
**Information technology — Open
systems interconnection —**

**Part 2:
The Directory: Models**

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This document was prepared by ITU-T as ITU-T X.501 (10/2019) and drafted in accordance with its editorial rules, in collaboration with Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

This ninth edition cancels and replaces the eighth edition (ISO/IEC 9594-2:2017), which has been technically revised.

A list of all parts in the ISO/IEC 9594 series can be found on the ISO website.

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CONTENTS

	<i>Page</i>
SECTION 1 – GENERAL	1
1 Scope	1
2 References	2
2.1 Normative references	2
2.2 Non-normative references	3
3 Definitions	3
3.1 Communication definitions	3
3.2 Basic Directory definitions	3
3.3 Distributed operation definitions	3
3.4 Replication definitions	3
4 Abbreviations	4
5 Conventions	5
SECTION 2 – OVERVIEW OF THE DIRECTORY MODELS	6
6 Directory Models	6
6.1 Definitions	6
6.2 The Directory and its users	6
6.3 Directory and DSA Information Models	7
6.4 Directory Administrative Authority Model	7
SECTION 3 – MODEL OF DIRECTORY USER INFORMATION	9
7 Directory Information Base	9
7.1 Definitions	9
7.2 Objects	10
7.3 Directory entries	10
7.4 Directory Information Tree (DIT)	10
8 Directory entries	11
8.1 Definitions	11
8.2 Overall structure	13
8.3 Object classes	14
8.4 Attribute types	16
8.5 Attribute values	16
8.6 Attribute type hierarchies	16
8.7 Friend attributes	17
8.8 Contexts	17
8.9 Matching rules	18
8.10 Entry collections	21
8.11 Compound entries and families of entries	22
9 Names	23
9.1 Definitions	23
9.2 Names in general	23
9.3 Relative distinguished name	23
9.4 Name matching	24
9.5 Distinguished names	24
9.6 Alias names	25
10 Hierarchical groups	25
10.1 Definitions	25
10.2 Hierarchical relationship	26
10.3 Sequential ordering of a hierarchical group	26
SECTION 4 – DIRECTORY ADMINISTRATIVE MODEL	28
11 Directory Administrative Authority model	28
11.1 Definitions	28

11.2	Overview	28
11.3	Policy	29
11.4	Specific administrative authorities	29
11.5	Administrative areas and administrative points	30
11.6	DIT Domain policies	32
11.7	DMD policies	32
SECTION 5 – MODEL OF DIRECTORY ADMINISTRATIVE AND OPERATIONAL INFORMATION		34
12	Model of Directory Administrative and Operational Information.....	34
12.1	Definitions.....	34
12.2	Overview	34
12.3	Subtrees	35
12.4	Operational attributes	37
12.5	Entries	37
12.6	Subentries.....	38
12.7	Information model for collective attributes.....	39
12.8	Information model for context defaults.....	40
SECTION 6 – THE DIRECTORY SCHEMA		41
13	Directory Schema.....	41
13.1	Definitions.....	41
13.2	Overview	41
13.3	Object class definition.....	43
13.4	Attribute type definition	45
13.5	Matching rule definition.....	48
13.6	Relaxation and tightening.....	50
13.7	DIT structure definition.....	56
13.8	DIT content rule definition.....	59
13.9	Context type definition.....	60
13.10	DIT Context Use definition.....	61
13.11	Friends definition.....	62
13.12	Syntax definitions.....	63
14	Directory System Schema	63
14.1	Overview	63
14.2	System schema supporting the administrative and operational information model	63
14.3	System schema supporting the administrative model.....	64
14.4	System schema supporting general administrative and operational requirements	65
14.5	System schema supporting access control.....	67
14.6	System schema supporting the collective attribute model.....	67
14.7	System schema supporting context assertion defaults.....	67
14.8	System schema supporting the service administration model	68
14.9	System schema supporting password administration	68
14.10	System schema supporting hierarchical groups.....	69
14.11	Maintenance of system schema	70
14.12	System schema for first-level subordinates	71
15	Directory schema administration.....	71
15.1	Overview	71
15.2	Policy objects	71
15.3	Policy parameters	71
15.4	Policy procedures	72
15.5	Subschema modification procedures.....	72
15.6	Entry addition and modification procedures	73
15.7	Subschema policy attributes.....	73
SECTION 7 – DIRECTORY SERVICE ADMINISTRATION.....		79
16	Service Administration Model.....	79



