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**The LDAP Change Sequence Number  
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Abstract

This document defines a syntax schema element for the Lightweight Directory Access Protocol (LDAP) which is used to hold a Change Sequence Number (CSN). In general, a change sequence number represents the place and time that a directory entity was changed. It may be used by various attributes for various LDAP replication, and synchronization applications.

## Discussion Forum

Technical discussion of this document will take place on the IETF LDAP Extensions mailing list <ldapext@ietf.org>. Please send editorial comments directly to the author(s).

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## **1. Introduction**

A number of technologies have been documented, implemented and experimented with which in one way or another seek to replicate, or synchronize directory data. A common need among these technologies is to determine which of two copies of an element represents the latest or most authoritative data. Part of meeting this need involves associating a change sequence number to an element copy at the time of an update to that element. When replication or synchronization occurs, the change sequence numbers associated with directory elements can be used to decide which element's data will be copied to the other element(s).



## **2. Conventions**

Imperative keywords defined in [[RFC2119](#)] are used in this document, and carry the meanings described there.

The General Considerations of [[I-D.ietf-ldapbis-syntaxes](#)] apply to the syntax definition in this document.

The terms "directory element" and "element" refer to data held in a directory and may apply to an attribute value, attribute, entry, or any other identifiable directory entity.

### **3. Syntaxes**

#### **3.1. ChangeSequenceNumber Syntax**

A value of the ChangeSequenceNumber syntax is the time of a change along with a replicaID which represents the Directory System Agent (DSA) holding the element when it was changed. There are also two sequence numbers used to disambiguate directory entities that are changed at the same time and place.

The Abstract Syntax Notation One (ASN.1)[[X680](#)] type corresponding to this syntax is defined as follows:

```
ChangeSequenceNumber ::= SEQUENCE {  
    time GeneralizedTime,  
    timeCount INTEGER (0 .. MaxInt),  
    replicaID UTF8String,  
    changeCount INTEGER (0 .. MaxInt)}
```

```
MaxInt INTEGER ::= 2147483647 -- (231 - 1) --
```

GeneralizedTime is defined in [[X680](#)]. Local time without a differential SHALL NOT be used.

UTF8String is defined below.

The LDAP-specific encoding of a value of this syntax is the Generic String Encoding Rules (GSER)[[RFC3641](#)] encoding of the ASN.1 type.

Example:

```
{ time "196701160315-0700",  
  timeCount 0,  
  replicaID "DSA666",  
  changeCount 1 }
```

The following is an LDAP syntax description [[RFC2252](#)] suitable for publication in the subschema.

```
( IANA-ASSIGNED-OID.1 DESC 'ChangeSequenceNumber' )
```





### **3.2. UTF8String**

The UTF8String syntax is used to express a string of characters from the [[ISO.10646-1.1993](#)] character set (a superset of [[Unicode](#)]), encoded following the [[UTF-8](#)] algorithm. Note that Unicode characters U+0000 through U+007F are the same as ASCII 0 through 127, respectively, and have the same single octet UTF-8 encoding. Other Unicode characters have a multiple octet UTF-8 encoding.

```
UTF8String ::= OCTET STRING -- UTF-8 encoded,
```

```
-- [ISO10646] characters
```

The LDAP-specific encoding of a value of this syntax are the UTF-8 encoded characters themselves.

The following is an LDAP syntax description [[RFC2252](#)] suitable for publication in the subschema.

```
( IANA-ASSIGNED-OID.2 DESC 'UTF8String' )
```



## **4. Matching Rules**

### **4.1. changeSequenceNumberMatch Matching Rule**

The changeSequenceNumberMatch rule compares an assertion value of the ChangeSequenceNumber syntax to a value of a syntax (e.g the ChangeSequenceNumber syntax) whose corresponding ASN.1 type is ChangeSequenceNumber.

The rule evaluates to TRUE if and only if each of the components of the two values evaluate to TRUE using the following rules:

- o The time component uses generalizedTimeMatch.
- o The timeCount and changeCount components use integerMatch.
- o The replicaID component uses utf8CodePointMatch.

The following is a LDAP matching rule description [[RFC2252](#)] suitable for publication in the subschema.

```
( IANA-ASSIGNED-OID.3 NAME changeSequenceNumberMatch SYNTAX IANA-ASSIGNED-OID.1 )
```

### **4.2. utf8CodePointMatch Matching Rule**

The utf8CodePointMatch rule compares an assertion value of the UTF8String syntax to a value of a syntax (e.g the UTF8String syntax) whose corresponding ASN.1 type is UTF8String. The rule evaluates to TRUE if and only if the code points [[Unicode](#)] of each of the characters is equal.

