IBM Tivoli Directory Server Plug-in Reference for z/OS
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About this document

The IBM® Tivoli® Directory Server for z/OS® is the IBM implementation of the Lightweight Directory Access Protocol (LDAP) for the z/OS operating system.

This document contains reference information about using and writing plug-ins, which extend the capabilities of the IBM Tivoli Directory Server for z/OS (5694-A01).

Who should use this document

This document is intended for application programmers. Application programmers should be experienced and have previous knowledge of directory services.

Conventions used in this document

This document uses the following typographic conventions:

**Bold**  
**Bold** words or characters represent API names, functions, routines, utility names, and system elements that you must enter into the system literally, such as commands and options.

*Italic*  
*Italic* words or characters represent variables for which you must supply values.

Example font  
Path names, attributes, environment variables, parameter values, examples, and information displayed by the system appear in constant width type style.

[ ]  
Brackets enclose optional items in format and syntax descriptions.

{}  
Braces enclose a list from which you must choose an item in format and syntax descriptions.

|  
A vertical bar separates items in a list of choices.

...  
Horizontal ellipsis points indicate that you can repeat the preceding item one or more times.

\  
A backslash is used as a continuation character when entering commands from the shell that exceed one line (255 characters). If the command exceeds one line, use the backslash character \ as the last non-blank character on the line to be continued, and continue the command on the next line.

Where to find more information

Where necessary, this document references information in other documents. For complete titles and order numbers for all elements of z/OS, see [Z/OS Information Roadmap, SA22-7500](http://www.ibm.com/servers/eserver/zseries/zos/bkserv).

Softcopy publications

The IBM Tivoli Directory Server and LDAP libraries are available on a CD-ROM collection, z/OS Collection. The CD-ROM online library collections include Softcopy Reader, which is a program that enables you to view the softcopy documents.

z/OS online library

The softcopy z/OS publications are also available for Web browsing and for viewing or printing PDFs using the following URL:

http://www.ibm.com/servers/eserver/zseries/zos/bkserv
Preface

You can also provide comments about this document and any other z/OS documentation by visiting that URL. Your feedback is important in helping to provide the most accurate and high-quality information.
Chapter 1. Introduction to server plug-ins

This document explains how to create an IBM Tivoli Directory Server for z/OS plug-in. In general, a plug-in is a software module that adds function to an existing program or application. In this case, configured plug-ins extend the capabilities of your directory server.

Plug-ins are dynamically loaded into the LDAP server’s address space when the server is started. When the plug-in is loaded, a plug-in initialization routine is called to register plug-in functions. The server calls plug-in functions from the dynamically loaded library by using registered function pointers.

When the LDAP server receives a client request, the server attempts to call a configured database backend function to process the request. If a database backend is found that accepts the client request, that backend processes the request. LDAP server backends typically process client requests by reading or writing data to a database containing directory entries. In addition to these types of database operations, LDAP server backends may also provide functions that support replication and dynamic schema updates.

If a client request is not accepted by a database backend, then the LDAP server attempts to call a configured plug-in to process the request. If a plug-in is found, which accepts the request, that plug-in processes the request.

Once the request is processed by a configured database backend or plug-in, that backend or plug-in must return a message to the client. If the client request is not processed, the LDAP server returns an error message to the client. Only one message is returned to the client.

The following types of plug-ins are supported by the IBM Tivoli Directory Server for z/OS: (See Chapter 3, “Operation plug-ins,” on page 5 for more information.)

**pre-operation**
- a plug-in that is executed before a client request is processed. For example, a plug-in that checks for a new entry, before the new entry is added to a directory

**post-operation**
- a plug-in that is executed after a client request is processed. For example, a plug-in that audits clients after they bind to the server

**client-operation**
- a plug-in that is called to process a client request
Chapter 2. Building an LDAP server plug-in

Each plug-in is a separate dynamic link library (DLL) that is loaded by the LDAP server. The `slapi-plugin.h` include file defines the various structures and service routine prototypes that are available to the plug-in.

LDAP server SLAPI export definitions are contained in one of two DLL library load modules:
- The GLDSLP31.x side file contains the export definitions that a 31-bit plug-in DLL imports.
- The GLDSLP64.x side file contains the export definitions that a 64-bit plug-in DLL imports.

The plug-in must be stored as a member of a PDS or PDSE (a 64-bit plug-in DLL must be stored in a PDSE). The plug-in data set must be in the load list for the LDAP server, either through a STEPLIB statement or the system LNKLST.

The LDAP server `plugin` configuration option is used to define a plug-in, and must be added to the LDAP server configuration file. This option is described in *IBM Tivoli Directory Server Administration and Use for z/OS*, Chapter 8, Customizing the LDAP server configuration. It has three required parameters and one optional parameter:
1. the plug-in type - preOperation, clientOperation or postOperation
2. the plug-in DLL name
3. the name of the plug-in initialization routine, which will be called during LDAP server initialization
4. optional parameters which the plug-in can retrieve

For example:
```
plugin postOperation PLUGSAMP plugin_init "auditFile"
```

Steps for writing an IBM TDS for z/OS plug-in

How to build an IBM TDS for z/OS plug-in:
- Start by designing and writing the plug-in initialization routine and SLAPI service functions
  - The plug-in initialization routine must register the following that are supported by the plug-in:
    - service functions
    - message types
    - distinguished name suffixes
    - extended operation object identifiers
  - Return code 0 must be returned when successful and non-zero when not successful. The plug-in initialization routine receives as input, the plug-in parameter block (`Slapi_PBlock`) and returns an integer as the return value. An example of an initialization routine prototype:
    ```c
    int plugin_init ( Slapi_PBlock * pb );
    ```
- **Note:** For this example, the name `plugin_init` would be the initialization routine name used with the `plugin` configuration option.
- When writing the SLAPI service functions that implement the plug-in design, see Chapter 4, "Plug-in application service routines," on page 9 for application service routines to use and for defined prototypes. You can also see `slapi-plugin.h` for defined prototypes.
- Decide on any input parameters for the plug-in
  - Plug-in input parameters can be retrieved using the SLAPI_PLUGIN_ARGC or SLAPI_PLUGIN_ARGV parameters with the `slapi_pblock_get()` service routine.
- Include `slapi-plugin.h`, which contains defined SLAPI data structures and prototypes
- Export the plug-in initialization routine
Compile the plug-in code into object files

Link the plug-in object files with one of the LDAP server SLAPI side files listed above

Ensure the plug-in DLL module is in the load list of the LDAP server and is a member of either a PDS or PDSE

APF authorize the data set that contains the plug-in DLL

Edit and add the plugin configuration option to the LDAP server configuration file. See IBM Tivoli Directory Server Administration and Use for z/OS for more information about the configuration option.

Restart the LDAP server

You may want to program trace statements to follow processing flow in the plug-in. The trace macro, SLAPI_TRACE(), is provided in slapi-plugin.h to assist in tracing. This macro uses the slapi_trace() service routine, described in Chapter 4, "Plug-in application service routines," on page 9. For example:

```
SLAPI_TRACE((LDAP_DEBUG_PLUGIN, "PLUGSAMP", "Entered."));
```

A sample plug-in showing several examples of using SLAPI service routines and a makefile are provided in Appendix A, "Plug-in sample," on page 81:

- /usr/lpp/ldap/examples/plug-insample.c is the sample plug-in
- /usr/lpp/ldap/examples/makefile.plugin is its makefile
Chapter 3. Operation plug-ins

The IBM Tivoli Directory Server for z/OS supports the following operational plug-ins:

- Pre-operation
- Post-operation
- Client-operation

Pre-operation plug-ins

A pre-operation plug-in is executed before a client request is processed.

The plug-in initialization function is responsible for registering the message types supported by the plug-in by calling the `slapi_pblock_set()` routine. The plug-in will not be called for a message type that it has not registered.

The pre-operation message function receives the plug-in parameter block, `(Slapi_PBlock)`, as an input parameter and returns an integer as the function return value:

```c
int plug-in_message_function (  
    Slapi_PBlock * pb);  
```

The return value is zero if request processing continues and nonzero if request processing terminates. If a non-zero value is returned, the pre-operation plug-in must return a result message to the client by calling the `slapi_send_ldap_result()` routine. If a zero value is returned, the pre-operation plug-in must not return a result to the client. A result message is not returned for ABANDON and UNBIND requests and the plug-in return value is ignored for these message types.

Note: Post-operation plug-ins are called even if a nonzero value is returned by the pre-operation plug-in.

Post-operation plug-ins

A post-operation plug-in is executed after a client request is processed.

The plug-in initialization function is responsible for registering the message types supported by the plug-in by calling the `slapi_pblock_set()` routine. The plug-in will not be called for a message type that it has not registered.

A post-operation message function receives the plug-in parameter block, `(Slapi_PBlock)`, as an input parameter. There is no function return value.

```c
void plug-in_message_function (  
    Slapi_PBlock * pb);  
```

The plug-in must not return a result message to the client since this has already been done before the post-operation plug-in is called. The `slapi_pblock_get()` routine is called to obtain the result code returned to the client for the request.

Client-operation plug-ins

A client-operation plug-in is executed after a client request is processed. For ADD, BIND, COMPARE, DELETE, MODIFY, MODIFY DN and SEARCH requests, the plug-in is called if it registered a suffix that matches the target DN for the request. For EXTENDED OPERATION requests, the plug-in is called if it registered an object identifier that matches the object identifier in the request. All client-operation plug-ins are called for ABANDON and UNBIND requests.
The client-operation plug-in initialization function is responsible for registering the message types, distinguished name suffixes and extended operations supported by the plug-in by calling the `slapi_pblock_set()` routine. The plug-in is only called for message types or extended operations that it has registered for.

The client-operation message function receives the plug-in parameter block (`Slapi_PBlock`) as an input parameter. There is no function return value.

```c
void plug-in_message_function (
    Slapi_PBlock * pb);
```

The client-operation plug-in must return a result message to the client for all message types except ABANDON and UNBIND (these message types do not return a response to the client). The `slapi_send_ldap_result()` routine is used to send the result message to the client. For a SEARCH request, the `slapi_send_ldap_search_entry()` and `slapi_send_ldap_referral()` routines are used to send the search results to the client before sending the result message.

Additional server controls are registered with the LDAP server by specifying SLAPI_PLUGIN_CTLLIST when calling the `slapi_pblock_set()` routine. Server control registration is only permitted during plug-in initialization. At any time, a plug-in can retrieve the list of server controls registered by specifying SLAPI_PLUGIN_CTLLIST when calling the `slapi_pblock_get()` routine.

The plug-in can access the server controls supplied with a client request by specifying SLAPI_REQCONTROLS when calling the `slapi_pblock_get()` routine. The plug-in can also set a list of server controls to be returned in the client result message by specifying SLAPI_RETCONTROLS when calling the `slapi_pblock_set()` routine.

In addition to client requests, the client-operation plug-in can also register a callback routine. The callback routine is called by the LDAP server when the server needs additional information. The plug-in calls the `slapi_pblock_get()` routine for the SLAPI_CALLBACK_TYPE parameter to get the callback type. Some examples of callbacks are:

- Get the user password
- Get the group list
- Get the alternate names

**ABANDON**

Each client-operation plug-in is called for an ABANDON request if the plug-in has registered a SLAPI_PLUGIN_ABANDON_FN routine. The plug-in must not return a response to the client since there is no client response for an ABANDON request. The plug-in stops processing a request that is abandoned by the client.

Instead of registering a SLAPI_PLUGIN_ABANDON_FN routine, the plug-in can periodically call the `slapi_op_abandoned()` routine to see if an active request is abandoned by the client.

**ADD**

The client-operation plug-in is called for an ADD request if the entry DN matches a suffix registered by the plug-in and the plug-in registered a SLAPI_PLUGIN_ADD_FN routine. The plug-in is responsible for processing the request and returning the result message to the client.

**BIND**

The client-operation plug-in is called for a simple BIND if the authentication DN matches a suffix registered by the plug-in and the plug-in registered a SLAPI_PLUGIN_BIND_FN routine. A SASL BIND is not passed to the plug-in. The plug-in is responsible for authenticating the DN and returning the result message to the client. Extended group gathering is performed for an authentication DN located in a plug-in database but plug-in databases are not included in the group gathering process.

**COMPARE**

The client-operation plug-in is called for a COMPARE request if the entry DN matches a suffix
registered by the plug-in and the plug-in registered a `SLAPI_PLUGIN_COMPARE_FN` routine. The plug-in is responsible for processing the request and returning the result message to the client.

**DELETE**

The client-operation plug-in is called for a DELETE request if the entry DN matches a suffix registered by the plug-in and the plug-in registered a `SLAPI_PLUGIN_DELETE_FN` routine. The plug-in is responsible for processing the request and returning the result message to the client.

**EXTENDED OPERATION**

The client-operation plug-in is called for an EXTENDED OPERATION request if the request object identifier matches an object identifier registered by the plug-in and the plug-in registered a `SLAPI_PLUGIN_EXT_OP_FN` routine. The plug-in is responsible for processing the extended operation request and returning the result to the client. The `slapi_pblock_set()` routine is used to set the extended operation result object identifier (SLAPI_EXT_OP_RET_OID) and value (SLAPI_EXT_OP_RET_VALUE) in the result message. The `slapi_send ldap result()` routine is then used to return the result to the client.

