW capped (Y/N) | V1R10 | X | X | X | | | | | | | | | | 31.0 |
| HWI_SGPP_PW_MIN 73 (115) | Minimum SGPPW value | V1R10 | X | X | X | | | | | | | | | | 38.0 |
| HWI_SGPP_PW_MAX 74 (116) | Maximum SGPPW value | V1R10 | X | X | X | | | | | | | | | | 39.0 |
| HWI_SGPP_PW 75 (117) | Current SGPPW value | V1R10 | X | | | | | | | | | | | 41.0 |
| HWI_SGPP_PW_CAP 76 (118) | SGPPW capped (Y/N) | V1R10 | X | | | | | | | | | | | 42.0 |
| HWI_WLM 77 (119) | WLM allowed to change processing weight related attributes (Y/N) | V1R10 | X | X | X | | | | | | | | | | 40.0 |
| HWI_IFAIP_PW 78 (120) | Integrated facility for applications initial processing weight | V1R10 | X | X | X | | | | | | | | | | 60.0 |
| HWI_IFAIP_PW_CAP 79 (121) | IFAIPW capped (Y/N) | V1R10 | X | X | X | | | | | | | | | | 61.0 |
| HWI_IFAIP_PW_MIN 7A (122) | Minimum IFAIPW value | V1R10 | X | X | X | | | | | | | | | | 62.0 |
### HWIQUERY and HWISET attributes

**Table 69. HWIQUERY and HWISET attributes  (continued)**

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<th>Image</th>
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## HWIQUERY and HWISET attributes

Table 69. HWIQUERY and HWISET attributes (continued)

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**HWIQUERY and HWISET attributes**

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<th>Image</th>
<th>CapRec</th>
<th>Reset AProf</th>
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## HWIQUERY and HWISET attributes

**Table 69. HWIQUERY and HWISET attributes (continued)**

<p>| Attribute constant equate symbol with hexadecimal and (decimal) values | Description | Starting z/OS release | Settable using HWISET | CPC | Image | CapRec | Reset AProf | Image AProf | Load AProf | User-defined Image Group | HWMCA attribute suffix |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HWI_NUM_SHARED_IFA E4 (228) | Number of shared integrated facility for applications (IFA) processors for image | V1R11 | X | | | | X | | | | 111.0 |
| HWI_NUM_RES_SHARED_IFA E5 (229) | Number of reserved shared integrated facility for applications (IFA) processors for image | V1R11 | X | | | | X | | | | 112.0 |
| HWI_NUM.Shared_IFL E6 (230) | Number of shared integrated facility for Linux (IFL) processors for image | V1R11 | X | | | | X | | | | 113.0 |
| HWI_NUM_RES.Shared_IFL E7 (231) | Number of reserved shared integrated facility for Linux (IFL) processors for image | V1R11 | X | | | | X | | | | 114.0 |
| HWI_NUM.Shared_JCF E8 (232) | Number of shared internal coupling facility (ICF) processors for image | V1R11 | X | | | | X | | | | 115.0 |
| HWI_NUM_RES.Shared_JCF E9 (233) | Number of reserved shared internal coupling facility (ICF) processors for image | V1R11 | X | | | | X | | | | 116.0 |
| HWI.Num_SHARED_ZHPI EA (234) | Number of shared System z integrated information processors (zIIPs) for image | V1R11 | X | | | | X | | | | 117.0 |
| HWI_NUM_RES.Shared_ZHPI EB (235) | Number of reserved shared System z integrated information processors (zIIPs) for image | V1R11 | X | | | | X | | | | 118.0 |
| HWI_BASIC_CPU_AUTH_COUNT_CNTL EC (236) | Basic CPU counter facility for the image enabled (Y/N) | V1R12 | X | | | | | | | | 168.0 |
| HWI_PROBSTATE_CPU_AUTH_COUNT_CNTL ED (237) | Problem state CPU counter facility for the image enabled (Y/N) | V1R12 | X | | | | | | | | 169.0 |
| HWI_CRYPTOACTIVITY_CPU_AUTH_COUNT_CNTL EE (238) | Crypto activity CPU counter facility for the image enabled (Y/N) | V1R12 | X | | | | | | | | 170.0 |</p>
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<th>CapRec</th>
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<th>Image AProf</th>
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<td>204.0</td>
</tr>
<tr>
<td>HWI_CLOCK_TYPE</td>
<td>Clock type assignment (time source setting)</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>205.0</td>
</tr>
<tr>
<td>HWI_TIME_OFFSET_DAYS</td>
<td>Number of days currently set as offset from external time source’s TOD</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>206.0</td>
</tr>
<tr>
<td>HWI_TIME_OFFSET_HOURS</td>
<td>Number of hours currently set as offset from external time source’s TOD</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>207.0</td>
</tr>
<tr>
<td>HWI_TIME_OFFSET_MINUTES</td>
<td>Number of minutes currently set as offset from external time source’s TOD</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>208.0</td>
</tr>
<tr>
<td>HWI_TIME_OFFSET_INCREASE</td>
<td>Local time zone: TRUE means east of GMT; FALSE means west of GMT</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>209.0</td>
</tr>
<tr>
<td>HWI_LICCC_VALIDATION_ENABLED</td>
<td>Activation profile must conform to the current LICCC configuration (Y/N)</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>210.0</td>
</tr>
</tbody>
</table>
Table 69. HWIQUERY and HWISET attributes (continued)

