
**Information technology — Open Systems
Interconnection — The Directory —**

**Part 3:
Abstract service definition**

*Technologies de l'information — Interconnexion de systèmes ouverts
(OSI) — L'annuaire
Partie 3: Définition du service abstrait*

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of the joint technical committee is to prepare International Standards. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 9594-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*, in collaboration with ITU-T. The identical text is published as Rec. ITU-T X.511 (10/2012).

This seventh edition cancels and replaces the sixth edition (ISO/IEC 9594-3:2008), which has been technically revised. It also incorporates the Technical Corrigenda ISO/IEC 9594-3:2008/Cor.1:2011 and ISO/IEC 9594-3:2008/Cor.2:2012.

ISO/IEC 9594 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — The Directory*:

- *Part 1: Overview of concepts, models and services*
- *Part 2: Models*
- *Part 3: Abstract service definition*
- *Part 4: Procedures for distributed operation*
- *Part 5: Protocol specifications*
- *Part 6: Selected attribute types*
- *Part 7: Selected object classes*
- *Part 8: Public-key and attribute certificate frameworks*
- *Part 9: Replication*

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Introduction

This Recommendation | International Standard, together with the other Recommendations | International Standards, has been produced to facilitate the interconnection of information processing systems to provide directory services. A set of such systems, together with the directory information that they hold, can be viewed as an integrated whole, called the *Directory*. The information held by the Directory, collectively known as the Directory Information Base (DIB), is typically used to facilitate communication between, with or about objects such as application entities, people, terminals, and distribution lists.

The Directory plays a significant role in Open Systems Interconnection, whose aim is to allow, with a minimum of technical agreement outside of the interconnection standards themselves, the interconnection of information processing systems:

- from different manufacturers;
- under different managements;
- of different levels of complexity; and
- of different ages.

This Recommendation | International Standard defines the capabilities provided by the Directory to its users.

This Recommendation | International Standard provides the foundation frameworks upon which industry profiles can be defined by other standards groups and industry forums. Many of the features defined as optional in these frameworks may be mandated for use in certain environments through profiles. This seventh edition technically revises and enhances the sixth edition of this Recommendation | International Standard.

This seventh edition specifies versions 1 and 2 of the Directory protocols.

The first and second editions specified only version 1. Most of the services and protocols specified in this edition are designed to function under version 1. However some enhanced services and protocols, e.g., signed errors, will not function unless all Directory entities involved in the operation have negotiated version 2. Whichever version has been negotiated, differences between the services and between the protocols defined in the six editions, except for those specifically assigned to version 2, are accommodated using the rules of extensibility defined in Rec. ITU-T X.519 | ISO/IEC 9594-5.

Annex A, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module for the Directory abstract service.

Annex B, which is not an integral part of this Recommendation | International Standard, provides charts that describe the semantics associated with Basic Access Control as it applies to the processing of a Directory operation.

Annex C, which is not an integral part of this Recommendation | International Standard, gives examples of the use of families of entries.

Annex D, which is not an integral part of this Recommendation | International Standard, includes an updated copy of an external ASN.1 module referenced by this Directory Specification.

Annex E, which is not an integral part of this Recommendation | International Standard, lists the amendments and defect reports that have been incorporated to form this edition of this Recommendation | International Standard.

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**INTERNATIONAL STANDARD
RECOMMENDATION ITU-T**

**Information technology – Open Systems Interconnection –
The Directory: Abstract service definition**

1 Scope

This Recommendation | International Standard defines in an abstract way the externally visible service provided by the Directory.