**MODIFY**

The client-operation plug-in is called for a MODIFY request if the entry DN matches a suffix registered by the plug-in and the plug-in registered a `SLAPI_PLUGIN_MODIFY_FN` routine. The plug-in is responsible for processing the request and returning the result message to the client.

**MODIFY DN**

The client-operation plug-in is called for a MODIFY DN request if the entry DN matches a suffix registered by the plug-in and the plug-in registered a `SLAPI_PLUGIN_MODRDN_FN` routine. The plug-in is responsible for processing the request and returning the result message to the client.

**SEARCH**

The client-operation plug-in is called for a SEARCH request if the base DN matches a suffix registered by the plug-in and the plug-in registered a `SLAPI_PLUGIN_SEARCH_FN` routine. The plug-in is responsible for processing the request and returning the result message to the client. Search entries are returned by calling the `slapi_send ldap search entry()` routine, search referrals are returned by calling the `slapi_send ldap referral()` routine, and the search result is returned by calling the `slapi_send ldap result()` routine.

**UNBIND**

Each client-operation plug-in is called for an UNBIND request if the plug-in registered a `SLAPI_PLUGIN_UNBIND_FN` routine. The plug-in must not return a response to the client since there is no client response for an UNBIND request. The plug-in does not release any resources that are allocated for the connection.
Chapter 4. Plug-in application service routines

This topic describes the plug-in application service routines. The `slapi-plugin.h` include file defines the data structures and function prototypes. The `GLDSLP31.x` and `GLDSLP64.x` side files provide the DLL import definitions for 31-bit and 64-bit load modules.

Text data is represented in UTF-8 format. The application is responsible for any necessary code page conversions.

The service routines assume that the directory objects (entries, attributes and filters) are used by a single thread. The application is responsible for providing concurrency control if it is sharing directory objects among multiple threads.
slapi_add_internal()

Purpose
Issue an ADD entry request.

Format
#include <slapi-plugin.h>

Slapi_PBlock * slapi_add_internal (  
    const char * dn,  
    LDAPMod ** mods,  
    LDAPControl ** controls,  
    int l)

Parameters

Input

dn  The distinguished name of the new entry.

mods  The mod_op field is ignored other than checking the LDAP_MOD_BVALUES flag. The attribute value is specified as a BerVal structure if the LDAP_MOD_BVALUES flag is set and is specified as a character string if it is not set.

controls  A NULL-terminated array of server controls for the ADD request. Specify NULL if there are no server controls.

l  This parameter is not used and should be set to 0. It is included for compatibility with other LDAP implementations.

Usage
The slapi_add_internal() routine issues an ADD request and returns the results to the plug-in for processing. The LDAP Version 3 protocol and the current client authentication is used for the ADD request. The request is unauthenticated if a client request is not being processed. You should call the slapi_pblock_get() routine to obtain the results from the returned parameter block. The following values can be retrieved from the parameter block:

• SLAPI_PLUGIN_INTOP_RESULT - The result code from the result message
• SLAPI_PLUGIN_INTOP_ERRMSG - The error message from the result message
• SLAPI_PLUGIN_INTOP_MATCHED_DN - The matched DN from the result message
• SLAPI_PLUGIN_INTOP_REFERRALS - The referrals from the result message

Related topics
The function return value is the address of a plug-in parameter block or NULL if the ADD request is not issued. The slapi_pblock_destroy() routine is to release the plug-in parameter block when it is no longer needed. The errno variable is set to one of the following values when the function return value is NULL:

EINVAL  A parameter is not valid
EIO  Unable to process the ADD request
ENOMEM  Insufficient storage is available
slapi_attr_get_normalized_values()

**Purpose**
Obtain the normalized attribute values.

**Format**
```c
#include <slapi-plugin.h>

int slapi_attr_get_normalized_values (  
    Slapi_Attr *attr,  
    BerVal ***vals)
```

**Parameters**

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>attr</strong></td>
<td>The directory entry attribute.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>vals</strong></td>
<td>This variable sets the address of the normalized attribute value array or the NULL if there are no attribute values. The end of the array is indicated by a NULL value address. The application must not modify or release the normalized attribute values.</td>
</tr>
</tbody>
</table>

**Usage**
The `slapi_attr_get_normalized_values()` routine returns the address of the array of normalized attribute values. The attribute values are normalized using the equality matching rule for the attribute type as defined in the LDAP schema. The unnormalized attribute values are returned if the attribute type does not have an equality matching rule.

**Related topics**
The function return value is 0 if the normalized attribute values are returned and -1 if an error occurred. The `errno` variable is set to one of the following values when the function return value is -1:

- **EINVAL** A parameter is not valid
slapi_attr_get_numvalues()

slapi_attr_get_numvalues()

Purpose
Obtain the number of attribute values.

Format
#include <slapi-plugin.h>

int slapi_attr_get_numvalues (
    Slapi_Attr * attr,
    int * numValues)

Parameters

Input

t
The directory entry attribute.

Output

numValues
This variable is set to the number of attribute values.

Usage

The slapi_attr_get_numvalues() routine returns the number of values for the supplied attribute.

Related topics

The function return value is 0 if the number of attribute values is returned or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EINVAL
A parameter is not valid
slapi_attr_get_type()

Purpose
Obtain the attribute type.

Format
#include <slapi-plugin.h>

int slapi_attr_get_type (    Slapi_Attr * attr,    char ** type)

Parameters
Input
attr The directory entry attribute.

Output
type This variable is set to the address of the attribute type. The application must not modify or release the attribute type.

Usage
The slapi_attr_get_type() routine returns the name of a directory attribute. The returned value is the lowercased primary attribute name as defined in the LDAP schema.

Related topics
The function return value is 0 if the attribute type is returned or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
ENOENT Attribute type is not set
slapi_attr_get_values()

Purpose
Obtain the attribute values.

Format
#include <slapi-plugin.h>

int slapi_attr_get_values
    (Slapi_Attr * attr,
     BerVal *** vals)

Parameters
Input
attr The directory entry attribute.

Output
vals This variable is set to the address of the attribute value array or to NULL if there are no attribute values. The end of the array is indicated by a NULL BerVal address. The application must not modify or release the attribute values.

Usage
The slapi_attr_get_values() routine returns the address of the array of attribute values.

Related topics
The function return value is 0 if the attribute values are returned and -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
slapi_attr_value_cmp()

**Purpose**
Compare two attribute values.

**Format**
```c
#include <slapi-plugin.h>

int slapi_attr_value_cmp(
    Slapi_Attr * attr,
    BerVal * value1,
    BerVal * value2)
```

**Parameters**

**Input**
- **attr**
  The directory entry attribute.
- **values1**
  The first attribute value.
- **values2**
  The second attribute value.

**Usage**
The `slapi_attr_value_cmp()` routine compares two values using the equality matching rule for the attribute type as defined in the LDAP schema. The unnormalized attribute values are compared if there is no equality matching rule for the attribute type.

**Related topics**
The function return value is 0 if the attribute values are equal, 1 if the attribute values are not equal and -1 if an error occurred. The `errno` variable is set to one of the following values when the function return value is -1:

- **EILSEQ**
  Unable to normalize attribute value
- **EINVAL**
  A parameter is not valid
- **ENOMEM**
  Insufficient storage is available
- **ESRCH**
  Attribute type is not defined in LDAP schema
slapi_ch_calloc()

**Purpose**
Allocate storage for an array.

**Format**

```c
#include <slapi-plugin.h>

void *slapi_ch_calloc(
    unsigned long elemCount,
    unsigned long elemSize)
```

**Parameters**

**Input**

- `elemCount` The number of elements in the array.
- `elemSize` The size of each element in the array.

**Usage**

The `slapi_ch_calloc()` routine allocates storage for an array. Call the `slapi_ch_free()` routine to release the storage when it is no longer needed.

**Related topics**

The function return value is the address of the allocated storage or NULL if the storage is not allocated. The `errno` variable is set to ENOMEM if the storage is not allocated.
slapi_ch_free()

**Purpose**
Release allocated storage.

**Format**
```c
#include <slapi-plugin.h>

void slapi_ch_free (void * ptr)
```

**Parameters**

**Input**
- `ptr` The address of the storage is released.

**Usage**
The `slapi_ch_free()` routine releases allocated storage.

**Related topics**
There is no function return value.
slapi_ch_free_values()

Purpose
Release an array of values.

Format
#include <slapi-plugin.h>

void slapi_ch_free_values (BerVal **values)

Parameters
Input
values The array of values. The end of the array is indicated by a NULL BerVal address.

Usage
The slapi_ch_free_values() routine releases an array of BerVal structures. Each value is released and then the array is released.

Related topics
There is no function return value.
slapi_ch_malloc()

Purpose
Allocate storage.

Format
#include <slapi-plugin.h>

void * slapi_ch_malloc (  
  unsigned long size)  

Parameters
Input
size      The number of bytes is allocated.

Usage
The slapi_ch_malloc() routine allocates storage for use by the plug-in. Call the slapi_ch_free() routine to release the storage when it is no longer needed.

Related topics
The function return value is the address of the allocated storage or NULL if the storage is not allocated. The errno variable is set to ENOMEM if the storage is not allocated.
slapi_ch_realloc()

Purpose
Reallocate storage.

Format
#include <slapi-plugin.h>

void * slapi_ch_realloc (  
    void * block,  
    unsigned long newSize)

Parameters
Input
block The address of block is reallocated.
newSize The new size for the block.

Usage
The slapi_ch_realloc() routine reallocates a block of storage. The size of the original block is changed or a new block of storage is allocated. The contents of the original block of storage are copied to the new block and the original block is released if a new block of storage is allocated. Call the slapi_ch_free() routine to release the storage when it is no longer needed.

Related topics
The function return value is the address of the reallocated storage or NULL if the storage is not reallocated. The errno variable is set to ENOMEM if the storage is not reallocated. The original storage block is still allocated if the reallocate request is not successful.
slapi_ch_strdup()

Purpose
Duplicate a character string.

Format
#include <slapi-plugin.h>

char * slapi_ch_strdup (const char * string)

Parameters
Input
string The string is duplicated.

Usage
The slapi_ch_strdup() routine duplicates a character string by allocating storage for the new string and then copying the original string to the allocated storage. Call the slapi_ch_free() routine to release the copied string when it is no longer needed.

Related topics
The function return value is the address of the duplicated string or NULL if the storage is not allocated. The errno variable sets to ENOMEM if the storage is not allocated.
slapi_compare_internal()

slapi_compare_internal()

Purpose
Issue a COMPARE request.

Format
#include <slapi-plugin.h>

Slapi_PBlock * slapi_compare_internal (  
    const char *      dn,  
    const char *      type,  
    const BerVal *    value,  
    LDAPControl **    controls)

Parameters

Input

dn      The distinguished name of the entry.
type    The attribute name.
value   The attribute value.
controls A NULL-terminated array of server controls for the COMPARE request. Specify NULL if there are no server controls.

Usage
The slapi_compare_internal() routine issues a COMPARE request and returns the results to the plug-in for processing. The LDAP Version 3 protocol and the current client authentication are used for the COMPARE request. The request is unauthenticated if a client request is not being processed. The slapi_pblock_get() routine is called to obtain the results from the returned parameter block. The following values are retrieved from the parameter block:

- SLAPI_PLUGIN_INTOP_RESULT - The result code from the result message.
- SLAPI_PLUGIN_INTOP_ERRMSG - The error message from the result message.
- SLAPI_PLUGIN_INTOP_MATCHED_DN - The matched DN from the result message.
- SLAPI_PLUGIN_INTOP_REFERRALS - The referrals from the result message.

Related topics
The function return value is the address of the plug-in parameter block or NULL if the COMPARE request is not issued. Call the slapi_pblock_destroy() routine to release the plug-in parameter block when it is no longer needed. The errno variable is set to one of the following values when the function return value is NULL:

- EINVAL A parameter is not valid
- EIO Unable to process the COMPARE request
- ENOMEM Insufficient storage is available
slapi_control_present()

Purpose
Determine if a server control is present.

Format
#include <slapi-plugin.h>

int slapi_control_present (
    LDAPControl ** controls,
    const char * oid,
    BerVal ** value,
    int * isCritical)

Parameters
Input
controls The array of server controls. The end of the array is indicated by a NULL control address.
oid The object identifier of the desired control.

Output
value This variable is set to the address of the control value if the control is found. The application must not modify or release the control value.
isCritical The returned value is 1 if the control is critical and 0 otherwise.

Usage
The slapi_control_present() routine searches an array of server controls for a control with the specified object identifier. If the control is found, a pointer to the control value is returned along with an indication of whether or not the control is marked as critical.

Related topics
The function return value is 1 if the control is found, 0 if the control is not found and -1 if an error occurred. The errno variable ise set to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
ENOMEM Insufficient storage is available
slapi_delete_internal()

Purpose
Issue a DELETE request.

Format
#include <slapi-plugin.h>

Slapi_PBlock * slapi_delete_internal (  
    const char * dn,  
    LDAPControl ** controls,  
    int l)

Parameters

Input
dn          The distinguished name of the entry.
controls    A NULL-terminated array of server controls for the DELETE request. Specify NULL if there
            are no server controls.
l          This parameter is not used and should be set to 0. It is included for compatibility with
            other LDAP implementations.