	<i>Page</i>
16.1	Definitions..... 79
16.2	Service-type/user-class model..... 79
16.3	Service-specific administrative areas 80
16.4	Introduction to search-rules..... 81
16.5	Subfilters 81
16.6	Filter requirements 82
16.7	Attribute information selection based on search-rules 82
16.8	Access control aspects of search-rules 83
16.9	Contexts aspects of search-rules..... 83
16.10	Search-rule specification 83
16.11	Matching restriction definition..... 91
16.12	Search-validation function 91
SECTION 8 – SECURITY 93	
17	Security model..... 93
17.1	Definitions..... 93
17.2	Security policies 93
17.3	Protection of Directory operations 94
18	Basic Access Control..... 95
18.1	Scope and application..... 95
18.2	Basic Access Control model 95
18.3	Access control administrative areas 98
18.4	Representation of Access Control Information 100
18.5	ACI operational attributes 105
18.6	Protecting the ACI..... 106
18.7	Access control and Directory operations..... 106
18.8	Access Control Decision Function 106
18.9	Simplified Access Control 108
19	Rule-based Access Control..... 108
19.1	Scope and application..... 108
19.2	Rule-based Access Control model 108
19.3	Access control administrative areas 109
19.4	Security Label 109
19.5	Clearance..... 110
19.6	Access Control and Directory operations..... 111
19.7	Access Control Decision Function 111
19.8	Use of Rule-based and Basic Access Control 112
20	Data Integrity in Storage 112
20.1	Introduction 112
20.2	Protection of an Entry or Selected Attribute Types..... 112
20.3	Context for Protection of a Single Attribute Value 114
SECTION 9 – DSA MODELS 115	
21	DSA Models 115
21.1	Definitions..... 115
21.2	Directory Functional Model 115
21.3	Directory Distribution Model 116
SECTION 10 – DSA INFORMATION MODEL..... 118	
22	Knowledge..... 118
22.1	Definitions..... 118
22.2	Introduction 118
22.3	Knowledge References..... 119
22.4	Minimum Knowledge 121
22.5	First Level DSAs 121
22.6	Knowledge references to LDAP servers 122

23	Basic Elements of the DSA Information Model.....	122
	23.1 Definitions.....	122
	23.2 Introduction.....	122
	23.3 DSA Specific Entries and their Names.....	123
	23.4 Basic Elements.....	124
24	Representation of DSA Information.....	125
	24.1 Representation of Directory User and Operational Information.....	126
	24.2 Representation of Knowledge References.....	126
	24.3 Representation of Names and Naming Contexts.....	133
SECTION 11 – DSA OPERATIONAL FRAMEWORK.....		135
25	Overview.....	135
	25.1 Definitions.....	135
	25.2 Introduction.....	135
26	Operational bindings.....	135
	26.1 General.....	135
	26.2 Application of the operational framework.....	136
	26.3 States of cooperation.....	137
27	Operational binding specification and management.....	138
	27.1 Operational binding type specification.....	138
	27.2 Operational binding management.....	139
	27.3 Operational binding specification templates.....	139
28	Operations for operational binding management.....	141
	28.1 Application-context definition.....	141
	28.2 Establish Operational Binding operation.....	142
	28.3 Modify Operational Binding operation.....	145
	28.4 Terminate Operational Binding operation.....	147
	28.5 Operational Binding Error.....	148
	28.6 Operational Binding Management Bind and Unbind.....	149
SECTION 12 – INTERWORKING WITH LDAP.....		151
29	Overview.....	151
	29.1 Definitions.....	151
	29.2 Introduction.....	151
30	LDAP interworking model.....	151
	30.1 LDAP interworking scenarios.....	151
	30.2 Overview of bound DSA handling LDAP operations.....	152
	30.3 General LDAP requestor characteristics.....	152
	30.4 LDAP extension mechanisms.....	153
31	LDAP specific system schema.....	153
	31.1 Operational Attribute types from IETF RFC 4512.....	153
Annex A – Object identifier usage.....		156
Annex B – Information framework in ASN.1.....		159
Annex C – Subschema administration in ASN.1.....		170
Annex D – Service administration in ASN.1.....		175
Annex E – Basic Access Control in ASN.1.....		179
Annex F – DSA operational attribute types in ASN.1.....		183
Annex G – Operational binding management in ASN.1.....		186
Annex H – Enhanced security in ASN.1.....		191
Annex I – LDAP system schema.....		194
Annex J – The mathematics of trees.....		196
Annex K – Name design criteria.....		197