<table>
<thead>
<tr>
<th>Attribute constant equate symbol with hexadecimal and (decimal) values</th>
<th>Description</th>
<th>Starting z/OS release</th>
<th>Settable using HWISET</th>
<th>CPC</th>
<th>Image</th>
<th>CapRec</th>
<th>Reset APProf</th>
<th>Image APProf</th>
<th>Load APProf</th>
<th>User-defined Image Group</th>
<th>HWMCA attribute suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_GLOBAL__PERFORMANCE__DATA_CONTROL FD (253)</td>
<td>LPAR can be used to view processing unit activity data for all other LPARs on the same CPC (Y/N)</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>211.0</td>
</tr>
<tr>
<td>HWI_IO__CONFIGURATION__CONTROL FE (254)</td>
<td>LPAR can be used to read and write any IOCDS (Y/N)</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>212.0</td>
</tr>
<tr>
<td>HWI_CROSS__PARTITION__AUTHORITY FF (255)</td>
<td>LPAR can be used to issue instructions that reset or deactivate other LPARs (Y/N)</td>
<td>V1R13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>213.0</td>
</tr>
<tr>
<td>HWI_LOGICAL__PARTITION__ISOLATION 100 (256)</td>
<td>Re-configurable channel paths assigned to LPAR are reserved for its exclusive use (Y/N)</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>214.0</td>
</tr>
</tbody>
</table>

HWICMD

This table shows the BCPii HWICMD types and the objects that can be targeted for each command.

Table 70. HWICMD types

<table>
<thead>
<tr>
<th>Command type / Constant with hexadecimal and (decimal) values</th>
<th>Description</th>
<th>Starting z/OS release</th>
<th>CPC</th>
<th>Image</th>
<th>User-defined Image Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_CMD_ACTIVATE 1 (1)</td>
<td>Activate target object</td>
<td>• CPC and image: V1R10 • User-defined image group: V1R13</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_DEACTIVATE 2 (2)</td>
<td>Deactivate target object</td>
<td>• CPC and image: V1R10 • User-defined image group: V1R13</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_HWS MG 3 (3)</td>
<td>Resend all hardware messages or delete one hardware message</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_CBU 4 (4)</td>
<td>Activate or deactivate capacity backup</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_OOCOD 5 (5)</td>
<td>Activate or deactivate On/Off Capacity on Demand</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_PROFILE 6 (6)</td>
<td>Import or export activation profiles</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_RESERVE 7 (7)</td>
<td>Add or delete a reserve for an application</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 70. HWICMD types (continued)

