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Internet Assigned Numbers Authority (IANA) Considerations for the Lightweight Directory Access Protocol (LDAP)

Status of This Memo

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Abstract

This document provides procedures for registering extensible elements of the Lightweight Directory Access Protocol (LDAP). The document also provides guidelines to the Internet Assigned Numbers Authority (IANA) describing conditions under which new values can be assigned.

1. Introduction

The Lightweight Directory Access Protocol [RFC4510] (LDAP) is an extensible protocol. LDAP supports:

- the addition of new operations,
- the extension of existing operations, and
- the extensible schema.

This document details procedures for registering values used to unambiguously identify extensible elements of the protocol, including the following:

- LDAP message types
- LDAP extended operations and controls
- LDAP result codes
- LDAP authentication methods
- LDAP attribute description options
- Object Identifier descriptors

These registries are maintained by the Internet Assigned Numbers Authority (IANA).

In addition, this document provides guidelines to IANA describing the conditions under which new values can be assigned.

This document replaces RFC 3383.

2. Terminology and Conventions

This section details terms and conventions used in this document.

2.1. Policy Terminology

The terms "IESG Approval", "Standards Action", "IETF Consensus", "Specification Required", "First Come First Served", "Expert Review", and "Private Use" are used as defined in BCP 26 [RFC2434].

The term "registration owner" (or "owner") refers to the party authorized to change a value's registration.

2.2. Requirement Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119]. In this case, "the specification", as used by BCP 14, refers to the processing of protocols being submitted to the IETF standards process.

2.3. Common ABNF Productions

A number of syntaxes in this document are described using ABNF [RFC4234]. These syntaxes rely on the following common productions:

```
ALPHA = %x41-5A / %x61-7A      ; "A"-"Z" / "a"-"z"
LDIGIT = %x31-39               ; "1"-"9"
DIGIT = %x30 / LDIGIT          ; "0"-"9"
HYPHEN = %x2D                  ; "-"
DOT = %x2E                     ; "."
number = DIGIT / ( LDIGIT 1*DIGIT )
keychar = ALPHA / DIGIT / HYPHEN
leadkeychar = ALPHA
keystring = leadkeychar *keychar
keyword = keystring
```

Keywords are case insensitive.

3. IANA Considerations for LDAP

This section details each kind of protocol value that can be registered and provides IANA guidelines on how to assign new values.

IANA may reject obviously bogus registrations.

LDAP values specified in RFCs MUST be registered. Other LDAP values, except those in private-use name spaces, SHOULD be registered. RFCs SHOULD NOT reference, use, or otherwise recognize unregistered LDAP values.

3.1. Object Identifiers

Numerous LDAP schema and protocol elements are identified by Object Identifiers (OIDs) [X.680]. Specifications that assign OIDs to elements SHOULD state who delegated the OIDs for their use.

For IETF-developed elements, specifications SHOULD use OIDs under "Internet Directory Numbers" (1.3.6.1.1.x). For elements developed by others, any properly delegated OID can be used, including those under "Internet Directory Numbers" (1.3.6.1.1.x) or "Internet Private Enterprise Numbers" (1.3.6.1.4.1.x).

Internet Directory Numbers (1.3.6.1.1.x) will be assigned upon Expert Review with Specification Required. Only one OID per specification will be assigned. The specification MAY then assign any number of OIDs within this arc without further coordination with IANA.

Internet Private Enterprise Numbers (1.3.6.1.4.1.x) are assigned by IANA <<http://www.iana.org/cgi-bin/enterprise.pl>>. Practices for IANA assignment of Internet Private Enterprise Numbers are detailed in RFC 2578 [RFC2578].

To avoid interoperability problems between early implementations of a "work in progress" and implementations of the published specification (e.g., the RFC), experimental OIDs SHOULD be used in "works in progress" and early implementations. OIDs under the Internet Experimental OID arc (1.3.6.1.3.x) may be used for this purpose. Practices for IANA assignment of these Internet Experimental numbers are detailed in RFC 2578 [RFC2578].

3.2. Protocol Mechanisms

LDAP provides a number of Root DSA-Specific Entry (DSE) attributes for discovery of protocol mechanisms identified by OIDs, including the supportedControl, supportedExtension, and supportedFeatures attributes [RFC4512].

A registry of OIDs used for discovery of protocol mechanisms is provided to allow implementors and others to locate the technical specification for these protocol mechanisms. Future specifications of additional Root DSE attributes holding values identifying protocol mechanisms MAY extend this registry for their values.