Usage
The slapi_delete_internal() routine issues a DELETE request and returns the results to the plug-in for
processing. The LDAP Version 3 protocol and the current client authentication is used for the DELETE
request. The request is unauthenticated if a client request is not being processed. Call the
slapi_pblock_get() routine to obtain the results from the returned parameter block. The following values
can be retrieved from the parameter block:

- SLAPI_PLUGIN_INTOP_RESULT - The result code from the result message
- SLAPI_PLUGIN_INTOP_ERRMSG - The error message from the result message
- SLAPI_PLUGIN_INTOP_MATCHED_DN - The matched DN from the result message
- SLAPI_PLUGIN_INTOP_REFERRALS - The referrals from the result message

Related topics
The function return value is the address of a plug-in parameter block or NULL if the DELETE request is
not issued. Call the slapi_pblock_destroy() routine to release the plug-in parameter block when it is no
longer needed. The errno variable is set to one of the following values when the function return value is
NULL:

EINVAL      A parameter is not valid
EIO         Unable to process the DELETE request
ENOMEM      Insufficient storage is available
slapi_dn_ignore_case_v3()

Purpose
Normalize a distinguished name and convert to lowercase.

Format
#include <slapi-plugin.h>

char * slapi_dn_ignore_case_v3 (const char * dn)

Parameters
Input
dn The distinguished name to be normalized.

Usage
The slapi_dn_ignore_case_v3() routine converts a distinguished name (DN) by removing leading and trailing spaces, spaces between name components and spaces around the equals signs. The API normalizes the attribute type name to the lowercased primary attribute type name in the LDAP schema definition. Any semicolons used to separate relative distinguished names (RDN) are converted to commas. The entire name is then converted to lowercase. A compound RDN is sorted alphabetically by the primary attribute type names. Special characters within a DN are represented using the backslash (\) escape character. For example,
cn="a \+ b", o=ibm, c=us

is converted to
cn=a\+b,o=ibm,c=us

Escaped hexadecimal attribute values are converted to the character representation. For example,
cn=\4a\6f\68\6e Doe,ou=Engineering,o=Darius

is converted to
cn=john doe,ou=engineering,o=darius

BER-encoded attribute values are converted to UTF-8 values. For example,
cn=\0408a6f686e20446f65,ou=Engineering,o=Darius

is converted to
cn=john doe,ou=engineering,o=darius

If an attribute type is not defined in the LDAP schema, the primary attribute type name is the lowercased attribute type.

Related topics
The function return value is the normalized name or NULL if an error occurred. Call the slapi_ch_free() routine to release the normalized name when it is no longer needed. The errno variable is set to one of the following values when the function return value is NULL:

EINVAL A parameter is not valid
ENOMEM Insufficient storage is available
slapi_dn_ignore_case_v3()

NULL will be returned if a NULL DN is passed in and EINVAL will be the return value. EINVAL will be the return value.
slapi_dn_isparent()

Purpose
Determines whether or not a particular DN is the parent of another specified DN. Before calling this function, call slapi_dn_ignore_case_v3 to normalize the DNs, which also converts all characters to lowercase.

Format
#include <slapi-plugin.h>

int slapi_dn_isparent(
    const char * parentdn,
    const char * childdn)

Parameters
Input
parentdn   Determine if this DN is the parent of childdn.
childdn    Determine if this DN is the child of parentdn.

Usage
The slapi_dn_isparent() routine takes two normalized, lowercase DNs as input and compares them, determining if the first DN is the parent of the second DN. Input string formats are expected to be UTF-8 characters.

Related topics
A nonzero positive value is returned if parentdn is the parent of childdn, 0 if the parentdn is not the parent of childdn and -1 if an error is detected.
slapi_dn_normalize_v3()

Purpose
Normalize a distinguished name and preserve the case of attribute values.

Format
#include <slapi-plugin.h>

char * slapi_dn_normalize_v3 ( const char * dn )

Parameters
Input

dn The distinguished name to be normalized.

Usage
The slapi_dn_normalize_v3() routine converts a distinguished name (DN) by removing leading and trailing spaces, spaces between name components and spaces around the equals signs. The API normalizes the attribute type name to the primary attribute type name in the LDAP schema definition. Any semicolons used to separate relative distinguished names (RDN) are converted to commas. A compound RDN is sorted alphabetically by the primary attribute type names. Special characters within a DN are represented using the backslash (\) escape character. For example,

cn="a + b", o=ibm, c=us

is converted to

cn=a\+b,o=ibm,c=us

Escaped hexadecimal attribute values are converted to the character representation. For example,

cn=\4a\6f\68\6e Doe,ou=Engineering,o=Darius

is converted to

cn=John Doe,ou=Engineering,o=Darius

BER-encoded attribute values are converted to UTF-8 values. For example,

cn=#04084a6f686e20446f65,ou=Engineering,o=Darius

is converted to

cn=John Doe,ou=Engineering,o=Darius

If an attribute type is not defined in the LDAP schema, the primary attribute type name is the lowercased attribute type.

Related topics
The function return value is the normalized name or NULL if an error occurred. Call the slapi_ch_free() routine to release the normalized name when it is no longer needed. The errno variable is set to one of the following values when the function return value is NULL:

EINVAL A parameter is not valid
ENOMEM Insufficient storage is available

NULL will be returned if a NULL DN is passed in and EINVAL will be the return value.
slapi_dn_normalize_case_v3()

Purpose
Normalize a distinguished name and convert case-insensitive attribute values to uppercase.

Format
#include <slapi-plugin.h>

char * slapi_dn_normalize_case_v3 (const char * dn)

Parameters
Input
dn The distinguished name to be converted.

Usage
The slapi_dn_normalize_case_v3() routine:
• Converts a distinguished name (DN) to a canonical form by removing leading and trailing spaces, spaces between name components and spaces around the equals signs
• Normalizes the attribute type name to the uppercased primary attribute type name in the LDAP schema definition
• Any semicolons used to separate relative distinguished names (RDN) are converted to commas
• A compound RDN is sorted alphabetically by the primary attribute type names
• An attribute value is converted to uppercase if the associated matching rule is case insensitive, otherwise the case of the attribute value is preserved
• Special characters within a DN are represented using the backslash (\) escape character

For example,
cn="a + b", o=ibm, c=us

is converted to
CN=A\+B,O=IBM,C=US

Escaped hexadecimal attribute values are converted to the character representation. For example,
cn=\4a\6f\68\6e Doe,ou=Engineering,o=Darius

is converted to
CN=JOHN DOE,OU=ENGINEERING,O=DARIUS

BER-encoded attribute values are converted to UTF-8 values. For example,
cn=#04084a6f686e20446f65,ou=Engineering,o=Darius

is converted to
CN=JOHN DOE,OU=ENGINEERING,O=DARIUS

If an attribute type is not defined in the LDAP schema, the primary attribute type name is the uppercased attribute type and the attribute matching rule is caseIgnoreMatch.
slapi_dn_normalize_case_v3()

Related topics
The function return value is the normalized name or NULL if an error occurred. Call the \texttt{slapi\_ch\_free()} routine to release the normalized name when it is no longer needed. The \textit{errno} variable is set to one of the following values when the function return value is NULL:

- \texttt{EINVAL} A parameter is not valid
- \texttt{ENOMEM} Insufficient storage is available

NULL will be returned if a NULL DN is passed in and \texttt{EINVAL} will be the return value.
slapi_entry_add_value()

Purpose
Add an attribute value to a directory entry.

Format
#include <slapi-plugin.h>

int slapi_entry_add_value (  
    Slapi_Entry * entry,  
    const char * type,  
    BerVal * value)

Parameters
Input
entry The directory entry.
type The attribute name. This can be the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.
value The attribute value to be added. Specify NULL to add the attribute without a value (an error is returned if the attribute already exists).

Usage
The slapi_entry_add_value() routine adds an attribute value to a directory entry that was allocated by the slapi_entry_alloc() routine. A case-insensitive compare is used when searching for the attribute type. The attribute type is created if it does not already exist for the entry. An error is returned if the entry already contains the attribute value. Use the slapi_entry_merge_value() routine if you want to ignore a duplicate attribute value. Use the slapi_entry_replace_value() routine to replace the existing attribute values with the new value.

The slapi_entry_add_value() routine makes a copy of the supplied attribute value. An error is returned if the attribute value is not normalized using the equality matching rule defined for the attribute type.

Related topics
The function return value is 0 if the attribute value is added to the entry or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

- EEXIST The attribute value already exists
- EILSEQ Unable to normalize attribute value
- EINVAL A parameter is not valid
- ENOMEM Insufficient storage is available
- ESRCH Attribute type is not defined in LDAP schema
slapi_entry_add_values()

Purpose
Add an attribute value to a directory entry.

Format
#include <slapi-plugin.h>

int slapi_entry_add_values(
    Slapi_Entry * entry,
    const char * type,
    BerVal * values)

Parameters
Input
entry The directory entry.
type The attribute name. This can be the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.
value A NULL-terminated array of values to be added.

Usage
The slapi_entry_add_values() routine adds multiple attribute values to a directory entry that was allocated by the slapi_entry_alloc() routine. A case-insensitive compare is used when searching for the attribute type. The attribute type is created if it does not already exist for the entry. An error is returned if the entry already contains one of the supplied attribute values and none of the attribute values are added to the entry. Use the slapi_entry_merge_values() routine to add non-matching attribute values when the entry contains one or more matching attribute values. Use the slapi_entry_replace_values() routine to replace the existing attribute values with the new values.

The slapi_entry_add_values() routine makes copies of the supplied attribute values. An error is returned if the attribute values is not normalized using the equality matching rule defined for the attribute type.

Related topics
The function return value is 0 if the attribute value is added to the entry or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EEXIST The attribute value already exists
EILSEQ Unable to normalize attribute value
EINVAL A parameter is not valid
ENOMEM Insufficient storage is available
ESRCH Attribute type is not defined in LDAP schema
slapi_entry_alloc()

Purpose
Allocate a new directory entry.

Format
#include <slapi-plugin.h>

Slapi_Entry * slapi_entry_alloc ( void )

Parameters
None.

Usage
The slapi_entry_alloc() routine allocates a new directory entry. After the entry is allocated, the
slapi_entry_set_dn() routine is called to set the entry distinguished name and the
slapi_entry_add_values() routine is called to add the entry attributes. The slapi_entry_free() routine is
called to release the directory entry when it is no longer needed.

Related topics
The function return value is the address of the new entry or NULL if an error occurred. The errno variable
is set to one of the following values when the function return value is NULL:

ENOMEM Insufficient storage is available
slapi_entry_attr_delete()

Purpose
Delete a directory entry attribute.

Format
#include <slapi-plugin.h>

int slapi_entry_attr_delete (  
    Slapi_Entry * entry,  
    const char * type)

Parameters
Input
entry The directory entry.
type The attribute name. This is the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.

Usage
The slapi_entry_attr_delete() routine deletes an attribute from a directory entry. A case-insensitive compare is used when searching for the attribute type.

Related topics
The function return value is 0 if the attribute was deleted, 1 if the entry does not contain the attribute, and -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
ENOMEM Insufficient storage is available
slapi_entry_attr_find()

Purpose
Find a directory entry attribute.

Format
#include <slapi-plugin.h>

int slapi_entry_attr_find (Slapi_Entry * entry, const char * type, Slapi_Attr ** attr)

Parameters
Input
entry The directory entry.
type The attribute name. This is the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.

Output
attr This variable is set to the address of the attribute if the attribute is found in the directory entry. The application must not modify or release the attribute.

Usage
The slapi_entry_attr_find() routine searches the directory entry for the specified attribute and returns the address of the attribute if it is found. A case-insensitive compare is used when searching for the attribute type. The attribute name in the returned attribute is the lowercased primary attribute name as defined in the LDAP schema.

Related topics
The function return value is 0 if the attribute is found and -1 otherwise. The errno variable sets to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
ENOENT Attribute not found
ESRCH Attribute type is not defined in LDAP schema
slapi_entry_delete_value()

slapi_entry_delete_value()

Purpose
Remove an attribute value from a directory entry.

Format
#include <slapi-plugin.h>

int slapi_entry_delete_value (Slapi_Entry *entry, const char *type, BerVal *value)

Parameters
Input
entry    The directory entry.
type     The attribute name. This is the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.
value    The attribute value to be deleted.

Usage
The slapi_entry_delete_value() routine removes an attribute value from a directory entry. The attribute is deleted if there are no attribute values left after deleting the requested value. A case-insensitive compare is used when searching for the attribute type. An error is returned if the entry does not contain the requested attribute value. Use the slapi_entry_attr_delete() routine to delete an attribute and all of its values.

An error is returned if the attribute value is not normalized using the equality matching rule defined for the attribute type.

Related topics
The function return value is 0 if the requested attribute value is deleted or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EILSEQ    Unable to normalize attribute value
EINVAL    A parameter is not valid
ENOENT    The attribute value was not found
ESRCH     Attribute type is not defined in LDAP schema
slapi_entry_delete_values()

**Purpose**
Remove multiple attribute values from a directory entry.

**Format**

```c
#include <slapi-plugin.h>

int slapi_entry_delete_values(
    Slapi_Entry * entry,
    const char * type,
    BerVal * values)
```

**Parameters**

**Input**

- `entry` The directory entry.
- `type` The attribute name. This is the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.
- `values` A NULL-terminated array of attribute values to be deleted.