<table>
<thead>
<tr>
<th>Command type / Constant with hexadecimal and (decimal) values</th>
<th>Description</th>
<th>Starting z/OS release</th>
<th>CPC</th>
<th>Image</th>
<th>User-defined Image Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_CMD_SYSRESET 8 (8)</td>
<td>Reset target object</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_START 9 (9)</td>
<td>Start all CPs on target object</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_STOP A (10)</td>
<td>Stop all CPs on target object</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_PSWRESTART B (11)</td>
<td>Restart one CP</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_OSCMD C (12)</td>
<td>Issue an operating system command</td>
<td>V1R10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_LOAD D (13)</td>
<td>IPL operating system or systems</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_TEMPCAP E (14)</td>
<td>Add or remove temporary capacity</td>
<td>V1R10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_SYSRESET_IPLT F (15)</td>
<td>Reset an image if the IPL token matches the specified IPLT</td>
<td>V1R11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_ACTIVATE_WITH_ACTPROF 10 (16)</td>
<td>Activate using the specified activation profile</td>
<td>V1R11</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_POWER_CONTROL 11 (17)</td>
<td>Specify power control characteristics</td>
<td>V1R10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_SCSI_LOAD 12 (18)</td>
<td>IPL Linux operating system or systems</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>HWI_CMD_SCSI_DUMP 13 (19)</td>
<td>Dump a Linux operating system</td>
<td>V1R12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_SYSPLEX_TIME_SWAP_CTS 14 (20)</td>
<td>Swap the role of current time server (CTS) in a configured STP-only coordinated timing network (CTN) from preferred time server to backup time server or vice versa</td>
<td>V1R13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_SYSPLEX_TIME_SET_STP_CONFIG 15 (21)</td>
<td>Set the configuration for an STP-only coordinated timing network (CTN)</td>
<td>V1R13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_SYSPLEX_TIME_CHANGE_STP_ONLY_CTN 16 (22)</td>
<td>Change the STP_ID portion of the CTN ID for an entire STP-only coordinated timing network (CTN)</td>
<td>V1R13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### HWICMD attributes

Table 70. HWICMD types (continued)

<table>
<thead>
<tr>
<th>Command type / Constant with hexadecimal and (decimal) values</th>
<th>Description</th>
<th>Starting z/OS release</th>
<th>CPC</th>
<th>Image</th>
<th>User-defined Image Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>HWI_CMD_SYSPLEX_TIME_JOIN_STP_ONLY_CTN 17 (23)</td>
<td>Allow a CPC to join an STP-only coordinated timing network (CTN)</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HWI_CMD_SYSPLEX_TIME_LEAVE_STP_ONLY_CTN 18 (24)</td>
<td>Remove a CPC from an STP-only coordinated timing network (CTN)</td>
<td>V1R13</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### HWIEVENT

This table shows the BCPii HWIEVENT types and the objects that can be registered or unregistered for each event.

Table 71. HWIEVENT types

<table>
<thead>
<tr>
<th>Event ID / Bit position in structure specified (non-REXX)</th>
<th>Description</th>
<th>Starting z/OS release</th>
<th>CPC</th>
<th>Image</th>
<th>User-defined Image Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hwi_Event_CmdResp 97</td>
<td>Notice of command completion from the SE</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_StatusChg 98</td>
<td>Object status change</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_NameChg 99</td>
<td>Object name change</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_ActProfChg 100</td>
<td>Object has changed associated activation profile</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_ObjCreate 101</td>
<td>New object has been defined</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_ObjDestroy 102</td>
<td>Object has been undefined</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_ObjException 103</td>
<td>Object has entered into or out of an exception state</td>
<td>V1R10</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_ApplStarted 104</td>
<td>Console application has started</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_ApplEnded 105</td>
<td>Console application is ending</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_HwMsg 106</td>
<td>Hardware message associated has been issued</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_HwMsgDel 107</td>
<td>Hardware message has been deleted</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_SecurityEvent 108</td>
<td>Security event has been logged</td>
<td>V1R10</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### HWIEVENT attributes