Protocol mechanisms are registered on a First Come First Served basis.

3.3. LDAP Syntaxes

This registry provides a listing of LDAP syntaxes [RFC4512]. Each LDAP syntax is identified by an OID. This registry is provided to allow implementors and others to locate the technical specification describing a particular LDAP Syntax.

LDAP Syntaxes are registered on a First Come First Served with Specification Required basis.

Note: Unlike object classes, attribute types, and various other kinds of schema elements, descriptors are not used in LDAP to identify LDAP Syntaxes.

3.4. Object Identifier Descriptors

LDAP allows short descriptive names (or descriptors) to be used instead of a numeric Object Identifier to identify select protocol extensions [RFC4511], schema elements [RFC4512], LDAP URL [RFC4516] extensions, and other objects.

Although the protocol allows the same descriptor to refer to different object identifiers in certain cases and the registry supports multiple registrations of the same descriptor (each indicating a different kind of schema element and different object identifier), multiple registrations of the same descriptor are to be avoided. All such multiple registration requests require Expert Review.

Descriptors are restricted to strings of UTF-8 [RFC3629] encoded Unicode characters restricted by the following ABNF:

name = keystring

Descriptors are case insensitive.

Multiple names may be assigned to a given OID. For purposes of registration, an OID is to be represented in numeric OID form (e.g., 1.1.0.23.40) conforming to the following ABNF:

numericoid = number 1*(DOT number)

While the protocol places no maximum length restriction upon descriptors, they should be short. Descriptors longer than 48 characters may be viewed as too long to register.

A value ending with a hyphen ("-") reserves all descriptors that start with that value. For example, the registration of the option "descrFamily-" reserves all options that start with "descrFamily-" for some related purpose.

Descriptors beginning with "x-" are for Private Use and cannot be registered.

Descriptors beginning with "e-" are reserved for experiments and will be registered on a First Come First Served basis.

All other descriptors require Expert Review to be registered.

The registrant need not "own" the OID being named.

The OID name space is managed by the ISO/IEC Joint Technical Committee 1 - Subcommittee 6.

3.5. AttributeDescription Options

An AttributeDescription [RFC4512] can contain zero or more options specifying additional semantics. An option SHALL be restricted to a string of UTF-8 encoded Unicode characters limited by the following ABNF:

option = kestring

Options are case insensitive.

While the protocol places no maximum length restriction upon option strings, they should be short. Options longer than 24 characters may be viewed as too long to register.

Values ending with a hyphen ("-") reserve all option names that start with the name. For example, the registration of the option "optionFamily-" reserves all options that start with "optionFamily-" for some related purpose.

Options beginning with "x-" are for Private Use and cannot be registered.

Options beginning with "e-" are reserved for experiments and will be registered on a First Come First Served basis.

All other options require Standards Action or Expert Review with Specification Required to be registered.

3.6. LDAP Message Types

Each protocol message is encapsulated in an LDAPMessage envelope [RFC4511]. The protocolOp CHOICE indicates the type of message encapsulated. Each message type consists of an ASN.1 identifier in the form of a keyword and a non-negative choice number. The choice number is combined with the class (APPLICATION) and data type (CONSTRUCTED or PRIMITIVE) to construct the BER tag in the message's encoding. The choice numbers for existing protocol messages are implicit in the protocol's ASN.1 defined in [RFC4511].

New values will be registered upon Standards Action.

Note: LDAP provides extensible messages that reduce but do not eliminate the need to add new message types.

3.7. LDAP Authentication Method

The LDAP Bind operation supports multiple authentication methods [RFC4511]. Each authentication choice consists of an ASN.1 identifier in the form of a keyword and a non-negative integer.

The registrant SHALL classify the authentication method usage using one of the following terms:

- | | |
|-------------|--|
| COMMON | - method is appropriate for common use on the Internet. |
| LIMITED USE | - method is appropriate for limited use. |
| OBSOLETE | - method has been deprecated or otherwise found to be inappropriate for any use. |

Methods without publicly available specifications SHALL NOT be classified as COMMON. New registrations of the class OBSOLETE cannot be registered.

New authentication method integers in the range 0-1023 require Standards Action to be registered. New authentication method integers in the range 1024-4095 require Expert Review with Specification Required. New authentication method integers in the range 4096-16383 will be registered on a First Come First Served basis. Keywords associated with integers in the range 0-4095 SHALL NOT start with "e-" or "x-". Keywords associated with integers in

the range 4096-16383 SHALL start with "e-". Values greater than or equal to 16384 and keywords starting with "x-" are for Private Use and cannot be registered.