**Usage**

The `slapi_entry_delete_values()` routine removes multiple attribute values from a directory entry. The attribute is deleted if there are no attribute values left after deleting the requested values. A case-insensitive compare is used when searching for the attribute type. An error is returned if the entry does not contain the requested attribute values. Use the `slapi_entry_attr_delete()` routine to delete an attribute and all of its values.

An error is returned if the attribute value is not normalized using the equality matching rule defined for the attribute type.

**Related topics**

The function return value is 0 if the requested attribute values are deleted or -1 if an error occurred. The `errno` variable is set to one of the following values when the function return value is -1:

- **EILSEQ** Unable to normalize attribute value
- **EINVAL** A parameter is not valid
- **ENOENT** The attribute value was not found
- **ESRCH** Attribute type is not defined in LDAP schema
**slapi_entry_dup()**

**Purpose**
Duplicate a directory entry.

**Format**
```
#include <slapi-plugin.h>

Slapi_Entry * slapi_entry_dup (Slapi_Entry * entry)
```

**Parameters**

**Input**
- `entry` The directory entry to be duplicated.

**Usage**
The **slapi_entry_dup()** routine creates a copy of a directory entry. Call the **slapi_entry_free()** routine to release the copied directory entry when it is no longer needed.

**Related topics**
The function return value is the address of the copied directory entry or NULL if an error occurred. The `errno` variable is set to one of the following values when the function return value is NULL:
- **EINVAL** A parameter is not valid
- **ENOMEM** Insufficient storage is available
slapi_entry_first_attr()

Purpose
Obtain the first attribute in a directory entry.

Format
#include <slapi-plugin.h>

int slapi_entry_first_attr (
  Slapi_Entry * entry,
  Slapi_Attr ** attr)

Parameters

Input
entry The directory entry.

Output
attr This variable is set to the address of the first attribute. The application must not modify or release the attribute.

Usage
The slapi_entry_first_attr() routine returns the first attribute in a directory entry. The attribute type in the returned attribute is the primary attribute name. The application cycles through all of the entry attributes by calling slapi_entry_first_attr() to obtain the first attribute and then repeatedly calling slapi_entry_next_attr() to obtain the remaining attributes.

Related topics
The function return value is 0 if the attribute is found and -1 otherwise. The errno variable sets to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
ENOENT The entry has no attributes
slapi_entry_free()  

Purpose  
Free a directory entry.

Format  
#include <slapi-plugin.h>  
void slapi_entry_free (  
   Slapi_Entry * entry)

Parameters  
Input  
entry The directory entry to be freed.

Usage  
The slapi_entry_free() routine frees a directory entry that was allocated by the slapi_entry_alloc() or slapi_entry_dup() routine. The entry name and any entry attributes are freed.

Related topics  
There is no function return value.
slapi_entry_get_dn()

Purpose
Obtain the directory entry name.

Format
#include <slapi-plugin.h>

char * slapi_entry_get_dn (Slapi_Entry * entry)

Parameters
Input
entry The directory entry.

Usage
The slapi_entry_get_dn() routine returns the distinguished name of a directory entry. This name must not be modified or released by the application.

Related topics
The function return value is the address of the entry name or NULL if an error occurred. The errno variable sets to one of the following values when the function return value is NULL:

- EINVAL A parameter is not valid
- ENOENT Attribute type is not set
slapi_entry_merge_value()

slapi_entry_merge_value()

Purpose
Add an attribute value to a directory entry.

Format

```c
#include <slapi-plugin.h>

int slapi_entry_merge_value (  
    Slapi_Entry * entry,  
    const char * type,  
    BerVal * value)
```

Parameters

**Input**

- **entry**: The directory entry.
- **type**: The attribute name. This is the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.
- **value**: The attribute value to be added. Specify NULL to add the attribute without a value (the attribute is created if it does not exist).

Usage

The `slapi_entry_merge_value()` routine adds an attribute value to a directory entry that was allocated by the `slapi_entry_alloc()` routine. A case-insensitive compare is used when searching for the attribute type. The attribute type is created if it does not already exist for the entry. No error is returned if the entry already contains the supplied attribute value. Use the `slapi_entry_add_value()` routine to add the attribute value if you want to be notified when a duplicate attribute value exists. Use the `slapi_entry_replace_value()` routine to replace the existing attribute values with a new value.

The `slapi_entry_merge_value()` routine makes a copy of the supplied attribute value. An error is returned if the attribute value is not normalized using the equality matching rule defined for the attribute type.

Related topics

The function return value is 0 if the attribute value is added to the entry or -1 if an error occurred. The `errno` variable is set to one of the following values when the function return value is -1:

- EILSEQ: Unable to normalize attribute value
- EINVAL: A parameter is not valid
- ENOMEM: Insufficient storage is available
- ESRCH: Attribute type is not defined in LDAP schema
slapi_entry_merge_values()

Purpose
Add multiple attribute values to a directory entry.

Format
#include <slapi-plugin.h>

int slapi_entry_merge_values (  
  Slapi_Entry * entry,  
  const char * type,  
  BerVal * values)

Parameters

Input
entry   The directory entry.
type    The attribute name. This is the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.
values  A NULL-terminated array of values to be added.

Usage
The slapi_entry_merge_values() routine adds multiple attribute values to a directory entry that was allocated by the slapi_entry_alloc() routine. A case-insensitive compare is used when searching for the attribute type. The attribute type is created if it does not already exist for the entry. No error is returned if the entry already contains the supplied attribute values. Use the slapi_entry_add_values() routine to add the attribute value if you want to be notified when the entry contains one or more matching attribute values. Use the slapi_entry_replace_values() routine to replace the existing attribute values with the new values.

The slapi_entry_merge_values() routine makes copies of the supplied attribute values. An error is returned if the attribute values is not normalized using the equality matching rule defined for the attribute type.

Related topics
The function return value is 0 if the attribute values are added to the entry or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EILSEQ</td>
<td>Unable to normalize attribute value</td>
</tr>
<tr>
<td>EINVAL</td>
<td>A parameter is not valid</td>
</tr>
<tr>
<td>ENOMEM</td>
<td>Insufficient storage is available</td>
</tr>
<tr>
<td>ESRCH</td>
<td>Attribute type is not defined in LDAP schema</td>
</tr>
</tbody>
</table>
slapi_entry_next_attr()

slapi_entry_next_attr()

Purpose
obtain the next attribute in a directory entry.

Format
#include <slapi-plugin.h>

int slapi_entry_next_attr (  
    Slapi_Entry * entry,  
    Slapi_Attr * prevAttr,  
    Slapi_Attr ** attr)

Parameters

Input
entry The directory entry.
prevAttr The previous attribute returned by slapi_entry_first_attr() or slapi_entry_next_attr().

Output
attr This variable is set to the address of the attribute following the attribute specified by the prevAttr parameter. The application must not modify or release the attribute.

Usage
The slapi_entry_next_attr() routine returns the next attribute in a directory entry. The attribute type in the returned attribute is the primary attribute name. The application cycles through all of the entry attributes by calling slapi_entry_first_attr() to obtain the first attribute and then repeatedly calling slapi_entry_next_attr() to obtain the remaining attributes.

Related topics
The function return value is 0 if the attribute is found and -1 otherwise. The errno variable sets to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
ENOENT There are no more attributes
slapi_entry_replace_value()

Purpose
Replace the attribute values in a directory entry.

Format
#include <slapi-plugin.h>

int slapi_entry_replace_value(
    Slapi_Entry * entry,
    const char * type,
    BerVal * value)

Parameters
Input
entry The directory entry.
type The attribute name. This is the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.
value The replacement attribute value. Specify NULL to remove all of the values for the attribute (the attribute is created if it does not exist).

Usage
The slapi_entry_replace_value() routine replaces all of the attribute values in a directory entry that was allocated by the slapi_entry_alloc() routine. A case-insensitive compare is used when searching for the attribute type. The attribute type is created if it does not already exist for the entry. Use the slapi_entry_add_value() or slapi_entry_merge_value() routine to add an attribute value to the existing values.

The slapi_entry_replace_value() routine makes a copy of the supplied attribute value. An error is returned if the attribute value is not normalized using the equality matching rule defined for the attribute type.

Related topics
The function return value is 0 if the attribute values are replaced or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EILSEQ Unable to normalize attribute value
EINVAL A parameter is not valid
ENOMEM Insufficient storage is available
ESRCH Attribute type is not defined in LDAP schema
slapi_entry_replace_values()

Purpose
Replace the attribute values in a directory entry.

Format
#include <slapi-plugin.h>

int slapi_entry_replace_values (  
  Slapi_Entry * entry, 
  const char * type,  
  BerVal * values)

Parameters

Input

entry The directory entry.
type The attribute name. This is the attribute object identifier, the primary attribute name or an alternate attribute name as defined in the LDAP schema.
value A NULL-terminated array of replacement values.

Usage
The slapi_entry_replace_values() routine replaces all of the attribute values in a directory entry that was allocated by the slapi_entry_alloc() routine. A case-insensitive compare is used when searching for the attribute type. The attribute type is created if it does not already exist for the entry. Use the slapi_entry_add_values() or slapi_entry_merge_values() routine to add attribute values to the existing values.

The slapi_entry_replace_values() routine makes a copy of the supplied attribute value. An error is returned if the attribute value is not normalized using the equality matching rule defined for the attribute type.

Related topics
The function return value is 0 if the attribute values are replaced or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

- EEXIST Duplicate value in replacement values
- EILSEQ Unable to normalize attribute value
- ENOMEM Insufficient storage is available
- ESRCH Attribute type is not defined in LDAP schema
slapi_entry_schema_check()

Purpose
Check a directory entry against the LDAP schema.

Format
#include <slapi-plugin.h>

int slapi_entry_schema_check (Slapi_Entry *entry)

Parameters
Input
entry The directory entry.

Usage
The slapi_entry_schema_check() routine validates a directory entry using the LDAP schema.

An error is returned if any of the following conditions are true:
• The entry contains an undefined attribute type or object class.
• The entry contains an obsolete attribute type or object class.
• The entry contains an attribute type that can not be modified by the user.
• The entry contains an attribute type that is not allowed by the entry object classes.
• A single-valued attribute type contains multiple attribute values.
• A required attribute type is not found and the extensibleObject object class is not specified.
• There is not one and only one base structural object class.
• An auxiliary object class is a base object class.

Related topics
The function return value is 0 if the directory entry is valid or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDOM</td>
<td>Obsolete attribute type or object class</td>
</tr>
<tr>
<td>EEXIST</td>
<td>Single-valued attribute has multiple values</td>
</tr>
<tr>
<td>EILSEQ</td>
<td>An auxiliary object class is a base object class or there is not one and only one structural object class</td>
</tr>
<tr>
<td>EINVAL</td>
<td>A parameter is not valid</td>
</tr>
<tr>
<td>ENOENT</td>
<td>Required attribute not found</td>
</tr>
<tr>
<td>ENOMEM</td>
<td>Insufficient storage is available</td>
</tr>
<tr>
<td>EPERM</td>
<td>Attribute cannot be modified by user</td>
</tr>
<tr>
<td>ERANGE</td>
<td>Attribute not allowed by object class</td>
</tr>
<tr>
<td>ESRCH</td>
<td>Undefined attribute type or object class</td>
</tr>
</tbody>
</table>
slapi_entry_set_dn()

Purpose
Set the directory entry name.

Format
#include <slapi-plugin.h>

int slapi_entry_set_dn ( 
    Slapi_Entry * entry, 
    const char * dn) 

Parameters
Input
entry The directory entry.
dn The distinguished name for the entry.

Usage
The slapi_entry_set_dn() routine sets or changes the entry name for a directory entry allocated by the slapi_entry_alloc() routine. The slapi_entry_set_dn() routine must not be used to change the name in a directory entry returned by the slapi_pblock_get() routine. The slapi_entry_set_dn() routine stores a copy of the supplied name in the directory entry. The storage for the previous DN is released.

Related topics
The function return value is 0 if the entry name is set and -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
ENOMEM Insufficient storage is available
slapi_filter_get_attribute_type()

Purpose
Obtain the search filter attribute type.

Format
#include <slapi-plugin.h>

int slapi_filter_get_attribute_type (  
    Slapi_Filter * filter,  
    char ** type)

Parameters
Input
filter The search filter.

Output
type This variable is set to the address of the attribute type for the search filter. The application must not modify or release the attribute type.

Usage
The slapi_filter_get_attribute_type() routine returns the attribute type for the following search filters:

- LDAP_FILTER_APPROX
- LDAP_FILTER_EQUALITY
- LDAP_FILTER_GE
- LDAP_FILTER_LE
- LDAP_FILTER_PRESENT
- LDAP_FILTER_SUBSTRINGS

An error is returned if the search filter is not one of these types. The attribute type is the lowercased primary attribute name as defined in the LDAP schema.

Related topics
The function return value is 0 if the attribute type is returned or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

- EINVAL A parameter is not valid
- EPERM The filter does not have an attribute type
- ESRCH Attribute type is not defined in LDAP schema
slapi_filter_get_ava()

Purpose
Obtain the search filter assertion value.

Format
#include <slapi-plugin.h>

int slapi_filter_get_ava (Slapi_Filter * filter,
                         char ** type,
                         BerVal ** value)

Parameters
Input
filter The search filter.

