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).

Intended audience

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.

For a list of titles and order numbers of the documents that are useful for IBM Tivoli Directory Server for z/OS, see Bibliography.
**Softcopy publications**

The IBM Tivoli Directory Server library is available on the following DVD softcopy collection in both BookManager® and Portable Document Format (PDF) files. The collection includes Softcopy Reader, which is a program that enables you to view the BookManager files. You can view or print the PDF files with an Adobe Reader.

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**IBM systems center publications**

IBM systems centers produce documents known as IBM Redbooks® that can help you set up and use IBM Tivoli Directory Server for z/OS. See the IBM Redbooks site at [http://www.redbooks.ibm.com/](http://www.redbooks.ibm.com/).

These documents have not been subjected to any formal review nor have they been checked for technical accuracy, but they represent current product understanding (at the time of their publication) and provide valuable information about a wide range of IBM Tivoli Directory Server for z/OS topics. They are not shipped with IBM Tivoli Directory Server for z/OS; you must order them separately.

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The z/OS Basic Skills Information Center is a Web-based information resource intended to help users learn the basic concepts of z/OS, the operating system that runs most of the IBM mainframe computers in use today. The Information Center is designed to introduce a new generation of Information Technology professionals to basic concepts and help them prepare for a career as a z/OS professional, such as a z/OS system programmer.

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- Provide basic education and information about z/OS without charge
- Shorten the time it takes for people to become productive on the mainframe
- Make it easier for new people to learn z/OS.
To access the z/OS Basic Skills Information Center, open your Web browser to the following Web site, which is available to all users (no login required):

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Summary of changes

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

Changes made in z/OS Version 1 Release 13

This document contains information that was previously presented in z/OS IBM Tivoli Directory Server Plug-in Reference, SA76-0148-00, which supports z/OS Version 1 Release 10.

New information:

- The "Readers' Comments - We'd Like to Hear from You" section at the back of this publication has been replaced with "How to send your comments to IBM" on page xi. The hardcopy mail-in form has been replaced with a page that provides information appropriate for submitting readers comments to IBM.
- The operation plug-ins have been updated to support paged and sorted search results.
- The slapi_search_internal() and slapi_send_ldap_search_entry() plug-in application service routines have been updated to support paged and sorted search results.
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 plug-in 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, Customizing the LDAP server configuration] chapter. 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 is 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 by 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 that 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 might 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 87:

- /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 is not 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 nonzero 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.

If the client request is a paged search request, pre-operation plug-ins are only executed before the initial paged search request.

### 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 is not 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.
If the client request is a paged search request, post-operation plug-ins are only executed after the last page of a paged search request is returned.

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.

If the client request is a paged search request, the client-operation plug-in is only called during the initial paged search request.

**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 `GLDSSLP31.x` and `GLDSSLP64.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

```c
#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()

slapi_attr_get_normalized_values()

Purpose
Obtain the normalized attribute values.

Format
#include <slapi-plugin.h>

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

Parameters
Input
attr
The directory entry attribute.

Output
vals
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.

Usage
The slapi_attr_get_normalized_values() routine returns the address of the array of normalized attribute values. The attribute values are normalized by 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()

Purpose
Obtain the number of attribute values.

Format
#include <slapi-plugin.h>

int slapi_attr_get_numvalues ( 
   Slapi_Attr *       attr, 
   int *             numValues)

Parameters
Input
attr        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**

```c
#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 primary attribute name, in lowercase, 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

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>attr</code></td>
<td>The directory entry attribute.</td>
</tr>
<tr>
<td><code>values1</code></td>
<td>The first attribute value.</td>
</tr>
<tr>
<td><code>values2</code></td>
<td>The second attribute value.</td>
</tr>
</tbody>
</table>

Usage

The `slapi_attr_value_cmp()` routine compares two values by 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
**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

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>ptr</code></td>
<td>The address of the storage is released.</td>
</tr>
</tbody>
</table>

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**

```c
#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()

**Purpose**
Issue a COMPARE request.

**Format**
```c
#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 wanted 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 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 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_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

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

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**
```c
#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 primary attribute type name, in lowercase, in the LDAP schema definition. Any semicolons used to separate relative distinguished names (RDNs) 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 by 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 attribute type in lowercase.

**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:
slapi_dn_ignore_case_v3()

EINVAL  A parameter is not valid
ENOMEM  Insufficient storage is available

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

Purpose
Determine whether 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 by 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=#04084a6f686e20446f4e53,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 attribute type in lowercase.

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
slapi_dn_normalize_v3()

ENOMEM Insufficient storage is available

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

Purpose
Normalize a distinguished name and convert not case-sensitive 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 not case-sensitive, otherwise the case of the attribute value is preserved
• Special characters within a DN are represented by 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=#04084a6f686e220446f65,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 attribute type, in uppercase, and the attribute matching rule is caseIgnoreMatch.

**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 is returned if a NULL DN is passed in and EINVAL is 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 not case-sensitive 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 by 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**

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>entry</td>
<td>The directory entry.</td>
</tr>
<tr>
<td>type</td>
<td>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.</td>
</tr>
<tr>
<td>value</td>
<td>A NULL-terminated array of values to be added.</td>
</tr>
</tbody>
</table>

**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 not case-sensitive 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 value is not normalized by 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