Note: LDAP supports Simple Authentication and Security Layers [RFC4422] as an authentication choice. SASL is an extensible authentication framework.

3.8. LDAP Result Codes

LDAP result messages carry a resultCode enumerated value to indicate the outcome of the operation [RFC4511]. Each result code consists of an ASN.1 identifier in the form of a keyword and a non-negative integer.

New resultCode integers in the range 0-1023 require Standards Action to be registered. New resultCode integers in the range 1024-4095 require Expert Review with Specification Required. New resultCode integers in the range 4096-16383 will be registered on a First Come First Served basis. Keywords associated with integers in the range 0-4095 SHALL NOT start with "e-" or "x-". Keywords associated with integers in the range 4096-16383 SHALL start with "e-". Values greater than or equal to 16384 and keywords starting with "x-" are for Private Use and cannot be registered.

3.9. LDAP Search Scope

LDAP SearchRequest messages carry a scope-enumerated value to indicate the extent of search within the DIT [RFC4511]. Each search value consists of an ASN.1 identifier in the form of a keyword and a non-negative integer.

New scope integers in the range 0-1023 require Standards Action to be registered. New scope integers in the range 1024-4095 require Expert Review with Specification Required. New scope integers in the range 4096-16383 will be registered on a First Come First Served basis. Keywords associated with integers in the range 0-4095 SHALL NOT start with "e-" or "x-". Keywords associated with integers in the range 4096-16383 SHALL start with "e-". Values greater than or equal to 16384 and keywords starting with "x-" are for Private Use and cannot be registered.

3.10. LDAP Filter Choice

LDAP filters are used in making assertions against an object represented in the directory [RFC4511]. The Filter CHOICE indicates a type of assertion. Each Filter CHOICE consists of an ASN.1 identifier in the form of a keyword and a non-negative choice number.

The choice number is combined with the class (APPLICATION) and data type (CONSTRUCTED or PRIMITIVE) to construct the BER tag in the message's encoding.

Note: LDAP provides the extensibleMatching choice, which reduces but does not eliminate the need to add new filter choices.

3.11. LDAP ModifyRequest Operation Type

The LDAP ModifyRequest carries a sequence of modification operations [RFC4511]. Each kind (e.g., add, delete, replace) of operation consists of an ASN.1 identifier in the form of a keyword and a non-negative integer.

New operation type integers in the range 0-1023 require Standards Action to be registered. New operation type integers in the range 1024-4095 require Expert Review with Specification Required. New operation type integers in the range 4096-16383 will be registered on a First Come First Served basis. Keywords associated with integers in the range 0-4095 SHALL NOT start with "e-" or "x-". Keywords associated with integers in the range 4096-16383 SHALL start with "e-". Values greater than or equal to 16384 and keywords starting with "x-" are for Private Use and cannot be registered.

3.12. LDAP authzId Prefixes

Authorization Identities in LDAP are strings conforming to the <authzId> production [RFC4513]. This production is extensible. Each new specific authorization form is identified by a prefix string conforming to the following ABNF:

```
prefix = keystack COLON
COLON = %x3A ; COLON (":" U+003A)
```

Prefixes are case insensitive.

While the protocol places no maximum length restriction upon prefix strings, they should be short. Prefixes longer than 12 characters may be viewed as too long to register.

Prefixes beginning with "x-" are for Private Use and cannot be registered.

Prefixes beginning with "e-" are reserved for experiments and will be registered on a First Come First Served basis.

All other prefixes require Standards Action or Expert Review with Specification Required to be registered.

3.13. Directory Systems Names

The IANA-maintained "Directory Systems Names" registry [IANADSN] of valid keywords for well-known attributes was used in the LDAPv2 string representation of a distinguished name [RFC1779]. LDAPv2 is now Historic [RFC3494].

Directory systems names are not known to be used in any other context. LDAPv3 [RFC4514] uses Object Identifier Descriptors [Section 3.2] (which have a different syntax than directory system names).

New Directory System Names will no longer be accepted. For historical purposes, the current list of registered names should remain publicly available.

4. Registration Procedure

The procedure given here MUST be used by anyone who wishes to use a new value of a type described in Section 3 of this document.

The first step is for the requester to fill out the appropriate form. Templates are provided in Appendix A.

If the policy is Standards Action, the completed form SHOULD be provided to the IESG with the request for Standards Action. Upon approval of the Standards Action, the IESG SHALL forward the request (possibly revised) to IANA. The IESG SHALL be regarded as the registration owner of all values requiring Standards Action.