Output
type This variable is set to the address of the attribute type for the search filter. The application
must not modify or release the attribute type.

value This variable is set to the address of the assertion value for the search filter. The
application must not modify or release the assertion value.

Usage
The slapi_filter_get_ava() routine returns the assertion value for the following search filters:
    LDAP_FILTER_APPROX
    LDAP_FILTER_EQUALITY
    LDAP_FILTER_GE
    LDAP_FILTER_LE
    LDAP_FILTER_PRESENT

An error is returned if the search filter is not one of these types. The attribute type is the lowercased
primary attribute name as defined in the LDAP schema. The assertion value is normalized using the
equality matching rule for the attribute type. An error is returned if the assertion value is not normalized.

Related topics
The function return value is 0 if the assertion value is returned or -1 if an error occurred. The errno
variable is set to one of the following values when the function return value is -1:

EILSEQ Assertion value is not normalized
EINVAL A parameter is not valid
EPERM The filter does not have an attribute type
ESRCH Attribute type is not defined in LDAP schema
slapi_filter_get_choice()

**Purpose**
Obtain the search filter type.

**Format**
```
#include <slapi-plugin.h>

int slapi_filter_get_choice ( 
    Slapi_Filter * filter)
```

**Parameters**

**Input**

*filter*  
The search filter.

**Usage**

The `slapi_filter_get_choice()` routine returns the search filter type. The top-level search filter is obtained by calling the `slapi_pblock_get()` routine with the SLAPI_SEARCH_FILTER parameter. Lower-level search filters are obtained by calling the `slapi_filter_list_first()` and `slapi_filter_list_next()` routines.

The following search filter types are defined:

<table>
<thead>
<tr>
<th>Header</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDAP_FILTER_AND</td>
<td>AND filter: (&amp;(cn=John)(sn=Doe))</td>
</tr>
<tr>
<td>LDAP_FILTER_OR</td>
<td>OR filter: (</td>
</tr>
<tr>
<td>LDAP_FILTER_NOT</td>
<td>NOT filter: (!(cn=John))</td>
</tr>
<tr>
<td>LDAP_FILTER_EQUALITY</td>
<td>EQ filter: (cn=John)</td>
</tr>
<tr>
<td>LDAP_FILTER_GE</td>
<td>GE filter: (cn&gt;=John)</td>
</tr>
<tr>
<td>LDAP_FILTER_LE</td>
<td>LE filter: (cn&lt;=John)</td>
</tr>
<tr>
<td>LDAP_FILTER_PRESENT</td>
<td>Presence filter: (cn=*)</td>
</tr>
<tr>
<td>LDAP_FILTER_APPROX</td>
<td>Approximate filter: (cn~=John)</td>
</tr>
<tr>
<td>LDAP_FILTER_SUBSTRINGS</td>
<td>Substrings filter: (cn=J*Doe)</td>
</tr>
</tbody>
</table>

**Related topics**

The function return value is one of the above search filter types or -1 if an error occurred. The *errno* variable is set to one of the following values when the function return value is -1:

- EINVAL  
  A parameter is not valid
slapi_filter_get_subfilt()

slapi_filter_get_subfilt()

Purpose
Obtain the search filter substrings.

Format
#include <slapi-plugin.h>

int slapi_filter_get_subfilt ( Slapi_Filter * filter, 
char ** type, 
char ** initial, 
char *** any, 
char ** final)

Parameters
Input
filter The search filter.

Output
type This variable is set to the address of the attribute type for the search filter. The application must not modify or release the attribute type.

initial This variable is set to the address of the 'initial' substring or NULL if there is no 'initial' substring. The application must not modify or release the substring.

any This variable is set to the address of the array of 'any' substrings or NULL if there are no 'any' substrings. The end of the array is indicated by a NULL string address. The application must not modify or release the substrings.

final This variable is set to the address of the 'final' substring or NULL if there is no 'final' substring. The application must not modify or release the substring.

Usage
The slapi_filter_get_subfilt() routine returns the substrings for an LDAP_FILTER_SUBSTRINGS search filter. An error is returned if this is not a substrings filter. The attribute type is the lowercased primary attribute name as defined in the LDAP schema. The substrings are normalized using the equality matching rule for the attribute type. An error is returned if the substrings are not normalized.

For example, if the filter is (cn=John*Q*Public), the initial substring is John, the final substring is Public, and the any substrings array contains the single substring Q.

Related topics
The function return value is 0 if the substrings are returned or -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EILSEQ Unable to normalize attribute value
EINVAL A parameter is not valid
EPERM The filter does not have substrings
ESRCH Attribute type is not defined in LDAP schema
slapi_filter_list_first()

Purpose
Obtain the first subfilter.

Format
#include <slapi-plugin.h>

Slapi_Filter * slapi_filter_list_first (Slapi_Filter * filter)

Parameters
Input
filter The search filter.

Usage
The slapi_filter_list_first() routine returns the first subfilter in an AND, OR, or NOT filter. For example, if the search filter is (&(cn=John)(sn=Doe)), the first subfilter is (cn=John). The top-level search filter is obtained by calling the slapi_pblock_get() routine with the SLAPI_SEARCH_FILTER parameter. Lower-level search filters are obtained by calling the slapi_filter_list_first() and slapi_filter_list_next() routines.

Related topics
The function return value is the first subfilter or NULL if an error occurred. The errno variable is set to one of the following values when the function return value is NULL:

EINVAL A parameter is not valid
ENOENT There are no subfilters
EPERM The filter is not an AND, OR, or NOT filter
slapi_filter_list_next()

slapi_filter_list_next()

Purpose
Obtain the next subfilter.

Format
#include <slapi-plugin.h>

Slapi_Filter * slapi_filter_list_next (  
    Slapi_Filter * filter,  
    Slapi_Filter * subfilter)  

Parameters
Input
filter        The search filter.
subfilter     The current subfilter.

Usage
The slapi_filter_list_next() routine returns the next subfilter in an AND or OR filter. For example, if the search filter is (&(cn=John)(sn=Doe)) and the current subfilter is (cn=John), then the next subfilter is (sn=Doe). The return value is NULL and errno is set to ENOENT when all of the subfilters have been processed.

Related topics
The function return value is the next subfilter or NULL if an error occurred. The errno variable is set to one of the following values when the function return value is NULL:

EINVAL   A parameter is not valid
ENOENT    There are no subfilters
EPERM     The filter is not an AND, OR, or NOT filter
slapi_isSDBM_authenticated()

**Purpose**
Determines whether or not the client BIND DN is contained in the SDBM backend.

**Format**
```
#include <slapi_plugin.h>

int slapi_isSDBM_authenticated ( Slapi_PBlock * pb )
```

**Parameters**

**Input**
- `pb`: The plug-in parameter block.

**Usage**
The `slapi_isSDBM_authenticated()` routine retrieves the BIND DN associated with the connection from the plug-in parameter block and checks whether the DN belongs to the SDBM backend, meaning the BIND DN is authenticated by the RACF® security server.

**Related topics**
A nonzero positive value is returned if the BIND DN was authenticated by the security server, 0 if it was not authenticated, and -1 if an error is detected.
slapi_log_error()

Purpose
Write a message to the LDAP server job log.

Format
#include <slapi-plugin.h>

void slapi_log_error(
    int msg_severity,
    char * subsystem,
    char * fmt, ...
)

Parameters
Input
msg_severity Level of severity of the message. Level of severity is one of the following:
- LDAP_MSG_LOW
- LDAP_MSG_MED
- LDAP_MSG_HIGH

To force the message to the console logically on LDAP_OP_CONSOLE with the
msg_severity, see Usage for when messages are written to the log.

subsystem Name of the plug-in subsystem in which this function is called.

fmt Message you want written. This message is in printf()-style format. Only the following
printf()-style substitution codes are supported:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>%d</td>
<td>signed integer</td>
</tr>
<tr>
<td>%ld</td>
<td>signed long integer</td>
</tr>
<tr>
<td>%u</td>
<td>unsigned integer</td>
</tr>
<tr>
<td>%lu</td>
<td>unsigned long integer</td>
</tr>
<tr>
<td>%x</td>
<td>lowercase hexadecimal unsigned integer (specify %08x or %8.8x for an 8-character value with zero-fill)</td>
</tr>
<tr>
<td>%lx</td>
<td>lowercase hexadecimal unsigned long integer</td>
</tr>
<tr>
<td>%X</td>
<td>uppercase hexadecimal unsigned integer (specify %08X or %8.8X for an 8-character value with zero-fill)</td>
</tr>
<tr>
<td>%lx</td>
<td>uppercase hexadecimal unsigned long integer</td>
</tr>
<tr>
<td>%p</td>
<td>pointer</td>
</tr>
<tr>
<td>%c</td>
<td>EBCDIC character</td>
</tr>
<tr>
<td>%s</td>
<td>EBCDIC string</td>
</tr>
</tbody>
</table>

The format specifications uses either the XPG4 "%n$f" form or the "%f" form, but the two forms cannot be intermixed in the same message.

Usage
1. The slapi_log_error() routine formats a message and writes it to the job log.
2. The message is written to the operator console depending on the setting of the environment variable LDAP_CONSOLE_LEVEL unless LDAP_OP_CONSOLE is logically ORed with the msg_severity. In this case, it will always be written to the operator console. The slapi_log_error() severity level equates to the LDAP_CONSOLE_LEVEL severity level as follows:
LDAP_MSG_LOW is an Information (I) severity level
LDAP_MSG_MED is an Attention (W) severity level
LDAP_MSG_HIGH is an Error (E) severity level

See [IBM Tivoli Directory Server Administration and Use for z/OS](https://www.ibm.com) for more information on the use of LDAP_CONSOLE_LEVEL, activity logging and LDAP server configuration.

3. Operator console messages must include a message identifier. The subsystem input field is used for the message identifier.

4. The message is written to the LDAP server activity log when activity logging is enabled.

5. Examples (*italics* are filled in with the appropriate system and LDAP server information):

   - slapi_log_error(LDAP_MSG_MED,
     "GLD1004I","LDAP server is ready for requests.
     ");

     Writes the following message to the job log:
     
     <date time> GLD1004I LDAP server is ready for requests.

   - slapi_log_error ( LDAP_MSG_HIGH,
     "GLD1059I","Listening for requests on %s port %d.\n", ip, port );

     where
     
     LDAP_CONSOLE_LEVEL=E
     ip is the string "127.0.0.1"
     port = 386

     Writes the following message to the job log:
     
     <date time> GLD1059I Listening for requests on 127.0.0.1 port 386.

     The same message is written to the operator console, depending on how your console is configured. The date and time is excluded.

   - slapi_log_error ( LDAP_MSG_LOW | LDAP_OP_CONSOLE,
     "GLD1005I", "LDAP server start command processed.\n" );

     Writes the following message to the job log:
     
     <date time> GLD1005I LDAP server start command processed.

     The same message is written to the operator console, depending on how your console is configured. The date and time is excluded.

**Related topics**

None.
slapi_modify_internal()

Purpose
Issue a modify request.

Format
#include <slapi-plugin.h>

Slapi_PBlock * slapi_modify_internal (  
    const char * dn,  
    LDAPMod ** mods,  
    LDAPControl ** controls,  
    int l)

Parameters
Input

dn  The distinguished name of the entry.
mods  A NULL-terminated array of modifications. The attribute value is specified as a BerVal  
      structure if the LDAP_MOD_BVALUES flag is set and is specified as a character string if it  
      is not set.
controls  A NULL-terminated array of server controls for the MODIFY request. Specify NULL if there  
           are no server controls.
l  This parameter is not used and is set to 0. It is included for compatibility with other LDAP  
           implementations.

Usage
The slapi_modify_internal() routine issues a MODIFY request and returns the results to the plug-in for  
processing. The LDAP Version 3 protocol and the current client authentication is used for the MODIFY  
request. The request is unauthenticated if a client request is not being processed. Call the  
slapi_pblock_get() routine to obtain the results from the returned parameter block. The following values  
can be retrieved from the parameter block:
• SLAPI_PLUGIN_INTOP_RESULT - The result code from the result message.
• SLAPI_PLUGIN_INTOP_ERRMSG - The error message from the result message.
• SLAPI_PLUGIN_INTOP_MATCHED_DN - The matched DN from the result message.
• SLAPI_PLUGIN_INTOP_REFERRALS - The referrals from the result message.

Related topics
The function return value is the address of a plug-in parameter block or NULL if the MODIFY request is  
not issued. Call the slapi_pblock_destroy() routine to release the plug-in parameter block when it is no  
longer needed. The errno variable is set to one of the following values when the function return value is  
NULL:
EINVAL  A parameter is not valid
EIO   Unable to process the MODIFY request
ENOMEM  Insufficient storage is available
slapi_modrdn_internal()

Purpose
Issue a MODIFY-DN request.

Format
#include <slapi-plugin.h>

Slapi_PBlock * slapi_modrdn_internal ( 
  const char * dn,
  const char * newrdn,
  int deloldrdn,
  LDAPControl ** controls,
  int l)

Parameters
Input
* $dn$ The distinguished name of the entry.
* $newrdn$ The new RDN for the entry.
* $deloldrdn$ Specify 1 if the old RDN is to be deleted and 0 if the old RDN is not to be deleted.
* $controls$ A NULL-terminated array of server controls for the MODIFY-DN request. Specify NULL if there are no server controls.
* $l$ The parameter is not used and should be set to 0. It is included for compatibility with other LDAP implementations.

