

---

---

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

**Part 2:  
Models**

*Technologies de l'information — Interconnexion de systèmes ouverts  
(OSI) — L'annuaire —*

*Partie 2: Les modèles*

Document Preview

ISO/IEC 9594-2:2017

<https://standards.iteh.ai/catalog/standards/iso/d4a7696d-3534-43fd-b8e9-a02753d050e0/iso-iec-9594-2-2017>



iTeh Standards  
(<https://standards.itih.ai>)  
Document Preview

ISO/IEC 9594-2:2017

<https://standards.itih.ai/catalog/standards/iso/d4a7696d-3534-43fd-b8e9-a02753d050e0/iso-iec-9594-2-2017>



**COPYRIGHT PROTECTED DOCUMENT**

© ISO/IEC 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Ch. de Blandonnet 8 • CP 401  
CH-1214 Vernier, Geneva, Switzerland  
Tel. +41 22 749 01 11  
Fax +41 22 749 09 47  
[copyright@iso.org](mailto:copyright@iso.org)  
[www.iso.org](http://www.iso.org)

## Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This eighth edition cancels and replaces the seventh edition (ISO/IEC 9594-2:2014), which has been technically revised.

This document was prepared by ISO/IEC JTC 1, *Information technology*, SC 6, *Telecommunications and information exchange between systems*, in collaboration with ITU-T. The identical text is published as ITU-T X.501 (10/2016).

A list of all parts in the ISO/IEC 9594 series, published under the general title *Information technology — Open Systems Interconnection — The Directory*, can be found on the ISO website.



## CONTENTS

|                                                        | <i>Page</i> |
|--------------------------------------------------------|-------------|
| SECTION 1 – GENERAL .....                              | 1           |
| 1 Scope .....                                          | 1           |
| 2 References .....                                     | 2           |
| 2.1 Normative references .....                         | 2           |
| 2.2 Non-normative reference.....                       | 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 .....                      | 4           |
| 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.....      | 8           |
| 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.....                            | 22          |
| 8.11 Compound entries and families of entries .....    | 22          |
| 9 Names.....                                           | 23          |
| 9.1 Definitions.....                                   | 23          |
| 9.2 Names in general .....                             | 24          |
| 9.3 Relative distinguished name.....                   | 24          |
| 9.4 Name matching .....                                | 25          |
| 9.5 Distinguished names .....                          | 25          |
| 9.6 Alias names .....                                  | 26          |
| 10 Hierarchical groups .....                           | 26          |
| 10.1 Definitions.....                                  | 26          |
| 10.2 Hierarchical relationship .....                   | 27          |
| 10.3 Sequential ordering of a hierarchical group ..... | 28          |

|                                                                                          |    |
|------------------------------------------------------------------------------------------|----|
| SECTION 4 – DIRECTORY ADMINISTRATIVE MODEL.....                                          | 29 |
| 11 Directory Administrative Authority model .....                                        | 29 |
| 11.1 Definitions.....                                                                    | 29 |
| 11.2 Overview .....                                                                      | 29 |
| 11.3 Policy .....                                                                        | 30 |
| 11.4 Specific administrative authorities .....                                           | 30 |
| 11.5 Administrative areas and administrative points .....                                | 31 |
| 11.6 DIT Domain policies.....                                                            | 33 |
| 11.7 DMD policies.....                                                                   | 33 |
| SECTION 5 – MODEL OF DIRECTORY ADMINISTRATIVE AND OPERATIONAL INFORMATION .....          | 35 |
| 12 Model of Directory Administrative and Operational Information.....                    | 35 |
| 12.1 Definitions.....                                                                    | 35 |
| 12.2 Overview .....                                                                      | 35 |
| 12.3 Subtrees .....                                                                      | 36 |
| 12.4 Operational attributes .....                                                        | 38 |
| 12.5 Entries .....                                                                       | 39 |
| 12.6 Subentries.....                                                                     | 39 |
| 12.7 Information model for collective attributes .....                                   | 40 |
| 12.8 Information model for context defaults .....                                        | 41 |
| SECTION 6 – THE DIRECTORY SCHEMA .....                                                   | 42 |
| 13 Directory Schema.....                                                                 | 42 |
| 13.1 Definitions.....                                                                    | 42 |
| 13.2 Overview .....                                                                      | 42 |
| 13.3 Object class definition.....                                                        | 44 |
| 13.4 Attribute type definition.....                                                      | 46 |
| 13.5 Matching rule definition.....                                                       | 50 |
| 13.6 Relaxation and tightening.....                                                      | 52 |
| 13.7 DIT structure definition.....                                                       | 58 |
| 13.8 DIT content rule definition.....                                                    | 61 |
| 13.9 Context type definition.....                                                        | 62 |
| 13.10 DIT Context Use definition.....                                                    | 63 |
| 13.11 Friends definition .....                                                           | 64 |
| 13.12 Syntax definitions.....                                                            | 65 |
| 14 Directory System Schema .....                                                         | 65 |
| 14.1 Overview .....                                                                      | 65 |
| 14.2 System schema supporting the administrative and operational information model ..... | 66 |
| 14.3 System schema supporting the administrative model.....                              | 66 |
| 14.4 System schema supporting general administrative and operational requirements .....  | 67 |
| 14.5 System schema supporting access control.....                                        | 69 |
| 14.6 System schema supporting the collective attribute model.....                        | 70 |
| 14.7 System schema supporting context assertion defaults.....                            | 70 |
| 14.8 System schema supporting the service administration model .....                     | 70 |
| 14.9 System schema supporting password administration .....                              | 71 |
| 14.10 System schema supporting hierarchical groups.....                                  | 72 |
| 14.11 Maintenance of system schema.....                                                  | 73 |
| 14.12 System schema for first-level subordinates .....                                   | 73 |
| 15 Directory schema administration.....                                                  | 73 |
| 15.1 Overview .....                                                                      | 73 |
| 15.2 Policy objects .....                                                                | 74 |
| 15.3 Policy parameters .....                                                             | 74 |
| 15.4 Policy procedures .....                                                             | 75 |
| 15.5 Subschema modification procedures.....                                              | 75 |
| 15.6 Entry addition and modification procedures .....                                    | 75 |
| 15.7 Subschema policy attributes.....                                                    | 76 |