If the policy is Expert Review, the requester SHALL post the completed form to the <directory@apps.ietf.org> mailing list for public review. The review period is two (2) weeks. If a revised form is later submitted, the review period is restarted. Anyone may subscribe to this list by sending a request to <directory-request@apps.ietf.org>. During the review, objections may be raised by anyone (including the Expert) on the list. After completion of the review, the Expert, based on public comments, SHALL either approve the request and forward it to the IANA OR deny the request. In either case, the Expert SHALL promptly notify the requester of the action. Actions of the Expert may be appealed [RFC2026]. The Expert is appointed by Applications Area Directors. The requester is viewed as the registration owner of values registered under Expert Review.

If the policy is First Come First Served, the requester SHALL submit the completed form directly to the IANA: <iana@iana.org>. The requester is viewed as the registration owner of values registered under First Come First Served.

Neither the Expert nor IANA will take position on the claims of copyright or trademark issues regarding completed forms.

Prior to submission of the Internet Draft (I-D) to the RFC Editor but after IESG review and tentative approval, the document editor SHOULD revise the I-D to use registered values.

5. Registration Maintenance

This section discusses maintenance of registrations.

5.1. Lists of Registered Values

IANA makes lists of registered values readily available to the Internet community on its web site: <<http://www.iana.org/>>.

5.2. Change Control

The registration owner MAY update the registration subject to the same constraints and review as with new registrations. In cases where the registration owner is unable or is unwilling to make necessary updates, the IESG MAY assume ownership of the registration in order to update the registration.

5.3. Comments

For cases where others (anyone other than the registration owner) have significant objections to the claims in a registration and the registration owner does not agree to change the registration, comments MAY be attached to a registration upon Expert Review. For registrations owned by the IESG, the objections SHOULD be addressed by initiating a request for Expert Review.

The form of these requests is ad hoc, but MUST include the specific objections to be reviewed and SHOULD contain (directly or by reference) materials supporting the objections.

6. Security Considerations

The security considerations detailed in BCP 26 [RFC2434] are generally applicable to this document. Additional security considerations specific to each name space are discussed in Section 3, where appropriate.

Security considerations for LDAP are discussed in documents comprising the technical specification [RFC4510].

7. Acknowledgement

This document is a product of the IETF LDAP Revision (LDAPBIS) Working Group (WG). This document is a revision of RFC 3383, also a product of the LDAPBIS WG.

This document includes text borrowed from "Guidelines for Writing an IANA Considerations Section in RFCs" [RFC2434] by Thomas Narten and Harald Alvestrand.

8. References

8.1. Normative References

- [RFC2026] Bradner, S., "The Internet Standards Process -- Revision 3", BCP 9, RFC 2026, October 1996.
- [RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.
- [RFC2434] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 2434, October 1998.
- [RFC2578] McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.
- [RFC3629] Yergeau, F., "UTF-8, a transformation format of ISO 10646", STD 63, RFC 3629, November 2003.
- [RFC4234] Crocker, D. and P. Overell, "Augmented BNF for Syntax Specifications: ABNF", RFC 4234, October 2005.
- [RFC4510] Zeilenga, K., Ed., "Lightweight Directory Access Protocol (LDAP): Technical Specification Road Map", RFC 4510, June 2006.
- [RFC4511] Sermersheim, J., Ed., "Lightweight Directory Access Protocol (LDAP): The Protocol", RFC 4511, June 2006.
- [RFC4512] Zeilenga, K., "Lightweight Directory Access Protocol (LDAP): Directory Information Models", RFC 4512, June 2006.
- [RFC4513] Harrison, R., Ed., "Lightweight Directory Access Protocol (LDAP): Authentication Methods and Security Mechanisms", RFC 4513, June 2006.

- [RFC4516] Smith, M., Ed. and T. Howes, "Lightweight Directory Access Protocol (LDAP): Uniform Resource Locator", RFC 4516, June 2006.
- [Unicode] The Unicode Consortium, "The Unicode Standard, Version 3.2.0" is defined by "The Unicode Standard, Version 3.0" (Reading, MA, Addison-Wesley, 2000. ISBN 0-201-61633-5), as amended by the "Unicode Standard Annex #27: Unicode 3.1" (<http://www.unicode.org/reports/tr27/>) and by the "Unicode Standard Annex #28: Unicode 3.2" (<http://www.unicode.org/reports/tr28/>).
- [X.680] International Telecommunication Union - Telecommunication Standardization Sector, "Abstract Syntax Notation One (ASN.1) - Specification of Basic Notation", X.680(2002) (also ISO/IEC 8824-1:2002).