Usage
The slapi_modrdn_internal() routine issues a MODIFY-DN request and returns the results to the plug-in for processing. The LDAP Version 3 protocol and the current client authentication is used for the MODIFY-DN request. The request is unauthenticated if a client request is not being processed. Call the slapi_pblock_get() routine to obtain the results from the returned parameter block. The following values can be retrieved from the parameter block:
• SLAPI_PLUGIN_INTOP_RESULT - The result code from the result message.
• SLAPI_PLUGIN_INTOP_ERRMSG - The error message from the result message.
• SLAPI_PLUGIN_INTOP_MATCHED_DN - The matched DN from the result message.
• SLAPI_PLUGIN_INTOP_REFERRALS - The referrals from the result message.

Related topics
The function return value is the address of a plug-in parameter block or NULL if the MODIFY-DN request is not issued. Call the slapi_pblock_destroy() routine to release the plug-in parameter block when it is no longer needed. The errno variable is set to one of the following values when the function return value is NULL:
• EINVAL A parameter is not valid
• EIO Unable to process the MODIFY-DN request
• ENOMEM Insufficient storage is available
slapi_op_abandoned()

Purpose
Check if the current request has been abandoned.

Format
#include <slapi-plugin.h>

int slapi_op_abandoned (Slapi_PBlock *pb)

Parameters
Input
pb The plug-in parameter block.

Usage
The slapi_op_abandoned() routine checks if the client has abandoned the current request.

Related topics
The function return value is 1 if the request is abandoned, 0 if the request is not abandoned, and -1 if an error occurred. The errno variable is set to one of the following values when the function return value is -1:

EINVAL A parameter is not valid
EPERM There is no client request
slapi_pblock_destroy()

Purpose
Release a plug-in parameter block returned for an internal request.

Format
#include <slapi-plugin.h>

void slapi_pblock_destroy ( Slapi_PBlock * pb)

Parameters
Input
pb The plug-in parameter block.

Usage
The slapi_pblock_destroy() routine releases a plug-in parameter block returned by an internal request routine, such as slapi_add_internal(). This routine must not be used to release a plug-in parameter block supplied as input to a plug-in callback routine.

Related topics
There is no function return value.
slapi_pblock_get()

Purpose
Retrieve a value from the plug-in parameter block.

Format
#include <slapi-plugin.h>

    int slapi_pblock_get(
        Slapi_PBlock * pb,
        int arg,
        void * value)

Parameters

Input
pb  The plug-in parameter block.
arg  The parameter value to be retrieved.

Output
value  The address of a variable that will be set to the parameter value.

Usage
The specified parameter value is retrieved from the plug-in parameter block. The plug-in must not modify
or release any of the values returned by the slapi_pblock_get() routine. For SLAPI_PLUGIN_PRIVATE
and SLAPI_CONN_PRIVATE, the parameter value is an address that is saved in the plug-in parameter
block and can be freed. EINVAL is returned if the parameter type or value is not valid while EPERM is
returned if the parameter type is not allowed for the current plug-in invocation.

These parameter types are valid only for a parameter block returned by an internal request routine:
    SLAPI_PLUGIN_INTOP_REFERRALS
    SLAPI_PLUGIN_INTOP_RESULT
    SLAPI_PLUGIN_INTOP_SEARCH_ENTRIES
    SLAPI_PLUGIN_INTOP_SEARCH_REFERRALS

The other parameter types are not valid for an internal request parameter block.

Table 3. Operational parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_PLUGIN_ARGC</td>
<td>int</td>
<td>The number of arguments specified on the plugin configuration statement.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_ARGV</td>
<td>char **</td>
<td>A NULL-terminated array of arguments specified on the plugin configuration statement. See SLAPI_PLUGIN_ARGC for the number of arguments.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_CTLLIST</td>
<td>char **</td>
<td>An array of server control object identifiers registered by the current plug-in. The value is NULL if there are no server controls.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_DB_SUFFIXES</td>
<td>char **</td>
<td>A NULL-terminated array of database suffixes registered for the current plug-in. The value is NULL if there are no database suffixes registered. The database suffixes are normalized as determined by the LDAP server schema.</td>
</tr>
</tbody>
</table>
### Table 3. Operational parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_PLUGIN_EXT_OP_OIDLIST</td>
<td>char **</td>
<td>A NULL-terminated array of extended operation object identifiers registered for the current plug-in. The value is NULL if there are no object identifiers registered.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_PRIVATE</td>
<td>void *</td>
<td>Private value set by the <code>slapi_pblock_set()</code> routine. Each plug-in can have its own private value and must be freed on termination.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_TYPE</td>
<td>int</td>
<td>Current plug-in type:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLAPI_PLUGIN_PREOPERATION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLAPI_PLUGIN_CLIENTOPERATION</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLAPI_PLUGIN_POSTOPERATION</td>
</tr>
</tbody>
</table>

### Table 4. General request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_CONN_ID</td>
<td>unsigned long</td>
<td>Client connection identifier. Connection identifiers are reused when a connection is closed. The plug-in registers a SLAPI_PLUGIN_CLOSE_FN if it needs to be informed when a client connection is closed.</td>
</tr>
<tr>
<td>SLAPI_CONN_PRIVATE</td>
<td>void *</td>
<td>Private value for the current connection. Each plug-in can have its own set of private connection values and must be freed on termination. The value is NULL if the plug-in has not set a private value for the connection.</td>
</tr>
<tr>
<td>SLAPI_CONN_VERSION</td>
<td>int</td>
<td>The LDAP protocol version for the connection. This is the previous protocol version while processing a BIND request (use the SLAPI_BIND_VERSION parameter to obtain the protocol version specified in the BIND request)</td>
</tr>
<tr>
<td>SLAPI_REQCONTROLS</td>
<td>LDAPControl **</td>
<td>A NULL-terminated array of server controls specified in the request. The value is NULL if there are no controls.</td>
</tr>
<tr>
<td>SLAPI_REQUEST_ID</td>
<td>unsigned int</td>
<td>Message identifier for the current client request.</td>
</tr>
<tr>
<td>SLAPI_REQUESTOR_ALT_NAMES</td>
<td>char **</td>
<td>A NULL-terminated array of normalized alternate names for the authentication DN. The value is NULL if there are no alternate names.</td>
</tr>
<tr>
<td>SLAPI_REQUESTOR_DN</td>
<td>char *</td>
<td>Authenticated DN of the client requesting the operation. A zero-length string is returned if the client is not authenticated.</td>
</tr>
<tr>
<td>SLAPI_REQUESTOR_GROUPS</td>
<td>char **</td>
<td>A NULL-terminated array of normalized group names for the authentication DN. The value is NULL if the authentication DN is not a member of any groups or if group gathering was not enabled for the BIND request.</td>
</tr>
</tbody>
</table>
### Table 4. General request parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_REQUESTOR_IS_ADMIN</td>
<td>int</td>
<td>The value is 1 if the requestor is the LDAP administrator. Otherwise, the value is 0.</td>
</tr>
<tr>
<td>SLAPI_REQUESTOR_NORM_DN</td>
<td>char *</td>
<td>Normalized authenticated DN of the client requesting the operation. A zero-length string is returned if the client is not authenticated.</td>
</tr>
<tr>
<td>SLAPI_REQUESTOR_SAFID</td>
<td>char *</td>
<td>SAF user ID of the bound client. A zero-length string is returned when no SAF user ID is associated with the client. The value is uppercased and in local code page.</td>
</tr>
<tr>
<td>SLAPI_REQUESTOR_SECURITY_LABEL</td>
<td>char *</td>
<td>The security label associated with the client requesting the operation. The security label is returned as a local code page string. A zero-length string is returned when the client is not authenticated or when LDAP server security label processing is not configured for client operations.</td>
</tr>
<tr>
<td>SLAPI_TARGET_DN</td>
<td>char *</td>
<td>Target DN specified in the current request. The value is NULL if the request does not have a target DN.</td>
</tr>
</tbody>
</table>

### Table 5. ABANDON request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_ABANDON_MSGID</td>
<td>unsigned int</td>
<td>Message identifier of the message is abandoned.</td>
</tr>
</tbody>
</table>

### Table 6. ADD request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_ADD_ENTRY</td>
<td>Slapi_Entry *</td>
<td>Entry to be added. The server will create SLAPI_ENTRY whenever an add is requested. This function returns the address of the entry. This entry will be freed at the end of the request.</td>
</tr>
<tr>
<td>SLAPI_ADD_TARGET</td>
<td>char *</td>
<td>DN of the entry to be added. This is the same value returned by SLAPI_TARGET_DN.</td>
</tr>
</tbody>
</table>

### Table 7. BIND request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_BIND_CREDENTIALS</td>
<td>BerVal *</td>
<td>Credentials from the BIND request.</td>
</tr>
<tr>
<td>SLAPI_BIND_METHOD</td>
<td>int</td>
<td>Bind method:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LDAP_AUTH_SIMPLE, LDAP_AUTH_SASL</td>
</tr>
<tr>
<td>SLAPI_BIND_TARGET</td>
<td>char *</td>
<td>Authentication DN from the BIND request. This is the same value returned by SLAPI_TARGET_DN.</td>
</tr>
</tbody>
</table>
Table 7. BIND request parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_BIND_VERSION</td>
<td>int</td>
<td>The LDAP protocol version from the BIND request.</td>
</tr>
</tbody>
</table>

Table 8. COMPARE request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_COMPARE_TARGET</td>
<td>char *</td>
<td>DN of the entry to be used for the comparison. This is the same value returned by SLAPI_TARGET_DN.</td>
</tr>
<tr>
<td>SLAPI_COMPARE_TYPE</td>
<td>char *</td>
<td>Attribute type to be used for the comparison. The lowercased primary attribute name is returned as defined in the LDAP schema.</td>
</tr>
<tr>
<td>SLAPI_COMPARE_VALUE</td>
<td>BerVal *</td>
<td>Attribute value to be used for the comparison. The normalized attribute value is returned if the attribute type has an equality matching filter, otherwise the unnormalized attribute value is returned.</td>
</tr>
</tbody>
</table>

Table 9. DELETE request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_DELETE_TARGET</td>
<td>char *</td>
<td>DN of the entry to be deleted. This is the same value returned by SLAPI_TARGET_DN.</td>
</tr>
</tbody>
</table>

Table 10. EXTENDED OPERATION request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_EXT_OP_REQ_OID</td>
<td>char *</td>
<td>Extended operation object identifier.</td>
</tr>
<tr>
<td>SLAPI_EXT_OP_REQ_VALUE</td>
<td>BerVal *</td>
<td>Extended operation value.</td>
</tr>
</tbody>
</table>

Table 11. MODIFY request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_MODIFY_MODS</td>
<td>LDAPMod **</td>
<td>A NULL-terminated array of modifications to be performed. The attribute values is represented as binary values in the LDAPMod entries (modv_bvals is used instead of modv_strvals and the LDAP_MOD_BVALUES flag is set).</td>
</tr>
<tr>
<td>SLAPI_MODIFY_TARGET</td>
<td>char *</td>
<td>DN of the entry to be modified. This is the same value returned by SLAPI_TARGET_DN.</td>
</tr>
</tbody>
</table>

Table 12. MODIFY DN request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_MODRDN_DELOLDRDN</td>
<td>int</td>
<td>1 if the old RDN is to be deleted, 0 if the old RDN is not to be deleted.</td>
</tr>
<tr>
<td>SLAPI_MODRDN_NEWRDN</td>
<td>char *</td>
<td>New RDN for the entry.</td>
</tr>
</tbody>
</table>
### Table 12. MODIFY DN request parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_MODRDN_NEWSUPERIOR</td>
<td>char *</td>
<td>DN of the new superior entry. The value is NULL if a new superior entry is not specified in the MODIFY DN request.</td>
</tr>
<tr>
<td>SLAPI_MODRDN_TARGET</td>
<td>char *</td>
<td>New DN for the renamed entry. This is the same value returned by SLAPI_TARGET_DN.</td>
</tr>
</tbody>
</table>

### Table 13. SEARCH request parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_SEARCH_ATTRS</td>
<td>char **</td>
<td>A NULL-terminated array of attribute types from the search request. The value is NULL if there are no attribute types in the search request. The attribute names are the lowercased primary attribute names as defined in the LDAP schema.</td>
</tr>
<tr>
<td>SLAPI_SEARCH_ATTRSONLY</td>
<td>int</td>
<td>1 if only attribute types are to be returned, 0 if attribute types and values are to be returned.</td>
</tr>
<tr>
<td>SLAPI_SEARCH_DEREF</td>
<td>int</td>
<td>Alias dereferencing: LDAP_DEREF_NEVER  LDAP_DEREF_FINDING  LDAP_DEREF_SEARCHING  LDAP_DEREF_ALWAYS</td>
</tr>
<tr>
<td>SLAPI_SEARCH_FILTER</td>
<td>Slapi_Filter *</td>
<td>Search filter.</td>
</tr>
<tr>
<td>SLAPI_SEARCH_SCOPE</td>
<td>int</td>
<td>Search scope:  LDAP_SCOPE_BASE  LDAP_SCOPE_ONELEVEL  LDAP_SCOPE_SUBTREE</td>
</tr>
<tr>
<td>SLAPI_SEARCH_SIZELIMIT</td>
<td>int</td>
<td>Search size limit. This is the smaller of the size limit from the search request and the size limit specified in the LDAP server configuration file. The configured size limit should be ignored for the LDAP administrator.</td>
</tr>
<tr>
<td>SLAPI_SEARCH_TARGET</td>
<td>char *</td>
<td>DN of the base entry for the search. This is the same value returned by SLAPI_TARGET_DN.</td>
</tr>
<tr>
<td>SLAPI_SEARCH_TIMELIMIT</td>
<td>int</td>
<td>Search time limit. This is the smaller of the time limit from the search request and the time limit specified in the LDAP server configuration file. The configured time limit is ignored for the LDAP administrator.</td>
</tr>
</tbody>
</table>