<table>
<thead>
<tr>
<th>Event ID / Bit position in structure specified (non-REXX)</th>
<th>Description</th>
<th>Starting z/OS release</th>
<th>CPC</th>
<th>Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hwi_Event_CapacityChg 109</td>
<td>Processing capacity has changed in some manner</td>
<td>V1R10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_CapacityRecord 110</td>
<td>A change has occurred to a temporary capacity record</td>
<td>V1R10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_OpSysMsg 111</td>
<td>Operating system message has been issued</td>
<td>V1R10</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Hwi_Event_HwCommError 112</td>
<td>Hardware communication error received</td>
<td>V1R10</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hwi_Event_BCPiiStatus 113</td>
<td>BCPii address space has stopped or started</td>
<td>V1R10</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Hwi_Event.DisabledWait 114</td>
<td>An image has entered a disabled wait state</td>
<td>V1R10</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Hwi_Event_PowerChange 115</td>
<td>Power characteristic or characteristics have changed</td>
<td>V1R10</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
HWIEVENT attributes
Appendix C. General use C/C++ header files

Programming interface information

C/C++ header files are shipped in z/OS V1R4 SYS1.SAMPLIB. These header files are analogous to traditional z/OS MVS mapping macros and are provided for general use. The following table lists the members and describes the interface. Descriptions of the data areas referenced can be found in z/OS MVS Data Areas in the z/OS Internet library (http://www.ibm.com/systems/z/os/zos/bkserv/).

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLSCADPL</td>
<td>Describes same data areas as assembler macro BLSABDPL. Depends on BLSCDESC.</td>
</tr>
<tr>
<td>BLSCADSY</td>
<td>Describes same data areas as assembler macro BLSADSY.</td>
</tr>
<tr>
<td>BLSCCBSP</td>
<td>Describes same data areas as assembler macro BLSACBSP. Depends on BLSCDESC.</td>
</tr>
<tr>
<td>BLSCDESC</td>
<td>Describes same data areas as assembler macros BLSRDATC, BLSRDATS, BLSRDATT,</td>
</tr>
<tr>
<td></td>
<td>BLSRESSY, and BLSRSASY. Many of the other members require that this header</td>
</tr>
<tr>
<td></td>
<td>file be included before they are included.</td>
</tr>
<tr>
<td>BLSCDRPX</td>
<td>Describes same data areas as assembler macro BLSRDPRX. Depends on BLSCDESC.</td>
</tr>
<tr>
<td>BLSCNAMP</td>
<td>Describes same data areas as assembler macro BLSRNAMP. Depends on BLSCDESC.</td>
</tr>
<tr>
<td>BLSCPCQE</td>
<td>Describes same data areas as assembler macro BLSRPCQE. Depends on BLSCDESC.</td>
</tr>
<tr>
<td>BLSCPPR2</td>
<td>Describes same data areas as assembler macro BLSUPPR2.</td>
</tr>
<tr>
<td>BLSCPWHS</td>
<td>Describes same data areas as assembler macro BLSRPWHS. Depends on BLSCDESC.</td>
</tr>
<tr>
<td>BLSCXMSP</td>
<td>Describes same data areas as assembler macro BLSRXMSP. Depends on BLSCDESC.</td>
</tr>
<tr>
<td>BLSCXSSP</td>
<td>Describes same data areas as assembler macro BLSRXSSP. Depends on BLSCDESC.</td>
</tr>
</tbody>
</table>

End of programming interface information
C/C++ header files
Appendix D. Accessibility

Accessible publications for this product are offered through the z/OS Information Center.