	<i>Page</i>
Annex L – Examples of various aspects of schema.....	199
L.1 Example of an attribute hierarchy	199
L.2 Example of a subtree specification.....	199
L.3 Schema specification.....	200
L.4 DIT content rules.....	201
L.5 DIT context use	202
Annex M – Overview of basic access control permissions.....	203
M.1 Introduction	203
M.2 Permissions required for operations	203
M.3 Permissions affecting error.....	204
M.4 Entry level permissions	204
M.5 Entry level permissions	205
Annex N – Examples of access control	206
N.1 Introduction	206
N.2 Design principles for Basic Access Control.....	206
N.3 Introduction to example	207
N.4 Policy affecting the definition of specific and inner areas	208
N.5 Policy affecting the definition of Directory Access Control Domains (DACDs)	209
N.6 Policy expressed in prescriptiveACI attributes	212
N.7 Policy expressed in subentryACI attributes	216
N.8 Policy expressed in entryACI attributes	217
N.9 ACDF examples	218
N.10 Rule-based access control	220
Annex O – DSE type combinations.....	221
Annex P – Modelling of knowledge	223
Annex Q – Subfilters	227
Annex R – Compound entry name patterns and their use.....	228
Annex S – Naming concepts and considerations	230
S.1 History tells us	230
S.2 A new look at name resolution.....	230
Annex T – Alphabetical index of definitions.....	236
Annex U – Amendments and corrigenda.....	238

Introduction

This Recommendation | International Standard, together with other Recommendations in the ITU-T X.500-series | parts of ISO/IEC 9594, 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 (OSI), 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 provides a number of different models for the Directory as a framework for the other Recommendations in the ITU-T X.500 series | parts of ISO/IEC 9594. The models are the overall (functional) model; the administrative authority model, generic Directory Information Models providing Directory User and Administrative User views on Directory information, generic DSA and DSA information models, an Operational Framework and a security model.

The generic Directory Information Models describe, for example, how information about objects is grouped to form Directory entries for those objects and how that information provides names for objects.

The generic DSA and DSA information models and the Operational Framework provide support for Directory distribution.

This Recommendation | International Standard provides a specialization of the generic Directory Information Models to support Directory Schema administration.

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 ninth edition technically revises and enhances the eighth edition of this Recommendation | International Standard.

Annex A, which is an integral part of this Recommendation | International Standard, summarizes the usage of ASN.1 object identifiers in the ITU-T X.500-series Recommendations | parts of ISO/IEC 9594.

Annex B, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module which contains all of the definitions associated with the information framework.

Annex C, which is an integral part of this Recommendation | International Standard, provides the subschema administration schema in ASN.1.

Annex D, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module for Service Administration.

Annex E, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module for Basic Access Control.

Annex F, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module which contains all the definitions associated with DSA operational attribute types.

Annex G, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module which contains all the definitions associated with operational binding management operations.

Annex H, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module which contains all the definitions associated with enhanced security.

Annex I, which is an integral part of this Recommendation | International Standard, provides the ASN.1 module which contains the definitions for LDAP system schema using the ASN.1 ATTRIBUTE information object.

Annex J, which is not an integral part of this Recommendation | International Standard, summarizes the mathematical terminology associated with tree structures.

Annex K, which is not an integral part of this Recommendation | International Standard, describes some criteria that can be considered in designing names.

Annex L, which is not an integral part of this Recommendation | International Standard, provides some examples of various aspects of Schema.

Annex M, which is not an integral part of this Recommendation | International Standard, provides an overview of the semantics associated with Basic Access Control permissions.

Annex N, which is not an integral part of this Recommendation | International Standard, provides an extended example of the use of Basic Access Control.