The following is a LDAP matching rule description [[RFC2252](#)] suitable for publication in the subschema.

```
( IANA-ASSIGNED-OID.4 NAME utf8CodePointMatch SYNTAX IANA-ASSIGNED-OID.2 )
```

### **4.3. changeSequenceNumberOrderingMatch Matching Rule**

The changeSequenceNumberOrderingMatch rule compares the ChangeSequenceNumber ordering of an assertion value of the ChangeSequenceNumber syntax to a value of a syntax (e.g the ChangeSequenceNumber syntax) whose corresponding ASN.1 type is ChangeSequenceNumber.

When evaluating ChangeSequenceNumber values for ordering, the components are evaluated in this order: time, timeCount, replicaID,



changeCount. If a component evaluates to TRUE using the appropriate ordering matching rule specified below, then the rule evaluates to TRUE. Otherwise if the component evaluates to TRUE using the equality matching rule specified below, the next component is evaluated. Otherwise the changeSequenceNumberOrderingMatch rule evaluates to FALSE or Undefined as appropriate.

- o The time components of the two values are evaluated for ordering using GeneralizedTimeOrderingMatch, and evaluated for equality using GeneralizedTimeMatch.
- o The timeCount and changeCount components of the two values are evaluated for ordering using integerOrderingMatch, and evaluated for equality using integerMatch.
- o The replicaID components of the two values are evaluated for ordering using utf8CodePointOrderingMatch and evaluated for equality using utf8CodePointMatch.

The following is a LDAP matching rule description [[RFC2252](#)] suitable for publication in the subschema.

```
( IANA-ASSIGNED-OID.5 NAME changeSequenceNumberOrderingMatch SYNTAX
SYNTAX IANA-ASSIGNED-OID.1 )
```

#### **4.4. utf8CodePointOrderingMatch Matching Rule**

The utf8CodePointOrderingMatch rule compares the ordering of an assertion value of the UTF8String syntax to a stored value of a syntax (e.g. the UTF8String syntax) whose corresponding ASN.1 type is UTF8String.

The rule evaluates to TRUE if, and only if, in the code point collation order, the stored value character string appears earlier than the assertion value character string, i.e., the stored value is "less than" the assertion value.

The following is a LDAP matching rule description [[RFC2252](#)] suitable for publication in the subschema.

```
( IANA-ASSIGNED-OID.6 NAME utf8CodePointOrderingMatch SYNTAX IANA-
ASSIGNED-OID.2 )
```



## **5. Attributes**

### **5.1. entryCSN Attribute**

The entryCSN operational attribute provides the CSN of the last update applied to the entry.

The following is a LDAP attribute type description [[RFC2252](#)] suitable for publication in the subschema.

```
( IANA-ASSIGNED-OID.7 NAME entryCSN DESC 'CSN of the entry content'  
EQUALITY changeSequenceNumberMatch ORDERING  
changeSequenceNumberOrderingMatch SYNTAX IANA-ASSIGNED-OID.1 SINGLE-  
VALUE NO-USER-MODIFICATION USAGE directoryOperation )
```

Servers MAY assign a CSN to each entry upon its addition to the directory and provide the entry's CSN as the value of the entryCSN operational attribute. If the entryCSN attribute is assigned, the attribute SHOULD be updated upon every update of the entry.





## **6. Security Considerations**

## **7. Normative References**

[I-D.ietf-ldapbis-syntaxes]

Legg, S., "Lightweight Directory Access Protocol (LDAP): Syntaxes and Matching Rules",  
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Multilingual Plane", ISO Standard 10646-1, May 1993.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate  
Requirement Levels", [BCP 14](#), [RFC 2119](#), March 1997.

[RFC2252] Wahl, M., Coulbeck, A., Howes, T., and S. Kille,  
"Lightweight Directory Access Protocol (v3): Attribute  
Syntax Definitions", [RFC 2252](#), December 1997.

[RFC3383] Zeilenga, K., "Internet Assigned Numbers Authority (IANA)  
Considerations for the Lightweight Directory Access  
Protocol (LDAP)", [BCP 64](#), [RFC 3383](#), September 2002.

[RFC3641] Legg, S., "Generic String Encoding Rules (GSER) for ASN.1  
Types", [RFC 3641](#), October 2003.