### Table 14. Callback parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_CALLBACK_NAME</td>
<td>char *</td>
<td>The normalized name for the callback request. The value is NULL if there is no name associated with the callback request.</td>
</tr>
</tbody>
</table>
### Table 14. Callback parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_CALLBACK_TYPE</td>
<td>int</td>
<td>The callback type. SLAPI_TYPE_DN_PW to obtain the password for a distinguished name SLAPI_TYPE_UID_PW to obtain the password for a user name SLAPI_TYPE_GROUPS to obtain the group list for a distinguished name SLAPI_TYPE_ALT_NAMES to obtain the Kerberos alternate names</td>
</tr>
</tbody>
</table>

### Table 15. General result parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_PLUGIN_OPRETURN</td>
<td>int</td>
<td>The result code for the current operation. The result code is set by the slapi_send_ldap_result() routine.</td>
</tr>
</tbody>
</table>

### Table 16. Internal request result parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_PLUGIN_INTOP_SEARCH_ENTRIES</td>
<td>Slap_Entry **</td>
<td>A NULL-terminated array of search entries returned for an internal search request. The value is NULL if there are no search entries.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_INTOP_SEARCH_REFERRALS</td>
<td>char *</td>
<td>A NULL-terminated array of search references returned for an internal search request. The value is NULL if there are no search references.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_INTOP_ERRMSG</td>
<td>char *</td>
<td>Error message returned in the result message for an internal request. The value is NULL if there is no error message.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_INTOP_MATCHED_DN</td>
<td>char *</td>
<td>Matched DN returned in the result message for an internal request. The value is NULL if there is no matched DN.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_INTOP_REFERRALS</td>
<td>char *</td>
<td>A NULL-terminated array of referrals returned in the result message for an internal request. The value is NULL if there are no referrals.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_INTOP_RESULT</td>
<td>int</td>
<td>Result code returned in the result message for an internal request.</td>
</tr>
</tbody>
</table>

### Related topics

The return value is 0 if the request is successful and -1 if there is an error. The errno variable is set to one of the following values when the function return value is -1:

- EFAULT  Value address is not valid
- EINVAL   A parameter is not valid
- ENOENT   Value does not exist
- ENOMEM   Insufficient storage is available
slapi_pbblock_get()

EPERM Insufficient storage is available
slapi_pblock_set()

Purpose

Format

```
#include <slapi-plugin.h>

int slapi_pblock_set (  
    Slapi_PBlock * pb,  
    int arg,  
    void * value)
```

Parameters

- **Input**
  - `pb`: The plug-in parameter block.
  - `arg`: The parameter value to be set.
  - `value`: The address of the parameter value or, for a registration parameter, the callback function.

Usage

The specified parameter value is set in the plug-in parameter block. The plug-in must release any storage allocated for the parameter value since the `slapi_pblock_set()` routine makes a copy of the parameter value before returning. For SLAPI_PLUGIN_PRIVATE and SLAPI_CONN_PRIVATE, the parameter value is an address that is saved in the plug-in parameter block. EINVAL is returned if the parameter type or value is not valid while EPERM is returned if the parameter type is not allowed for the current plug-in invocation.

Suffixes, extended operations and controls can only be set during initialization.

**Table 17. Registration parameters**

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_PLUGIN_ABANDON_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client ABANDON request.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_ADD_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client ADD request.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_BIND_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client BIND request.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_CALLBACK_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a server callback request. A callback routine is registered only by a client-operation plug-in.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_CLOSE_FN</td>
<td>void (*)(Slapi_PBlock *)</td>
<td>Routine to be called during LDAP server termination.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_COMPARE_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client COMPARE request.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_DELETE_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client DELETE request.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_DISCONNECT_FN</td>
<td>void (*)(Slapi_PBlock *)</td>
<td>Routine to be called when an LDAP client session is closed.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_EXT_OP_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client EXTENDED OPERATION request.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_MODIFY_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client MODIFY request.</td>
</tr>
</tbody>
</table>
slapi_pblock_set()

Table 17. Registration parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_PLUGIN_MODRDN_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client MODIFY DN request.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_SEARCH_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client SEARCH request.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_THREAD_FN</td>
<td>void (*)(Slapi_PBlock *)</td>
<td>Routine to be called when an LDAP server worker thread terminates.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_UNBIND_FN</td>
<td>int (*)(Slapi_PBlock *)</td>
<td>Routine to process a client UNBIND request.</td>
</tr>
</tbody>
</table>

Table 18. Operational parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_CONN_PRIVATE</td>
<td>void *</td>
<td>Private value for the current connection. Each plug-in can have its own set of private connection values.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_CTLLIST</td>
<td>char **</td>
<td>NULL-terminated array of server control object identifiers supported by the current plug-in. The LDAP server accepts an unrecognized critical control if the object identifier is registered by one or more plug-ins. The plug-in is responsible for any processing required by the server control.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_DB_SUFFIX</td>
<td>char **</td>
<td>NULL-terminated array of database suffixes for the current plug-in. This parameter is set only by a client-operation plug-in.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_EXT_OP_OIDLIST</td>
<td>char **</td>
<td>NULL-terminated array of extended operation object identifiers for the current plug-in. This parameter is set only by a client-operation plug-in.</td>
</tr>
<tr>
<td>SLAPI_PLUGIN_PRIVATE</td>
<td>void *</td>
<td>Private value that is retrieved by the slapi_pblock_get() routine. Each plug-in has its own private value.</td>
</tr>
</tbody>
</table>

Table 19. Callback parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_CALLBACK_ERRMSG</td>
<td>char *</td>
<td>An error message is returned to the LDAP client if an error occurred. Specify NULL if there is no error message.</td>
</tr>
<tr>
<td>SLAPI_CALLBACK_LIST</td>
<td>char **</td>
<td>A NULL-terminated array of names. This is the return value for a group list or alternate names callback. Specify NULL if there are no names.</td>
</tr>
<tr>
<td>SLAPI_CALLBACK_PASSWORD</td>
<td>char *</td>
<td>The user password. This is a return value for a password callback. Specify NULL if there is no password for the supplied name.</td>
</tr>
</tbody>
</table>
Table 19. Callback parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_CALLBACK_STATUS</td>
<td>int</td>
<td>This is the LDAP result code for the request. It is set to LDAP_SUCCESS if the callback request was processed, LDAP_UNWILLING_TO_PERFORM if the plug-in doesn't recognize the callback type, or an LDAP error code if an error occurred. The return status is LDAP_SUCCESS if there is no password, group or alternate name for the supplied name and the appropriate return value (SLAPI_CALLBACK_LIST or SLAPI_CALLBACK_PASSWORD) is set to NULL.</td>
</tr>
<tr>
<td>SLAPI_CALLBACK_TARGET_DN</td>
<td>char *</td>
<td>The entry name associated with the password returned for the SLAPI_CALLBACK_PASSWORD parameter. This is a return value for a password callback. Specify NULL if there is no entry.</td>
</tr>
</tbody>
</table>

Table 20. General result parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_RETCONTROLS</td>
<td>LDAPControl **</td>
<td>A NULL-terminated array of controls is returned in the result message. This parameter may be set only by a client-operation plug-in.</td>
</tr>
</tbody>
</table>

Table 21. EXTENDED OPERATION result parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_EXT_OP_RET_OID</td>
<td>char *</td>
<td>Extended operation object identifier.</td>
</tr>
<tr>
<td>SLAPI_EXT_OP_RET_VALUE</td>
<td>BerVal *</td>
<td>Extended operation value.</td>
</tr>
</tbody>
</table>

Related topics

The return value is 0 if the request is successful and -1 if there is an error. The errno variable is set to one of the following values when the function return value is -1:

- **EEXIST**       Value already exists
- **EFAULT**      Value address is not valid
- **EINVAL**      A parameter is not valid
- **ENOMEM**       Insufficient storage is available
- **EPERM**       A parameter is not allowed
slapi_search_internal()

Purpose
Issue a SEARCH request.

Format
#include <slapi-plugin.h>

Slapi_PBlock * slapi_search_internal (  
    const char * base,  
    int scope,  
    const char * filter,  
    LDAPControl ** controls,  
    char ** attrs,  
    int attrsonly)

Parameters
Input
base The base DN for the search.
scope The scope for the search must be:
    LDAP_SCOPE_BASE
    LDAP_SCOPE_ONELEVEL
    LDAP_SCOPE_SUBTREE
filter The filter for the search. The filter is set to (objectClass=*) if NULL is specified for this parameter.
controls A NULL-terminated array of server controls for the SEARCH request. Specify NULL if there are no server controls.
attrs A NULL-terminated array of attributes is returned for the search entries. Specify NULL if all attributes are returned. Note that operational attributes are returned only if they are explicitly listed in the attrs parameter.
attrsonly Specify 1 if just the attribute types are to be returned or 0 if both attribute types and attribute values are to be returned.

Usage
The slapi_search_internal() routine issues a SEARCH request and returns the results to the plug-in for processing. The LDAP Version 3 protocol and the current client authentication are used for the SEARCH request. The request is unauthenticated if a client request is not being processed. Call the slapi_pblock_get() routine to obtain the search results from the returned parameter block. The following values can be retrieved from the parameter block:
- SLAPI_PLUGIN_INTOP_RESULT - The result code from the result message
- SLAPI_PLUGIN_INTOP_ERRMSG - The error message from the result message
- SLAPI_PLUGIN_INTOP_MATCHED_DN - The matched DN from the result message
- SLAPI_PLUGIN_INTOP_REFERRALS - The referrals from the result message
- SLAPI_PLUGIN_INTOP_SEARCH_ENTRIES - The search entries
- SLAPI_PLUGIN_INTOP_SEARCH_REFERRALS - The search references
slapi_search_internal()

Related topics
The function return value is the address of the plug-in parameter block or NULL if the SEARCH request is not issued. Call the slapi_pblock_destroy() routine to release the plug-in parameter block when it is no longer needed. The errno variable is set to one of the following values when the function return value is NULL:

- EINVAL A parameter is not valid
- EIO Unable to process the SEARCH request
- ENOMEM Insufficient storage is available
slapi_send_ldap_referral()

slapi_send_ldap_referral()

Purpose
Send an LDAP search referral message to the client

Format
#include <slapi-plugin.h>

int slapi_send_ldap_referral (Slapi_PBlock * pb, Slapi_Entry * entry, BerVal ** refs, BerVal *** urls)

Parameters

Input
pb The plug-in parameter block.

entry The directory entry containing the referrals. The entry name is used if a referral value does not already contain a distinguished name. NULL is specified for this parameter if the referral values are complete and do not need to have the distinguished name added.

refs The referral values from the directory entry.

Input/Output
urls This variable points to a NULL-terminated array of referral urls for LDAP Version 2 clients. The variable is initialized to NULL before the first call to the slapi_send_ldap_referral() routine for the current search request. If the client is using the LDAP Version 2 protocol, the slapi_send_ldap_referral() routine allocates and expands this array to contain the new referral urls. Call the slapi_ch_free_values() routine to release the array when it is no longer needed. NULL is specified for this parameter if the client is using the LDAP Version 3 protocol.

Usage
The slapi_send_ldap_referral() routine processes a referral entry that is within the scope of a search request. The slapi_send_ldap_result() routine is called with a result code of LDAP_PARTIAL_RESULTS (LDAP Version 2) or LDAP_REFERRAL (LDAP Version 3) if the base entry for the search is a referral entry. The slapi_send_ldap_referral() routine is called only by a pre-operation or client-operation plug-in.

If the client is using the LDAP Version 3 protocol, a search referral message is created and sent to the client. The urls parameter is not used in this case.

If the client is using the LDAP Version 2 protocol, the referral urls are accumulated using the urls parameter. Upon completion of the search request, the application calls the slapi_send_ldap_result() routine with a result code of LDAP_PARTIAL_RESULTS and provide the referral urls. The referral array is freed by calling the slapi_ch_free_values() routine.

