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Incremental Retrieval of Multi-valued Properties

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2. Abstract

The Lightweight Directory Access protocol [[1](#)] provides a means for clients to read and write information stored in a distributed directory system. This information is stored as attributes of entries. The attributes may be multi-valued. The LDAP protocol reads a multi-valued attribute as a single entity. This can be inconvenient or even impossible when the number of values in a multi-valued attribute becomes large.

This document defines an option ("Range") that can be specified as part of an attribute description to retrieve the values of a multi-valued attribute incrementally. Servers MAY honor the range option.

3. Conventions used in this document

The key words ``MUST'', ``MUST NOT'', ``REQUIRED'', ``SHALL'', ``SHALL NOT'', ``SHOULD'', ``SHOULD NOT'', ``RECOMMENDED'', and ``MAY'' in this document are to be interpreted as described in [RFC 2119](#) [2].

4. The Range Option

Servers that support the range option MUST include the OID 1.2.840.113556.1.4.802 in the "supportedControls" operational property on the Root DSE. Clients SHOULD NOT use the Range option unless this OID is present. The Range option is a constant, case-insensitive string value, "Range=", followed by a range-specifier as defined below in 5.1.

5. Use of the Range Option in LDAP

This section defines how LDAP implementations MUST interpret Range specifiers in performing operations.

An attribute with the Range option is considered to be a subtype of the attribute without the Range option. If a server does not support incremental retrieval of multi-valued attributes, then it MUST always treat an attribute with a Range option as an unrecognized attribute.

AttributeDescriptions containing the Range option are valid only when presented by the client in the "attributes" field of a SearchRequest or returned by the server in the "attributes" field of a SearchResultEntry. If a client presents an AttributeDescription containing the Range option in any other context the server SHOULD treat it as an unrecognized attribute.

5.1 Attribute Description

An attribute consists of a type, a list of options for that type, and a set of one or more values. In LDAP, the type and the options are combined into the AttributeDescription, defined in section 4.1.5 of [1]. This is represented as an attribute type name and a possibly-empty list of options. One of these options specifies the zero-relative range of elements to be retrieved when presented in a SearchRequest message.

range-option ::= "Range=" <range-specifier>

```
range-specifier ::= <range-initial> ["-" <range-terminal>]
range-initial  ::= *(0-9)
range-terminal ::= (*(0-9))| <end-of-range>
end-of-range  ::= ""
```

Kashi and Randall	Standards Track	2
	Incremental Retrieval of	November 2001
	Multi-valued Properties	

There can be at most one Range option an AttributeDescription.
Examples of valid AttributeDescription:

```
member;Range=0-500
otherTelephoneNumber;Range=0-*
userCertificate;Range=21-305
```

5.2 Server Behavior

This section describes the behavior that all servers supporting incremental retrieval of multi-valued properties via the Range option MUST implement. A client MAY request all or any contiguous subset of the elements of a multi-valued attribute using the range specifier. The special character "*" indicates the end of the range when used as the terminal value in a range specifier. The server MUST return a Range option in the SearchResultEntry for all attributes in the SearchRequest that contained a valid Range option. A given Range option is treated as valid by the server if:

- it is well-formed according to 5.1
- range-initial is less than or equal to range-terminal
- range-initial is less than or equal to the actual count of values stored in the multi-valued attribute

The server MUST treat any AttributeDescription containing a valid attribute type with an invalid Range option as an error and return an empty set of values for the attribute in the SearchResultEntry message.

The Range option returned by the server in any given AttributeDescription indicates the actual range returned. The server MUST return the "*" character as the terminal value for a range when the last element in the multi-valued property is returned in the SearchResultEntry message. The server MAY omit the Range option if the complete set of values for the attribute is returned. If the server omits the Range option in a returned AttributeDescription the client SHOULD assume the complete set of values has been returned. Examples of valid AttributeDescriptions returned by the server:

```
member;Range=0-384
```

```
otherTelephoneNumber;Range=0-2
userCertificate;Range=21
userCertificate;Range=11-*
```

The server MAY return fewer elements than requested by the client.
The client SHOULD make additional requests to obtain the remainder.

Example of a server returning fewer elements than requested:

Client Request	Server Response
member;Range=0-5000	member;Range=0-500

Kashi and Randall	Standards Track	3
	Incremental Retrieval of	November 2001
	Multi-valued Properties	

member;Range=501-5000	member;Range=501-*
-----------------------	--------------------

A server that supports the Range option MAY limit the maximum number of elements for a given multi-valued attribute that can be returned in a single request. This allows the server to control the amount of resources required to service the retrieval of multi-valued properties.

Example of a client server exchange with a server that limits retrievals to 500 items:

Client Request	Server Response
member;Range=0-*	member;Range=0-500
member;Range=501-*	member;Range=501-1000
member;Range=1001-*	member;Range=1000-1307

The server MUST NOT return an AttributeDescription with a Range option specified for any attribute unless the client specified a Range option for that AttributeDescription in the SearchRequest.

If the client does not provide the Range option for a given property, and the server cannot return all elements of that property because doing so would exceed the administrative limit, then the server MUST return:

- an empty result for the requested attribute
- an additional AttributeDescription with a Range option for the requested Attribute populated with values per the range specifier.

This allows a server to limit the number of elements returned for a multi-valued property for which no Range option was specified and report the number of elements returned.

Example of a client server exchange between a client specifying no explicit range and a server that limits retrievals to 500 items and where the number of elements in the multi-valued property exceeds

the administrative limit:

Client Request	Server Response
member	member=,member;Range=0-499="member1;member2,à,member500"

5.3 Element Ordering

For a client to specify a range of elements in a multi-valued Attribute, there must be some concept of order. There is no implied ordering in the values of a multi-valued property (see [1], 4.1.8). The order of elements returned by the Range option is arbitrary (e.g. unsorted) but constant for the duration of a given LDAP connection if and only if the Attribute is not modified by another client between successive range requests. Modification of a multi-valued property while it is being fetched by successive range

Kashi and Randall	Standards Track	4
	Incremental Retrieval of	November 2001
	Multi-valued Properties	

requests may result in overlapping, duplicated, or skipped elements in the SearchResultEntry messages sent in response to the range requests. Logically adjacent range requests issued on different LDAP Sessions are not guaranteed to return contiguous result sets and clients SHOULD NOT issue requests in this manner.

6. Security Considerations

There are no known security considerations for this document. See the security considerations sections of [1] for security considerations of LDAP in general.

7. Acknowledgements

This document is based upon work done by S. Judd, A. Herron, and T. Williams.

8. References

- [1] Wahl, M., Kille, S. and Howes, T., "Lightweight Directory Access Protocol (v3)", Internet Standard, [RFC 2251](#), December, 1997.
- [2] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.

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Kashi and Randall	Standards Track	5
	Incremental Retrieval of	November 2001
	Multi-valued Properties	

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