This Recommendation | International Standard does not specify individual implementations or products.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- Recommendation ITU-T X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The basic model.*
- Recommendation ITU-T X.500 (2012) | ISO/IEC 9594-1:2014, *Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services.*
- Recommendation ITU-T X.501 (2012) | ISO/IEC 9594-2:2014, *Information technology – Open Systems Interconnection – The Directory: Models.*
- Recommendation ITU-T X.509 (2012) | ISO/IEC 9594-8:2014, *Information technology – Open Systems Interconnection – The Directory: Public-key and attribute certificate frameworks.*
- Recommendation ITU-T X.518 (2012) | ISO/IEC 9594-4:2014, *Information technology – Open Systems Interconnection – The Directory: Procedures for distributed operation.*
- Recommendation ITU-T X.519 (2012) | ISO/IEC 9594-5:2014, *Information technology – Open Systems Interconnection – The Directory: Protocol specifications.*
- Recommendation ITU-T X.520 (2012) | ISO/IEC 9594-6:2014, *Information technology – Open Systems Interconnection – The Directory: Selected attribute types.*
- Recommendation ITU-T X.521 (2012) | ISO/IEC 9594-7:2014, *Information technology – Open Systems Interconnection – The Directory: Selected object classes.*
- Recommendation ITU-T X.525 (2012) | ISO/IEC 9594-9:2014, *Information technology – Open Systems Interconnection – The Directory: Replication.*
- Recommendation ITU-T X.680 (2008) | ISO/IEC 8824-1:2008, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*
- Recommendation ITU-T X.681 (2008) | ISO/IEC 8824-2:2008, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification.*
- Recommendation ITU-T X.682 (2008) | ISO/IEC 8824-3:2008, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification.*
- Recommendation ITU-T X.683 (2008) | ISO/IEC 8824-4:2008, *Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications.*

2.2 Other references

- IETF RFC 2025 (1996), *The Simple Public-Key GSS-API Mechanism (SPKM)*.
- IETF RFC 4422 (2006), *Simple Authentication and Security Layer (SASL)*.
- IETF RFC 4511 (2006), *Lightweight Directory Access Protocol (LDAP): The Protocol*.

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.1 Basic Directory definitions

The following terms are defined in Rec. ITU-T X.500 | ISO/IEC 9594-1:

- a) *Directory*;
- b) *Directory Information Base*;
- c) *(Directory) User*.

3.2 Directory model definitions

The following terms are defined in Rec. ITU-T X.501 | ISO/IEC 9594-2:

- a) *Directory System Agent*;
- b) *Directory User Agent*.

3.3 Directory information base definitions

The following terms are defined in Rec. ITU-T X.501 | ISO/IEC 9594-2:

- a) *alias entry*;
- b) *ancestor*;
- c) *compound entry*;
- d) *(Directory) entry*;
- e) *Directory Information Tree*;
- f) *family (of entries)*;
- g) *immediate superior*;
- h) *immediately superior entry/object*;
- i) *object*;
- j) *object class*;
- k) *object entry*;
- l) *subordinate*;
- m) *superior*.

3.4 Directory entry definitions

The following terms are defined in Rec. ITU-T X.501 | ISO/IEC 9594-2:

- a) *attribute*;
- b) *attribute type*;
- c) *attribute value*;
- d) *attribute value assertion*;
- e) *context*;
- f) *context type*;
- g) *context value*;
- h) *operational attribute*;

- i) *matching rule*;
- j) *user attribute*.

3.5 Name definitions

The following terms are defined in Rec. ITU-T X.501 | ISO/IEC 9594-2:

- a) *alias, alias name*;
- b) *distinguished name*;
- c) *(directory) name*;
- d) *purported name*;
- e) *relative distinguished name*.

3.6 Distributed operations definitions

The following terms are defined in Rec. ITU-T X.518 | ISO/IEC 9594-4:

- a) *bound DSA*;
- b) *chaining*;
- c) *initial performer*;
- d) *LDAP requester*;
- e) *referral*.

3.7 Abstract service definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.7.1 additional search: A search that starts from `joinBaseObject` as specified by the originator in the `search` request.

3.7.2 contributing member: A family member within a compound entry, which has made a contribution to either a Read, Search or Modify Entry operation.

3.7.3 explicitly unmarked entry: An entry or a family member that is excluded from the `SearchResult` according to a specification given in a control attribute referenced by the governing-search-rule.

3.7.4 family grouping: A set of members of a compound attribute that are grouped together for the purpose of operation evaluation.

3.7.5 filter: An assertion about the presence or value of certain attributes of an entry in order to limit the scope of a search.

3.7.6 originator: The user that originated an operation.

3.7.7 participation member: A family member that is either a contributing member or is a member of a family grouping that as a whole matched a `search` filter.

3.7.8 primary search: The search that starts from `baseObject` as specified by the originator in the search request.

3.7.9 relaxation: A progressive modification of the behaviour of a filter during a search operation so as to achieve more matched entries if too few are received, or fewer matched entries if too many are received.

3.7.10 reply: A DAP/DSP result or an error; or an LDAP result.

3.7.11 request: Information consisting of an operation code and associated arguments to convey a directory operation from a requester to a performer.