The referral urls are modified based on the directory entry name and the search scope. The directory name is used for the distinguished name if the referral url does not contain a distinguished name. The referral scope is base if the search scope is one-level and the referral scope is sub if the search scope is sub. The slapi_send_ldap_referral() routine is not called if the search scope is base since the referral is returned in the LDAP result message and not as an LDAP search referral message.
Related topics

The function return value is 0 if the referrals have been processed or -1 if an error occurred. The *errno* variable is set to one of the following values when the function return value is -1:

- **EINVAL**: A parameter is not valid
- **EIO**: Unable to send the message
- **ENOMEM**: Insufficient storage is available
- **EPERM**: The plug-in is not a pre-operation or client-operation plug-in or the current request is not a search request
**slapi_send_ldap_result()**

**Purpose**
Send the LDAP result message to the client.

**Format**
```c
#include <slapi-plugin.h>

void slapi_send_ldap_result ( 
  Slapi_PBlock * pb, 
  int resultCode, 
  char * matchedDN, 
  char * errorText, 
  int numEntries, 
  BerVal ** referrals)
```

**Parameters**

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pb</td>
<td>The plug-in parameter block.</td>
</tr>
<tr>
<td>resultCode</td>
<td>The result code to be returned to the client.</td>
</tr>
<tr>
<td>_matchedDN</td>
<td>The matched DN returned to the client. Specify NULL for this parameter if no matched DN is returned.</td>
</tr>
<tr>
<td>_errorText</td>
<td>The error text returned to the client. Specify NULL for this parameter if no error text is returned.</td>
</tr>
<tr>
<td>numEntries</td>
<td>The number of search entries returned for the current search request. This parameter is specified as 0.</td>
</tr>
<tr>
<td>referrals</td>
<td>A NULL-terminated array of referral URLs returned to the client. Specify NULL for this parameter if no referrals are returned to the client. For the LDAP Version 3 protocol, referrals must not be specified unless the result code is LDAP_REFERRAL. For the LDAP Version 2 protocol, referrals are specified for any result code other than LDAP_SUCCESS (LDAP Version 2 referrals are appended to the error text).</td>
</tr>
</tbody>
</table>

**Usage**
The `slapi_send_ldap_result()` routine sends an LDAP result message to the LDAP client. Only one result message is returned for each LDAP request. The `slapi_send_ldap_result()` routine is called only by a pre-operation or client-operation plug-in. The `slapi_pblock_set()` routine can be called before calling the `slapi_send_ldap_result()` routine if the result message includes server controls, an extended result object identifier or an extended result value.

**Related topics**
There is no function return value.
slapi_send_ldap_search_entry()

Purpose
Send an LDAP search entry message to the client.

Format
#include <slapi-plugin.h>

int slapi_send_ldap_search_entry (
Slapi_PBlock * pb,
Slapi_Entry * entry,
LDAPControl ** controls,
char ** attrs,
int attrsonly)

Parameters
Input
pb The plug-in parameter block.
entry The directory entry.
controls A NULL-terminated array of LDAP controls returned with the search entry message.
Specify NULL for the array address if no controls should be returned.
attrs A NULL-terminated array of attribute types returned in the search entry message. Specify
NULL for the array address if all attributes are returned. Specify an array with just the
NULL entry if no attributes are returned. Operational attributes are returned only if they are
explicitly specified.
attrsonly Specify 1 to return only the attribute types and 0 to return the attribute types and values.

Usage
The slapi_send_ldap_search_entry() routine sends an LDAP search entry message to the LDAP client.
The slapi_send_ldap_search_entry() routine is called only by a pre-operation or client-operation plug-in.
The slapi_send_ldap_search_entry() routine is called for each directory entry that matches the search
parameters. The slapi_send_ldap_referral() routine is called to return a search referral message to the
client.

Related topics
The function return value is 0 if the search entry message is sent or -1 if an error occurred. The errno
variable is set to one of the following values when the function return value is -1:

ECANCELED Client has cancelled the request
EINVAL A parameter is not valid
EIO Unable to send the message
ENOMEM Insufficient storage is available
EPERM The plug-in is not a pre-operation or client-operation plug-in or the current
request is not a search request
ESRCH Attribute type is not defined in LDAP schema
slapi_trace()

slapi_trace()

Purpose
Writes an LDAP server trace message.

Format
#include <slapi-plugin.h>

void * slapi_trace (  
  long long traceLevel,  
  char * subsystem,  
  char * fmt, ...  )

Parameters

Input

traceLevel    Trace level of the message. Trace level must be one of the following:
  • LDAP_DEBUG_ACL
  • LDAP_DEBUG_ARGS
  • LDAP_DEBUG_BE_CAPABILITIES
  • LDAP_DEBUG_BER
  • LDAP_DEBUG_CACHE
  • LDAP_DEBUG_CONNS
  • LDAP_DEBUG_ERROR
  • LDAP_DEBUG_FILTER
  • LDAP_DEBUG_INFO
  • LDAP_DEBUG_LDAPBE
  • LDAP_DEBUG_LDBM
  • LDAP_DEBUG_MESSAGE
  • LDAP_DEBUG_MULTISERVER
  • LDAP_DEBUG_PACKETS
  • LDAP_DEBUG_PERFORMANCE
  • LDAP_DEBUG_PLUGIN
  • LDAP_DEBUG_REFERRAL
  • LDAP_DEBUG_REPL
  • LDAP_DEBUG_SCHEMA
  • LDAP_DEBUG_SDBM
  • LDAP_DEBUG_STATS
  • LDAP_DEBUG_STRBUF
  • LDAP_DEBUG_SYSPLEX
  • LDAP_DEBUG_TDBM
  • LDAP_DEBUG_THREAD
  • LDAP_DEBUG_TRACE

The trace level can be combined with (logical or) LDAP_USE_CTRACE, to write the message using the LDAP server CTRACE in-memory tracing.

fmt, ...    Message you want traced. This message can be in printf()-style format. Only the following printf()-style substitution codes are supported:
Table 22. printf()-style substitution codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>%d</td>
<td>signed integer</td>
</tr>
<tr>
<td>%ld</td>
<td>signed long integer</td>
</tr>
<tr>
<td>%u</td>
<td>unsigned integer</td>
</tr>
<tr>
<td>%lu</td>
<td>unsigned long integer</td>
</tr>
<tr>
<td>%x</td>
<td>lowercase hexadecimal unsigned integer (specify %08x or %8.8x for an 8-character value with zero-fill)</td>
</tr>
<tr>
<td>%lx</td>
<td>lowercase hexadecimal unsigned long integer</td>
</tr>
<tr>
<td>%X</td>
<td>uppercase hexadecimal unsigned integer (specify %08X or %8.8X for an 8-character value with zero-fill)</td>
</tr>
<tr>
<td>%lX</td>
<td>uppercase hexadecimal unsigned long integer</td>
</tr>
<tr>
<td>%p</td>
<td>pointer</td>
</tr>
<tr>
<td>%c</td>
<td>EBCDIC character</td>
</tr>
<tr>
<td>%s</td>
<td>EBCDIC string</td>
</tr>
</tbody>
</table>

Usage

1. The `slapi_trace()` routine formats a message and uses either the LDAP server debug trace functions or the CTRACE in-memory trace functions to write the message.

2. When initially writing a plug-in, you should use the LDAP_DEBUG_PLUGIN trace level. As the complexity of the plug-in grows, use the other trace levels to refine or reduce LDAP server trace output.

3. See [IBM Tivoli Directory Server Administration and Use for z/OS](#) for more information on LDAP server debug level tracing and CTRACE in-memory tracing in the Running the LDAP server chapter.

4. The message will be written using the LDAP server CTRACE in-memory trace functions by combining LDAP_USE_CTRACE with the `slapi_trace()` trace level.

5. Examples (<italics>) are filled in with the appropriate system and LDAP server information):
   - `slapi_trace ( LDAP_DEBUG_PLUGIN, "MyPLUG", "Attempting to read data." );`

      When LDAP server debugging is enabled and the debug level includes PLUGIN, formats, and traces the message:
      
      <date time><thread info> PLUGIN:MyPLUG: <function name>: Attempting to read data.
      
   - `slapi_trace ( LDAP_DEBUG_TRACE, ThisPLUG, "%d data bytes were read.", bytesIn );`

      When LDAP server debugging is enabled and the debug level includes TRACE, formats, and traces the message:
      
      <date time><thread info> TRACE: ThisPLUG: <function name>: value of bytesIn> data bytes were read.

   - `slapi_trace ( LDAP_DEBUG_PLUGIN | LDAP_USE_CTRACE, "PLUG", "I'm at this point." );`

      When LDAP server debugging is enabled and the debug level includes PLUGIN, formats, and traces the message using CTRACE in-memory tracing:
      
      <date time><thread info> PLUGIN:PLUG: <function name>: I'm at this point.

Related topics

None.
slapi_trace()
Appendix A. Plug-in sample

The sample plug-in and its makefile are located in /usr/lpp/ldap/examples.

The sample plug-in, /usr/lpp/ldap/examples/plugin_sample.c creates a post-operation plug-in that logs LDAP server BIND requests and results codes to a specified file. The specified file is an input parameter to the sample plug-in.

The makefile, /usr/lpp/ldap/examples/makefile.plugin can be used to build plugin_sample.c.

Steps for building and running a sample plug-in

How to build and run a sample plug-in:
1. Start by creating either a PDS or a PDSE dataset with the same attributes as SYS1.SIEALNKE. A PDSE dataset is required when building the plug-in sample as a 64-bit module.
2. APF authorize the dataset created.
3. Ensure the dataset is in the load list for the LDAP server, either through a STEPLIB statement or the system LNKLIST.
4. Edit /usr/lpp/ldap/examples/makefile.plugin and update PLUGSAMP_DLL with the name of the dataset you created. For example:
   PLUGSAMP_DLL = "//GLD.PLLUGSAMP_SIEALNKE(PLUGSAMP)"

   Also, if you are building a 64-bit DLL, set PLUGSAMP_ADDR_MODE to 64.
5. Save makefile.plugin
6. To compile and linkedit the sample plug-in using the makefile.plugin, enter make -f makefile.plugin.
7. Verify that no build or link errors occurred. Verify that your dataset now contains the member PLUGSAMP, or a member with the name you updated.
8. Stop the server.
9. Edit the LDAP server configuration file and add the plugin configuration option to the global section:
   plugin postOperation PLUGSAMP plugin_init "logFilename"

   where, "logFilename" is the name of the file you wish to have the log records written to, and it must be in double quotes.
10. If you are building a 64-bit DLL, then add the plugin configuration option in the following format:
    plugin postOperation PLUGSM31/PLUGSAMP plugin_init "logFilename"

    Note: For this 64-bit example, it is assumed PLUGSAMP is the name used when the 64-bit DLL was built, as shown above. The name PLUGSM31 is a place holder name for the plugin configuration option. It can be any name and no DLL with that name needs to exist.

    See IBM Tivoli Directory Server Administration and Use for z/OS Chapter 8. Customizing the LDAP server configuration, for a complete description of the plugin configuration option and its parameters.
11. Restart the LDAP server.

If you use the debug parameter PLUGIN, sample plug-in trace messages will be written to the LDAP server job log. For example:
START LDAPSRV,PARMS=\'-d PLUGIN'"
To test, perform an LDAP operation binding to the LDAP server. The sample plug-in will write a message to the log including the result code of the bind operation and the bind DN. For example:

Result: 0 DN: o=your company

See Chapter 2, “Building an LDAP server plug-in” for more information on building and writing a z/OS LDAP server plug-in.
Appendix B. Accessibility

Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/OS enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using assistive technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/OS. Consult the assistive technology documentation for specific information when using such products to access z/OS interfaces.

Keyboard navigation of the user interface

Users can access z/OS user interfaces using TSO/E or ISPF. Refer to z/OS TSO/E Primer and z/OS ISPF User’s Guide Vol I for information about accessing TSO/E and ISPF interfaces. These guides describe how to use TSO/E and ISPF, including the use of keyboard shortcuts or function keys (PF keys). Each guide includes the default settings for the PF keys and explains how to modify their functions.

z/OS information

z/OS information is accessible using screen readers with the BookServer/Library Server versions of z/OS books in the Internet library at: http://www.ibm.com/systems/z/os/zos/bkserv/
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**Programming interface information**

*IBM Tivoli Directory Server Plug-in Reference for z/OS* primarily documents intended Programming Interfaces that allow the customer to write programs to obtain services of z/OS LDAP.

*IBM Tivoli Directory Server Plug-in Reference for z/OS* also documents information that is not intended to be used as Programming Interfaces of z/OS LDAP. This information is identified where it occurs with an introductory statement to a topic.

**Policy for unsupported hardware**

Various z/OS elements, such as DFSMS™, HCD, JES2, JES3, and MVS™, contain code that supports specific hardware servers or devices. In some cases, this device-related element support remains in the product even after the hardware devices pass their announced End of Service date. z/OS may continue to service element code; however, it will not provide service related to unsupported hardware devices. Software problems related to these devices will not be accepted for service, and current service activity will cease if a problem is determined to be associated with out-of-support devices. In such cases, fixes will not be issued.

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This bibliography provides a list of publications that are useful when using the LDAP programming interface:

- IBM Tivoli Directory Server Administration and Use for z/OS, SC23-5191
- IBM Tivoli Directory Server Client Programming for z/OS
- z/OS Collection, SK3T-4269
- z/OS Communications Server: IP Configuration Guide, SC31-8775
- z/OS Cryptographic Services System SSL Programming, SC24-5901
- z/OS XL C/C++ Programming Guide, SC09-4765
- z/OS DCE Application Development Guide: Directory Services, SC24-5906
- z/OS Information Roadmap, SA22-7500
- z/OS Integrated Security Services Network Authentication Service Administration, SC24-5926
- z/OS Language Environment Customization, SA22-7564
- z/OS UNIX System Services Command Reference, SA22-7802
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z/OS
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