[UTF-8] International Organization for Standardization,  
"Information Technology - Universal Multiple-octet coded  
Character Set (UCS) - Amendment 2: UCS Transformation  
Format 8 (UTF-8)", ISO Standard 10646-1 Addendum 2,  
October 1996.

[Unicode] The Unicode Consortium, "The Unicode Standard", 2004.

[X680] International Telecommunications Union, "Abstract Syntax  
Notation One (ASN.1): Specification of basic notation",  
ITU-T Recommendation X.680, July 2002.



## **Appendix A. IANA Considerations**

Registration of the following values is requested [[RFC3383](#)].

### **A.1. LDAP Object Identifier Registrations**

It is requested that IANA register upon Standards Action an LDAP Object Identifier in identifying the protocol elements defined in this technical specification. The following registration template is provided:

Subject: Request for LDAP OID Registration

Person & email address to contact for further information:

Jim Sermersheim

jimse@novell.com

Specification: RFCXXXX

Author/Change Controller: IESG

Comments:

Seven delegations will be made under the assigned OID:

IANA-ASSIGNED-OID.1 ChangeSequenceNumber: LDAP Syntax

IANA-ASSIGNED-OID.2 UTF8String: LDAP Syntax

IANA-ASSIGNED-OID.3 changeSequenceNumberMatch: LDAP Matching Rule

IANA-ASSIGNED-OID.4 utf8CodePointMatch: LDAP Matching Rule

IANA-ASSIGNED-OID.5 changeSequenceNumberOrderingMatch: LDAP Matching Rule

IANA-ASSIGNED-OID.6 utf8CodePointOrderingMatch: LDAP Matching Rule

IANA-ASSIGNED-OID.7 entryCSN: LDAP Attribute Type

### **A.2. LDAP Descriptor Registrations**

It is requested that IANA register upon Standards Action the LDAP descriptors described in this document. The following registration templates are given:



Subject: Request for LDAP Descriptor Registration

Descriptor (short name): ChangeSequenceNumber

Object Identifier: IANA-ASSIGNED-OID.1

Person & email address to contact for further information:

Jim Sermersheim

jimse@novell.com

Usage: other

Specification: RFCXXXX

Author/Change Controller: IESG

Comments: LDAP Syntax

Subject: Request for LDAP Descriptor Registration

Descriptor (short name): UTF8String

Object Identifier: IANA-ASSIGNED-OID.2

Person & email address to contact for further information:

Jim Sermersheim

jimse@novell.com

Usage: other

Specification: RFCXXXX

Author/Change Controller: IESG

Comments: LDAP Syntax

Subject: Request for LDAP Descriptor Registration

Descriptor (short name): changeSequenceNumberMatch

Object Identifier: IANA-ASSIGNED-OID.3

Person & email address to contact for further information:



Jim Sermersheim

jimse@novell.com

Usage: other

Specification: RFCXXXX

Author/Change Controller: IESG

Comments: LDAP Matching Rule

Subject: Request for LDAP Descriptor Registration

Descriptor (short name): utf8CodePointMatch

Object Identifier: IANA-ASSIGNED-OID.4

Person & email address to contact for further information:

Jim Sermersheim

jimse@novell.com

Usage: other

Specification: RFCXXXX

Author/Change Controller: IESG

Comments: LDAP Matching Rule

Subject: Request for LDAP Descriptor Registration

Descriptor (short name): changeSequenceNumberOrderingMatch

Object Identifier: IANA-ASSIGNED-OID.5

Person & email address to contact for further information:

Jim Sermersheim

jimse@novell.com

Usage: other

Specification: RFCXXXX





Author/Change Controller: IESG

Comments: LDAP Matching Rule

Subject: Request for LDAP Descriptor Registration

Descriptor (short name): utf8CodePointOrderingMatch

Object Identifier: IANA-ASSIGNED-OID.6

Person & email address to contact for further information:

Jim Sermersheim

jimse@novell.com

Usage: other

Specification: RFCXXXX

Author/Change Controller: IESG

Comments: LDAP Matching Rule

Subject: Request for LDAP Descriptor Registration

Descriptor (short name): entryCSN

Object Identifier: IANA-ASSIGNED-OID.7

Person & email address to contact for further information:

Jim Sermersheim

jimse@novell.com

Usage: Attribute Type

Specification: RFCXXXX

Author/Change Controller: IESG

Comments: LDAP Attribute Type



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