8.2. Informative References

- [RFC1779] Kille, S., "A String Representation of Distinguished Names", RFC 1779, March 1995.
- [RFC3494] Zeilenga, K., "Lightweight Directory Access Protocol version 2 (LDAPv2) to Historic Status", RFC 3494, March 2003.
- [RFC4514] Zeilenga, K., Ed., "Lightweight Directory Access Protocol (LDAP): String Representation of Distinguished Names", RFC 4514, June 2006.
- [RFC4422] Melnikov, A., Ed. and K. Zeilenga, Ed., "Simple Authentication and Security Layer (SASL)", RFC 4422, June 2006.
- [IANADSN] IANA, "Directory Systems Names", <http://www.iana.org/assignments/directory-system-names>.

Appendix A. Registration Templates

This appendix provides registration templates for registering new LDAP values. Note that more than one value may be requested by extending the template by listing multiple values, or through use of tables.

A.1. LDAP Object Identifier Registration Template

Subject: Request for LDAP OID Registration

Person & email address to contact for further information:

Specification: (I-D)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.2. LDAP Protocol Mechanism Registration Template

Subject: Request for LDAP Protocol Mechanism Registration

Object Identifier:

Description:

Person & email address to contact for further information:

Usage: (One of Control or Extension or Feature or other)

Specification: (RFC, I-D, URI)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.3. LDAP Syntax Registration Template

Subject: Request for LDAP Syntax Registration

Object Identifier:

Description:

Person & email address to contact for further information:

Specification: (RFC, I-D, URI)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.4. LDAP Descriptor Registration Template

Subject: Request for LDAP Descriptor Registration

Descriptor (short name):

Object Identifier:

Person & email address to contact for further information:

Usage: (One of administrative role, attribute type, matching rule,
name form, object class, URL extension, or other)

Specification: (RFC, I-D, URI)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.5. LDAP Attribute Description Option Registration Template

Subject: Request for LDAP Attribute Description Option Registration
Option Name:

Family of Options: (YES or NO)

Person & email address to contact for further information:

Specification: (RFC, I-D, URI)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.6. LDAP Message Type Registration Template

Subject: Request for LDAP Message Type Registration

LDAP Message Name:

Person & email address to contact for further information:

Specification: (Approved I-D)

Comments:

(Any comments that the requester deems relevant to the request.)

A.7. LDAP Authentication Method Registration Template

Subject: Request for LDAP Authentication Method Registration

Authentication Method Name:

Person & email address to contact for further information:

Specification: (RFC, I-D, URI)

Intended Usage: (One of COMMON, LIMITED-USE, OBSOLETE)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.8. LDAP Result Code Registration Template

Subject: Request for LDAP Result Code Registration

Result Code Name:

Person & email address to contact for further information:

Specification: (RFC, I-D, URI)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.8. LDAP Search Scope Registration Template

Subject: Request for LDAP Search Scope Registration

Search Scope Name:

Filter Scope String:

Person & email address to contact for further information:

Specification: (RFC, I-D, URI)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.9. LDAP Filter Choice Registration Template

Subject: Request for LDAP Filter Choice Registration

Filter Choice Name:

Person & email address to contact for further information:

Specification: (RFC, I-D, URI)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

A.10. LDAP ModifyRequest Operation Registration Template

Subject: Request for LDAP ModifyRequest Operation Registration

ModifyRequest Operation Name:

Person & email address to contact for further information:

Specification: (RFC, I-D, URI)

Author/Change Controller:

Comments:

(Any comments that the requester deems relevant to the request.)

Appendix B. Changes since RFC 3383

This informative appendix provides a summary of changes made since RFC 3383.

- Object Identifier Descriptors practices were updated to require all descriptors defined in RFCs to be registered and recommending all other descriptors (excepting those in private-use name space) be registered. Additionally, all requests for multiple registrations of the same descriptor are now subject to Expert Review.
- Protocol Mechanisms practices were updated to include values of the 'supportedFeatures' attribute type.

- LDAP Syntax, Search Scope, Filter Choice, ModifyRequest operation, and authzId prefixes registries were added.
- References to RFCs comprising the LDAP technical specifications have been updated to latest revisions.
- References to ISO 10646 have been replaced with [Unicode].
- The "Assigned Values" appendix providing initial registry values was removed.
- Numerous editorial changes were made.

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