Annex O, which is not an integral part of this Recommendation | International Standard, describes some DSA specific entry combinations.

Annex P, which is not an integral part of this Recommendation | International Standard, provides a framework for the modelling of knowledge.

Annex Q, which is not an integral part of this Recommendation | International Standard, describes the concept of subfilters.

Annex R, which is not an integral part of this Recommendation | International Standard, describes recommendations and examples on how family members can be named.

Annex S, which is not an integral part of this Recommendation | International Standard, gives an introduction to naming concepts and considerations.

Annex T, which is not an integral part of this Recommendation | International Standard, lists alphabetically the terms defined in this Recommendation | International Standard.

Annex U, 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
ITU-T RECOMMENDATION**

**Information technology – Open Systems Interconnection –
The Directory: Models**

SECTION 1 – GENERAL

1 Scope

The models defined in this Recommendation | International Standard provide a conceptual and terminological framework for the other ITU-T X.500-series Recommendations | parts of ISO/IEC 9594 which define various aspects of the Directory.

The functional and administrative authority models define ways in which the Directory can be distributed, both functionally and administratively. Generic Directory System Agent (DSA) and DSA information models and an Operational Framework are also provided to support Directory distribution.

The generic Directory Information Models describe the logical structure of the Directory Information Base (DIB) from the perspective of Directory and Administrative Users. In these models, the fact that the Directory is distributed, rather than centralized, is not visible.

This Recommendation | International Standard provides a specialization of the generic Directory Information Models to support Directory Schema administration.

The other ITU-T Recommendations in the X.500 series | parts of ISO/IEC 9594 make use of the concepts defined in this Recommendation | International Standard to define specializations of the generic information and DSA models to provide specific information, DSA and operational models supporting particular directory capabilities (e.g., Replication):

- a) the service provided by the Directory is described (in Rec. ITU-T X.511 | ISO/IEC 9594-3) in terms of the concepts of the information framework: this allows the service provided to be somewhat independent of the physical distribution of the DIB;
- b) the distributed operation of the Directory is specified (in Rec. ITU-T X.518 | ISO/IEC 9594-4) so as to provide that service, and therefore maintain that logical information structure, given that the DIB is in fact highly distributed;
- c) replication capabilities offered by the component parts of the Directory to improve overall Directory performance are specified (in Rec. ITU-T X.525 | ISO/IEC 9594-9).

The security model establishes a framework for the specification of access control mechanisms. It provides a mechanism for identifying the access control scheme in effect in a particular portion of the Directory Information Tree (DIT), and it defines three flexible, specific access control schemes which are suitable for a wide variety of applications and styles of use. The security model also provides a framework for protecting the confidentiality and integrity of directory operations using mechanisms such as encryption and digital signatures. This makes use of the framework for authentication defined in Rec. ITU-T X.509 | ISO/IEC 9594-8 as well as generic upper layers security tools defined in Rec. ITU-T X.830 | ISO/IEC 11586-1.

DSA models establish a framework for the specification of the operation of the components of the Directory. Specifically:

- a) the Directory functional model describes how the Directory is manifested as a set of one or more components, each being a DSA;
- b) the Directory distribution model describes the principals according to which the DIB entries and entry-copies may be distributed among DSAs;
- c) the DSA information model describes the structure of the Directory user and operational information held in a DSA;
- d) the DSA operational framework describes the means by which the definition of specific forms of cooperation between DSAs to achieve particular objectives (e.g., shadowing) is structured.

2 References

2.1 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.