3.7.12 requester: A DUA, an LDAP client or a DSA sending a request to perform (i.e., invoke) an operation.

3.7.13 service controls: Parameters conveyed as part of an operation, which constrain various aspects of its performance.

3.7.14 strand: A family grouping comprising all the members in a path from a leaf family member up to the ancestor inclusive. A family member will reside in as many strands as there are leaf family members below it (as immediate or non-immediate subordinates).

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply.

ACI	Access Control Information
AVA	Attribute Value Assertion
DIB	Directory Information Base
DIT	Directory Information Tree
DMD	Directory Management Domain
DSA	Directory System Agent
DUA	Directory User Agent
LDAP	Lightweight Directory Access Protocol
RDN	Relative Distinguished Name

5 Conventions

The term "Directory Specification" (as in "this Directory Specification") shall be taken to mean Rec. ITU-T X.511 | ISO/IEC 9594-3. The term "Directory Specifications" shall be taken to mean the X.500-series Recommendations and all parts of ISO/IEC 9594.

This Directory Specification uses the term *first edition systems* to refer to systems conforming to the first edition of the Directory Specifications, i.e., the 1988 edition of the series of CCITT X.500 Recommendations and the ISO/IEC 9594:1990 edition.

This Directory Specification uses the term *second edition systems* to refer to systems conforming to the second edition of the Directory Specifications, i.e., the 1993 edition of the series of ITU-T X.500 Recommendations and the ISO/IEC 9594:1995 edition.

This Directory Specification uses the term *third edition systems* to refer to systems conforming to the third edition of the Directory Specifications, i.e., the 1997 edition of the series of ITU-T X.500 Recommendations and the ISO/IEC 9594:1998 edition.

This Directory Specification uses the term *fourth edition systems* to refer to systems conforming to the fourth edition of the Directory Specifications, i.e., the 2001 editions of Recs ITU-T X.500, X.501, X.511, X.518, X.519, X.520, X.521, X.525, and X.530, the 2000 edition of Rec. ITU-T X.509, and parts 1-10 of the ISO/IEC 9594:2001 edition.

This Directory Specification uses the term *fifth edition systems* to refer to systems conforming to the fifth edition of the Directory Specifications, i.e., the 2005 edition of the series of ITU-T X.500 Recommendations and the ISO/IEC 9594:2005 edition.

This Directory Specification uses the term *sixth edition systems* to refer to systems conforming to the sixth edition of the Directory Specifications, i.e., the 2008 edition of the series of ITU-T X.500 Recommendations and the ISO/IEC 9594:2008 edition.

This Directory Specification uses the term *seventh edition systems* to refer to systems conforming to the seventh edition of the Directory Specifications, i.e., the 2012 edition of the ITU-T X.500-series Recommendations and the ISO/IEC 9594:2014 edition.

This Directory Specification presents ASN.1 notation in the bold Courier New typeface. When ASN.1 types and values are referenced in normal text, they are differentiated from normal text by presenting them in the bold Courier New typeface. The names of procedures, typically referenced when specifying the semantics of processing, are differentiated from normal text by displaying them in bold Times New Roman. Access control permissions are presented in italicized Times New Roman.

If the items in a list are numbered (as opposed to using "-" or letters), then the items shall be considered steps in a procedure.

6 Overview of the Directory service

As described in Rec. ITU-T X.501 | ISO/IEC 9594-2, the services of the Directory are provided through access points to DUAs, each acting on behalf of a user. These concepts are depicted in Figure 1. Through an access point, the Directory provides service to its users by means of a number of Directory operations.

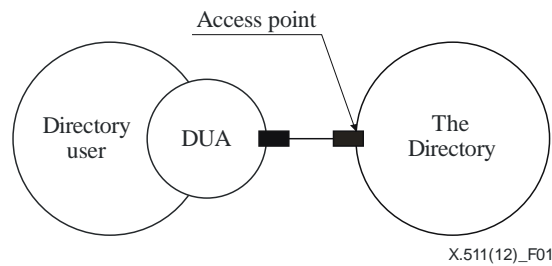


Figure 1 – Access to the Directory

The Directory operations are of three different kinds:

- a) Directory Read operations, which interrogate a single Directory entry;
- b) Directory Search operations, which interrogate potentially several Directory entries; and
- c) Directory Modify operations.