```c
#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
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 not case-sensitive 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 not case-sensitive compare is used when searching for the attribute type. The attribute name in the returned attribute is the primary attribute name in lowercase, 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()

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 not case-sensitive 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 by 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
#include <slapi-plugin.h>

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

Parameters

Input

entry       The directory entry.

Input

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.

Input

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 not case-sensitive 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 by 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
```c
#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

```c
#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()

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 not case-sensitive 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 by 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 not case-sensitive 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 value is not normalized by 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:
- 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_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()

slapi_entry_replace_value()

**Purpose**
Replace the attribute values in a directory entry.

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

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

**Parameters**

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>entry</td>
<td>The directory entry.</td>
</tr>
<tr>
<td>type</td>
<td>The attribute name. This is the attribute object identifier, the primary attribute name, or an alternate attribute name as defined in the LDAP schema.</td>
</tr>
<tr>
<td>value</td>
<td>The replacement attribute value. Specify NULL to remove all of the values for the attribute (the attribute is created if it does not exist).</td>
</tr>
</tbody>
</table>

**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 not case-sensitive 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 by 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 not  
case-sensitive 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 by 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  
ocurred. 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 by 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 cannot 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:

EDOM Obsolete attribute type or object class
EEXIST Single-valued attribute has multiple values
EILSEQ An auxiliary object class is a base object class or there is not one and only one structural object class
EINVAL A parameter is not valid
ENOENT Required attribute not found
ENOMEM Insufficient storage is available
EPERM Attribute cannot be modified by user
ERANGE Attribute not allowed by object class
ESRCH Undefined attribute type or object class
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

Output

Output

Output

Output

Output

Output

Output

Output

Output

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 primary attribute name, in lowercase, 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

```c
#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 primary attribute name, in lowercase, as defined in the LDAP schema. The assertion value is normalized by 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=*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.
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 primary attribute name, in lowercase, as defined in the LDAP schema. The substrings are normalized by 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 \texttt{(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 \texttt{errno} variable is set to one of the following values when the function return value is -1:

\begin{itemize}
  \item \texttt{EILSEQ} unable to normalize attribute value
\end{itemize}
slapi_filter_get_subfilt()

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EINVAL</td>
<td>A parameter is not valid</td>
</tr>
<tr>
<td>EPERM</td>
<td>The filter does not have substrings</td>
</tr>
<tr>
<td>ESRCH</td>
<td>Attribute type is not defined in LDAP schema</td>
</tr>
</tbody>
</table>
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()

Purpose

Obtain the next subfilter.

Format

```c
#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 the client BIND DN is contained in the SDBM backend.

**Format**
```c
#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

```c
#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 use 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.
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 is always 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](#) for more information about the use of LDAP_CONSOLE_LEVEL, activity logging, and LDAP server configuration.

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

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

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.\n" );`

  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 are 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 are excluded.

**Related topics**

None.
**slapi_modify_internal()**

**Purpose**
Issue a modify request.

**Format**

```c
#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**
Retrieves 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 is 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>
</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_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>
<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: SLAPI_PLUGIN_PREOPERATION SLAPI_PLUGIN_CLIENTOPERATION 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, abandoned, or an unbind occurs. The plug-in registers a SLAPI_PLUGIN_DISCONNECT_FN if it must be informed when a client connection is closed, abandoned, or an unbind occurs.</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>
</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_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>
<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_SAF_ID</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 creates SLAPI_ENTRY whenever an add is requested. This function returns the address of the entry. This entry is 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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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>
<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 primary attribute name, in lowercase, 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>
</tbody>
</table>
### Table 10. EXTENDED OPERATION request parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<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 are 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>
<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 primary attribute names in lowercase 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>
</tbody>
</table>
### Table 13. SEARCH request parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLAPI_SEARCH_DEREF</td>
<td>int</td>
<td>Alias dereferencing: LDAP_DEREF_NEVER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LDAP_DEREF_FINDING</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LDAP_DEREF_SEARCHING</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LDAP_SCOPE_BASE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LDAP_SCOPE_ONELEVEL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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>
<tr>
<td>SLAPI_CALLBACK_TYPE</td>
<td>int</td>
<td>The callback type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLAPI_TYPE_DN_PW to obtain the password for a distinguished name</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLAPI_TYPE_UID_PW to obtain the password for a user name</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLAPI_TYPE_GROUPS to obtain the group list for a distinguished name</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SLAPI_TYPE_ALT_NAMES to obtain the Kerberos alternate names</td>
</tr>
</tbody>
</table>
### slapi_pblock_get()

#### 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 <code>slapi_send_ldap_result()</code> 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
- EPERM: Insufficient storage is available
**slapi_pblock_set()**

**Purpose**

**Format**