If you experience difficulty with the accessibility of any z/OS information, please send a detailed message to mhvrcfs@us.ibm.com or to the following mailing address:

IBM Corporation
Attention: MHVRCFS Reader Comments
Department H6MA, Building 707
2455 South Road
Poughkeepsie, NY 12601-5400
USA

Accessibility features

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.

Dotted decimal syntax diagrams

Syntax diagrams are provided in dotted decimal format for users accessing the z/OS Information Center using a screen reader. In dotted decimal format, each syntax element is written on a separate line. If two or more syntax elements are always present together (or always absent together), they can appear on the same line, because they can be considered as a single compound syntax element.

Each line starts with a dotted decimal number; for example, 3 or 3.1 or 3.1.1. To hear these numbers correctly, make sure that your screen reader is set to read out punctuation. All the syntax elements that have the same dotted decimal number (for example, all the syntax elements that have the number 3.1) are mutually
exclusive alternatives. If you hear the lines 3.1 USERID and 3.1 SYSTEMID, you
know that your syntax can include either USERID or SYSTEMID, but not both.

The dotted decimal numbering level denotes the level of nesting. For example, if a
syntax element with dotted decimal number 3 is followed by a series of syntax
elements with dotted decimal number 3.1, all the syntax elements numbered 3.1
are subordinate to the syntax element numbered 3.

Certain words and symbols are used next to the dotted decimal numbers to add
information about the syntax elements. Occasionally, these words and symbols
might occur at the beginning of the element itself. For ease of identification, if the
word or symbol is a part of the syntax element, it is preceded by the backslash (\)
character. The * symbol can be used next to a dotted decimal number to indicate
that the syntax element repeats. For example, syntax element *FILE with dotted
decimal number 3 is given the format 3 * FILE. Format 3 * FILE indicates that
syntax element FILE repeats. Format 3 * * FILE indicates that syntax element *
FILE repeats.

Characters such as commas, which are used to separate a string of syntax
elements, are shown in the syntax just before the items they separate. These
characters can appear on the same line as each item, or on a separate line with the
same dotted decimal number as the relevant items. The line can also show another
symbol giving information about the syntax elements. For example, the lines 5.1*,
5.1 LASTRUN, and 5.1 DELETE mean that if you use more than one of the
LASTRUN and DELETE syntax elements, the elements must be separated by a
comma. If no separator is given, assume that you use a blank to separate each
syntax element.

If a syntax element is preceded by the % symbol, this indicates a reference that is
defined elsewhere. The string following the % symbol is the name of a syntax
fragment rather than a literal. For example, the line 2.1 %OP1 means that you
should refer to separate syntax fragment OP1.

The following words and symbols are used next to the dotted decimal numbers:
• ? means an optional syntax element. A dotted decimal number followed by the ?
symbol indicates that all the syntax elements with a corresponding dotted
decimal number, and any subordinate syntax elements, are optional. If there is
only one syntax element with a dotted decimal number, the ? symbol is
displayed on the same line as the syntax element, (for example 5? NOTIFY). If
there is more than one syntax element with a dotted decimal number, the ?
symbol is displayed on a line by itself, followed by the syntax elements that are
optional. For example, if you hear the lines 5 ?, 5 NOTIFY, and 5 UPDATE, you
know that syntax elements NOTIFY and UPDATE are optional; that is, you can
choose one or none of them. The ? symbol is equivalent to a bypass line in a
railroad diagram.
• ! means a default syntax element. A dotted decimal number followed by the !
symbol and a syntax element indicates that the syntax element is the default
option for all syntax elements that share the same dotted decimal number. Only
one of the syntax elements that share the same dotted decimal number can
specify a ! symbol. For example, if you hear the lines 2? FILE, 2.1! (KEEP), and
2.1 (DELETE), you know that (KEEP) is the default option for the FILE keyword.
In this example, if you include the FILE keyword but do not specify an option,
default option KEEP will be applied. A default option also applies to the next
higher dotted decimal number. In this example, if the FILE keyword is omitted,
default FILE(KEEP) is used. However, if you hear the lines 2? FILE, 2.1, 2.1.1!
(KEEP), and 2.1.1 (DELETE), the default option KEEP only applies to the next higher dotted decimal number, 2.1 (which does not have an associated keyword), and does not apply to 2? FILE. Nothing is used if the keyword FILE is omitted.