The Directory Read operations, the Directory Search operations and the Directory Modify operations are specified in clauses 9, 10, and 11, respectively. Conformance to Directory operations is specified in Rec. ITU-T X.519 | ISO/IEC 9594-5.

7 Information types and common procedures

7.1 Introduction

This clause identifies, and in some cases defines, a number of information types which are subsequently used in the definition of Directory operations. The information types concerned are those which are common to more than one operation, are likely to be in the future, or which are sufficiently complex or self-contained as to merit being defined separately from the operation which uses them.

Several of the information types used in the definition of the Directory Service are actually defined elsewhere. Clause 7.2 identifies these types and indicates the source of their definition. Each of the clauses (7.3 to 7.10) identifies and defines an information type.

This clause also specifies some common elements of procedure that apply to most or all of the Directory operations.

7.2 Information types defined elsewhere

The following information types are defined in Rec. ITU-T X.501 | ISO/IEC 9594-2:

- a) **Attribute;**
- b) **AttributeType;**
- c) **AttributeValue;**
- d) **AttributeValueAssertion;**
- e) **Context;**
- f) **ContextAssertion;**
- g) **DistinguishedName;**
- h) **Name;**
- i) **OPTIONALLY-PROTECTED;**
- j) **OPTIONALLY-PROTECTED-SEQ;**
- k) **RelativeDistinguishedName.**

The following information type is defined in Rec. ITU-T X.520 | ISO/IEC 9594-6:

- a) **PresentationAddress.**

The following information types are defined in Rec. ITU-T X.509 | ISO/IEC 9594-8:

- a) **Certificate;**

ISO/IEC 9594-3:2014 (E)

- b) **SIGNED**;
- c) **CertificationPath**.

The following information type is defined in Rec. ITU-T X.880 | ISO/IEC 13712-1:

- a) **InvokeId**.

The following information types are defined in Rec. ITU-T X.518 | ISO/IEC 9594-4:

- a) **OperationProgress**;
- b) **ContinuationReference**.

7.3 Common arguments

The **CommonArguments** information may be present to qualify the invocation of each operation that the Directory can perform.

```
CommonArguments ::= SET {
  serviceControls      [30] ServiceControls      DEFAULT {},
  securityParameters  [29] SecurityParameters  OPTIONAL,
  requestor           [28] DistinguishedName  OPTIONAL,
  operationProgress   [27] OperationProgress
                        DEFAULT {nameResolutionPhase notStarted},
  aliasedRDNs         [26] INTEGER              OPTIONAL,
  criticalExtensions  [25] BIT STRING          OPTIONAL,
  referenceType       [24] ReferenceType       OPTIONAL,
  entryOnly           [23] BOOLEAN             DEFAULT TRUE,
  exclusions          [22] Exclusions          OPTIONAL,
  nameResolveOnMaster [21] BOOLEAN             DEFAULT FALSE,
  operationContexts  [20] ContextSelection    OPTIONAL,
  familyGrouping     [19] FamilyGrouping      DEFAULT entryOnly,
  ... }
```

NOTE 1 – The above data type can only be used when included in set-constructs. An alternative data type **CommonArgumentsSeq** has been defined to be used in sequence-constructs (see Annex A).

The **ServiceControls** component is specified in clause 7.5. Its absence is deemed equivalent to there being an empty set of controls.

The **SecurityParameters** component is specified in clause 7.10. If the argument of the operation is to be signed by the requester, the **SecurityParameters** component shall be included. The absence of the **SecurityParameters** component is deemed equivalent to an empty set.

The **requestor** component, when present, shall hold the distinguished name of the originator (requester) of the operation. If the distinguished name of the requester was established at bind time, the **requestor** component shall be equal to that distinguished name. Likewise, it shall be equal to the distinguished name in **subject** field of the end-entity public-key certificate of the requester if the **certification-path** component of the **SecurityParameters** is present.

NOTE 2 – The bound DSA should check the equality of the distinguished names as indicated above (pre-seventh edition systems may not do that).

NOTE 3 – If the distinguished name of the requester was not established at bind time and the **certification-path** component of the **SecurityParameters** is not present in the request, a possible value in the **requestor** component should not be considered reliable for access control purposes.