```c
#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>
</tbody>
</table>
### Table 17. Registration parameters (continued)

<table>
<thead>
<tr>
<th>Name</th>
<th>Format</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<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>
<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_CTL_LIST</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_SUFIX</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>
</tbody>
</table>
### Table 18. 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>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 <code>slapi_pblock_get()</code> 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>
<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 does not 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

```c
#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. The pagedResults (OID 1.2.840.113556.1.4.319) server control is not supported on an internal SEARCH request.
- **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()**

**Purpose**

Send an LDAP search referral message to the client

**Format**

```c
#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 require 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 by 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.
slapi_send_ldap_referral()

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
```
#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. A matched DN must not be specified unless the result code is: LDAP_ALIAS_DEREF_PROBLEM</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. Error text is not specified if the result code is LDAP_SUCCESS.</td>
</tr>
<tr>
<td>numEntries</td>
<td>The number of search entries returned for the current search request. This parameter is specified as 0. This parameter is obsolete and is included for compatibility with other LDAP implementations.</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.
slapi_send_ldap_result()

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.

If the client search request specified a valid pagedResults (OID 1.2.840.113556.1.4.319) or SortKeyRequest (OID 1.2.840.113556.1.4.473) server control, the LDAP server performs paging or sorting of search entries after the search operation has returned from all pre-operation plug-ins, client-operation plug-ins, and LDAP server backend calls.

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 canceled the request
- EINVAL: A parameter is not valid
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EIO</td>
<td>Unable to send the message</td>
</tr>
<tr>
<td>ENOMEM</td>
<td>Insufficient storage is available</td>
</tr>
<tr>
<td>EPERM</td>
<td>The plug-in is not a pre-operation or client-operation plug-in or the current request is not a search request</td>
</tr>
<tr>
<td>ESRCH</td>
<td>Attribute type is not defined in LDAP schema</td>
</tr>
</tbody>
</table>
Purpose

Writes an LDAP server trace message.

Format

```c
#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 by using the LDAP server CTRACE in-memory tracing.
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 about LDAP server debug level tracing and CTRACE in-memory tracing in the Running the LDAP server chapter.

4. The message is written by 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 by 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 data set with the same attributes as SYS1.SIEALNKE. A PDSE data set is required when building the plug-in sample as a 64-bit module.
2. APF authorize the data set created.
3. Ensure that the data set is in the load list for the LDAP server, either through a STEPLIB statement or the system LNKLST.
4. Edit /usr/lpp/ldap/examples/makefile.plugin and update PLUGSAMP_DLL with the name of the data set you created. For example:

   PLUGSAMP_DLL = "G1D.PLUGIN.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 by using the makefile.plugin, enter make -f makefile.plugin.
7. Verify that no build or link errors occurred. Verify that your data set 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 want to have the log records written to, and it must be in double quotation marks.
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 must exist.

    See IBM Tivoli Directory Server Administration and Use for z/OS, Customizing the LDAP server configuration chapter, 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 is written to the LDAP server job log. For example:

```
START LDAPSRV,PARMS='\-d PLUGIN'
```

where, **LDAPSRV** is an example name and represents the name of your LDAP server start-up procedure.

When started, browse your LDAP server job log for plug-in initialization and trace messages. Also, the sample plug-in creates an empty log file. Verify that it was created.

To test, perform an LDAP operation binding to the LDAP server. The sample plug-in writes 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 about building and writing a z/OS LDAP server plug-in.
Appendix B. Accessibility

Publications for this product are offered in Adobe Portable Document Format (PDF) and should be compliant with accessibility standards. If you experience difficulties when using PDF files, you may view the information through the z/OS Internet Library website or the z/OS Information Center. If you continue to experience problems, send an email to mhvrcfs@us.ibm.com or write to:

IBM Corporation
Attention: MHVRCFS Reader Comments
Department H6MA, Building 707
2455 South Road
Poughkeepsie, NY 12601-5400
U.S.A.

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

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

Using assistive technologies

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

Keyboard navigation of the user interface

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

z/OS information

z/OS information is accessible using screen readers with the BookServer or 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* 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.

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UNIX is a registered trademark of The Open Group in the United States and other countries.
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*, SA23-2214
- *IBM Tivoli Directory Server Messages and Codes for z/OS*, SA23-2262
- *z/OS Collection*, SK3T-4271
- *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 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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