- * means a syntax element that can be repeated 0 or more times. A dotted decimal number followed by the * symbol indicates that this syntax element can be used zero or more times; that is, it is optional and can be repeated. For example, if you hear the line 5.1* data area, you know that you can include one data area, more than one data area, or no data area. If you hear the lines 3*, 3 HOST, and 3 STATE, you know that you can include HOST, STATE, both together, or nothing.

**Note:**

1. If a dotted decimal number has an asterisk (*) next to it and there is only one item with that dotted decimal number, you can repeat that same item more than once.
2. If a dotted decimal number has an asterisk next to it and several items have that dotted decimal number, you can use more than one item from the list, but you cannot use the items more than once each. In the previous example, you could write HOST STATE, but you could not write HOST HOST.
3. The * symbol is equivalent to a loop-back line in a railroad syntax diagram.

- + means a syntax element that must be included one or more times. A dotted decimal number followed by the + symbol indicates that this syntax element must be included one or more times; that is, it must be included at least once and can be repeated. For example, if you hear the line 6.1+ data area, you must include at least one data area. If you hear the lines 2+, 2 HOST, and 2 STATE, you know that you must include HOST, STATE, or both. Similar to the * symbol, the + symbol can only repeat a particular item if it is the only item with that dotted decimal number. The + symbol, like the * symbol, is equivalent to a loop-back line in a railroad syntax diagram.
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**data object**
A VSAM linear data set. A storage area, outside the user’s storage, that window services defines as a temporary object.

**data-in-virtual**
An MVS facility that enables a user to access a data object as though that data object resided in the user’s storage.

**gap**
The grouping of consecutive bytes that the program repeatedly skips over. When a reference pattern has a gap, gaps and reference units alternate throughout the data area. See also reference pattern and reference unit.

**hiperspace**
A range of up to two gigabytes of virtual storage that a program can use like a buffer.

**linear data set**
A type of VSAM data set where data is stored as a linear string of bytes.

**mapping**
A process where window services makes a data object or part of a data object accessible to a user program through a scroll area or through a window.

**object**
See data object.

**permanent data object**
A virtual storage access method (VSAM) linear data set that resides on DASD (also called a data-in-virtual object).

**reference pattern**
The order in which a program’s instructions process a data structure, such as an array. A reference pattern can be sequential or random and can contain gaps.

**reference unit**
A grouping of consecutive bytes that the program references. If the reference pattern has a gap, the reference unit is the grouping of bytes between gaps; gaps and reference units alternate throughout the data area. If the reference pattern does not have gaps, the reference unit is a logical grouping according to the structure of the data.

**scroll area**
An area of expanded storage that window services obtains. For a permanent object, window services maps a window to the scroll area and maps the scroll area to the permanent data object. You can use the scroll area to make interim changes to a permanent data object. For a temporary data object, the scroll area is the data object. Window services maps the window to the scroll area.

**scrolling**
A process where window services saves changes that a user has made in a window. For a permanent data object, window services saves the changes in the scroll area, without updating the permanent object. For a temporary object, window services updates the temporary object.

**temporary data object**
An area of expanded storage that window services provides for use by your program. You can use this storage to hold temporary data instead of using a DASD...
workfile. Window services provides no means for you to save a temporary data object.

**VSAM**

Virtual storage access method.

**window**

An area in the user’s storage where the user can view or change data in a data object that window services has made available.
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