The **operationProgress**, **referenceType**, **entryOnly**, **exclusions** and **nameResolveOnMaster** components are defined in Rec. ITU-T X.518 | ISO/IEC 9594-4. They are supplied by a DUA either:

- a) when acting on a continuation reference returned by a DSA in response to an earlier operation, and their values are copied by the DUA from the continuation reference; or
- b) when the DUA represents an administrative user that is managing the DSA Information Tree and the **managedDSAIT** option is set in the service controls.

The **aliasedRDNs** component indicates to the DSA that the **object** component of the operation was created by the dereferencing of an alias on an earlier operation attempt. The integer value indicates the number of RDNs in the name that came from dereferencing the alias. (The value would have been set in the referral response of the previous operation.)

NOTE 4 – This component is provided for compatibility with first edition implementations of the Directory. DUAs (and DSAs) implemented according to later editions of the Directory Specifications shall always omit this parameter from the

CommonArguments of a subsequent request. In this way, the Directory will not signal an error if aliases dereference to further aliases.

The **operationContexts** component supplies a set of context assertions which are applied to attribute value assertions and entry information selection made within this operation, which do not otherwise contain context assertions for the same attribute type and context type. If **operationContexts** is not present or does not address a particular attribute type or context type, then default context assertions shall be applied by the DSA as described in clause 7.6.1 and in clauses 8.9.2.2 and 12.8 of Rec. ITU-T X.501 | ISO/IEC 9594-2. If **allContexts** is chosen, then all contexts for all attribute types are valid and context defaults that might have been supplied by the DSA are overridden. (**ContextSelection** is defined in clause 7.6).

familyGrouping is used to describe which family members should be selected for processing by a given operation. It is described more fully in clause 7.3.2.

7.3.1 Critical extensions

The **criticalExtensions** component provides a mechanism to list a set of extensions that are critical to the performance of a Directory operation. If the originator of the extended operation wishes to indicate that the operation shall be performed with one or more extensions (i.e., that performing the operation without these extensions is not acceptable), it does so by setting the **criticalExtensions** bit(s) which corresponds to the extension(s). If the Directory, or some part of it, is unable to perform a critical extension, it returns an indication of **unavailableCriticalExtension** (as a **serviceError** or **PartialOutcomeQualifier**). If the Directory is unable to perform an extension that is not critical, it ignores the presence of the extension.

This Directory Specification does not establish rules regarding the order in which a performing DSA is to decode and process PDUs that it receives. A DSA that receives an unknown critical extension shall return a **ServiceError** with problem **unavailableCriticalExtension** to signal that the operation failed.

These Directory Specifications define a number of extensions. The extensions take such forms as additional numbered bits in a BIT STRING, or additional components of a SET or SEQUENCE, and are ignored by first edition systems. Each such extension is assigned an integer identifier, which is the number of the bit that may be set in **criticalExtensions**. If the criticality of an extension is defined to be critical, the DUA shall set the corresponding bit in **criticalExtensions**. If the defined criticality is non-critical, the DUA may or may not set the corresponding bit in **criticalExtensions**.

The extensions, their identifiers, the operations in which they are permitted, the recommended criticality, the clauses in which they are defined, and the corresponding LDAP controls (if any) are shown in Table 1.

Table 1 – Extensions

Extension	Identifier	Operations	Criticality	Defined (clauses)	LDAP control
subentries	1	All	Non-critical	7.5	1.3.6.1.4.1.4203.1.10.1
copyShallDo	2	Read, Compare, List, Search	Non-critical	7.5	
attribute size limit	3	Read, Search	Non-critical	7.5	
extraAttributes	4	Read, Search	Non-critical	7.6	
modifyRightsRequest	5	Read	Non-critical	9.1	
pagedResultsRequest	6	List, Search	Non-critical	10.1	1.2.840.113556.1.4.319
matchedValuesOnly	7	Search	Non-critical	10.2	1.2.826.0.1.3344810.2.3
extendedFilter	8	Search	Non-critical	10.2	
targetSystem	9	Add Entry	Critical	11.1	
useAliasOnUpdate	10	Add Entry, Remove Entry, Modify Entry	Critical	11.1	
newSuperior	11	Modify DN	Critical	11.4	
manageDSAIT	12	All	Critical	7.5, 7.12	2.16.840.1.113730.3.4.2
Use of contexts	13	Read, Compare, List, Search, Add Entry, Modify Entry, Modify DN	Non-critical	7.6, 7.8	
partialNameResolution	14	Read, Search	Non-critical	7.5	
overspecFilter	15	Search	Non-critical	10.1.3 f)	