2.1.1 Identical Recommendations | International Standards

- Recommendation ITU-T X.500 (2019) | ISO/IEC 9594-1:2020, *Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services.*
- Recommendation ITU-T X.509 (2019) | ISO/IEC 9594-8:2020, *Information technology – Open Systems Interconnection – The Directory: Public-key and attribute certificate frameworks.*
- Recommendation ITU-T X.511 (2019) | ISO/IEC 9594-3:2020, *Information technology – Open Systems Interconnection – The Directory: Abstract service definition.*
- Recommendation ITU-T X.518 (2019) | ISO/IEC 9594-4:2020, *Information technology – Open Systems Interconnection – The Directory: Procedures for distributed operation.*
- Recommendation ITU-T X.519 (2019) | ISO/IEC 9594-5:2020, *Information technology – Open Systems Interconnection – The Directory: Protocol specifications.*
- Recommendation ITU-T X.520 (2019) | ISO/IEC 9594-6:2020, *Information technology – Open Systems Interconnection – The Directory: Selected attribute types.*
- Recommendation ITU-T X.521 (2019) | ISO/IEC 9594-7:2020, *Information technology – Open Systems Interconnection – The Directory: Selected object classes.*
- Recommendation ITU-T X.525 (2019) | ISO/IEC 9594-9:2020, *Information technology – Open Systems Interconnection – The Directory: Replication.*
- Recommendation ITU-T X.660 (2011) | ISO/IEC 9834-1:2012, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: General procedures and top arcs of the ASN.1 Object Identifier tree.*
- Recommendation ITU-T X.680 (2015) | ISO/IEC 8824-1:2015, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*
- Recommendation ITU-T X.681 (2015) | ISO/IEC 8824-2:2015, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification.*
- Recommendation ITU-T X.682 (2015) | ISO/IEC 8824-3:2015, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification.*
- Recommendation ITU-T X.683 (2015) | ISO/IEC 8824-4:2015, *Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications.*
- Recommendation ITU-T X.690 (2015) | ISO/IEC 8825-1:2015, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*

2.1.2 Paired Recommendations | International Standards equivalent in technical content

- Recommendation ITU-T X.800 (1991) (previously CCITT Recommendation), *Security architecture for Open Systems Interconnection for CCITT applications.*
ISO 7498-2:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 2: Security Architecture.*

2.1.3 Other references

- IETF RFC 4510 (2006), *Lightweight Directory Access Protocol (LDAP): Technical Specification Road Map.*
- IETF RFC 4511 (2006), *Lightweight Directory Access Protocol (LDAP): The Protocol.*
- IETF RFC 4512 (2006), *Lightweight Directory Access Protocol (LDAP): Directory Information Models.*

2.2 Non-normative references

- Recommendation ITU-T X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.
- IETF RFC 4526 (2006), *Lightweight Directory Access Protocol (LDAP): Absolute True and False Filters*.
- Recommendation ITU-T X.811 (1995) | ISO/IEC 10181-2:1996, *Information technology – Open Systems Interconnection – Security frameworks for open systems: Authentication framework*.
- Recommendation ITU-T X.812 (1995) | ISO/IEC 10181-3:1996, *Information technology – Open Systems Interconnection – Security frameworks for open systems – Access control framework*.
- Recommendation ITU-T X.813 (1996) | ISO/IEC 10181-4:1997, *Information technology – Open Systems Interconnection – Security frameworks for open systems – Non-repudiation framework*.

3 Definitions

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

3.1 Communication definitions

The following terms are defined in Rec. ITU-T X.519 | ISO/IEC 9594-5:

- a) *application-context*;
- b) *application-entity*;
- c) *application process*.

3.2 Basic Directory definitions

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

- a) *Directory*;
- b) *Directory Access Protocol*;
- c) *Directory Information Base*; [ISO/IEC 9594-2:2020](https://standards.iteh.ai/catalog/standards/sist/8eab7c65-2b62-4ae3-87d3-a004a2ad4a96/iso-iec-9594-2-2020)
- d) *Directory Operational Binding Management Protocol*; <https://standards.iteh.ai/catalog/standards/sist/8eab7c65-2b62-4ae3-87d3-a004a2ad4a96/iso-iec-9594-2-2020>
- e) *Directory System Protocol*;
- f) *(Directory) user*.

3.3 Distributed operation definitions

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

- a) *access point*;
- b) *hierarchical operational binding*;
- c) *name resolution*;
- d) *non-specific hierarchical operational binding*;
- e) *relevant hierarchical operational binding*.

3.4 Replication definitions

The following terms are defined in Rec. ITU-T X.525 | ISO/IEC 9594-9:

- a) *cache-copy*;
- b) *consumer reference*;
- c) *entry-copy*;
- d) *master DSA*;
- e) *primary shadowing*;
- f) *replicated area*;
- g) *replication*;
- h) *secondary shadowing*;