|                                                                 |     |
|-----------------------------------------------------------------|-----|
| SECTION 7 – DIRECTORY SERVICE ADMINISTRATION.....               | 82  |
| 16 Service Administration Model.....                            | 82  |
| 16.1 Definitions.....                                           | 82  |
| 16.2 Service-type/user-class model.....                         | 82  |
| 16.3 Service-specific administrative areas.....                 | 83  |
| 16.4 Introduction to search-rules.....                          | 84  |
| 16.5 Subfilters.....                                            | 84  |
| 16.6 Filter requirements.....                                   | 85  |
| 16.7 Attribute information selection based on search-rules..... | 85  |
| 16.8 Access control aspects of search-rules.....                | 86  |
| 16.9 Contexts aspects of search-rules.....                      | 86  |
| 16.10 Search-rule specification.....                            | 86  |
| 16.11 Matching restriction definition.....                      | 94  |
| 16.12 Search-validation function.....                           | 95  |
| SECTION 8 – SECURITY.....                                       | 96  |
| 17 Security model.....                                          | 96  |
| 17.1 Definitions.....                                           | 96  |
| 17.2 Security policies.....                                     | 96  |
| 17.3 Protection of Directory operations.....                    | 97  |
| 18 Basic Access Control.....                                    | 98  |
| 18.1 Scope and application.....                                 | 98  |
| 18.2 Basic Access Control model.....                            | 98  |
| 18.3 Access control administrative areas.....                   | 101 |
| 18.4 Representation of Access Control Information.....          | 103 |
| 18.5 ACI operational attributes.....                            | 108 |
| 18.6 Protecting the ACI.....                                    | 109 |
| 18.7 Access control and Directory operations.....               | 109 |
| 18.8 Access Control Decision Function.....                      | 110 |
| 18.9 Simplified Access Control.....                             | 111 |
| 19 Rule-based Access Control.....                               | 111 |
| 19.1 Scope and application.....                                 | 111 |
| 19.2 Rule-based Access Control model.....                       | 112 |
| 19.3 Access control administrative areas.....                   | 113 |
| 19.4 Security Label.....                                        | 113 |
| 19.5 Clearance.....                                             | 114 |
| 19.6 Access Control and Directory operations.....               | 115 |
| 19.7 Access Control Decision Function.....                      | 115 |
| 19.8 Use of Rule-based and Basic Access Control.....            | 115 |
| 20 Data Integrity in Storage.....                               | 116 |
| 20.1 Introduction.....                                          | 116 |
| 20.2 Protection of an Entry or Selected Attribute Types.....    | 116 |
| 20.3 Context for Protection of a Single Attribute Value.....    | 117 |
| SECTION 9 – DSA MODELS.....                                     | 119 |
| 21 DSA Models.....                                              | 119 |
| 21.1 Definitions.....                                           | 119 |
| 21.2 Directory Functional Model.....                            | 119 |
| 21.3 Directory Distribution Model.....                          | 120 |
| SECTION 10 – DSA INFORMATION MODEL.....                         | 122 |
| 22 Knowledge.....                                               | 122 |
| 22.1 Definitions.....                                           | 122 |
| 22.2 Introduction.....                                          | 122 |
| 22.3 Knowledge References.....                                  | 123 |

|      |                                                                    |     |
|------|--------------------------------------------------------------------|-----|
| 22.4 | Minimum Knowledge .....                                            | 125 |
| 22.5 | First Level DSAs .....                                             | 126 |
| 22.6 | Knowledge references to LDAP servers .....                         | 126 |
| 23   | Basic Elements of the DSA Information Model .....                  | 126 |
| 23.1 | Definitions .....                                                  | 126 |
| 23.2 | Introduction .....                                                 | 127 |
| 23.3 | DSA Specific Entries and their Names .....                         | 127 |
| 23.4 | Basic Elements .....                                               | 129 |
| 24   | Representation of DSA Information .....                            | 130 |
| 24.1 | Representation of Directory User and Operational Information ..... | 130 |
| 24.2 | Representation of Knowledge References .....                       | 131 |
| 24.3 | Representation of Names and Naming Contexts .....                  | 138 |
|      | SECTION 11 – DSA OPERATIONAL FRAMEWORK .....                       | 140 |
| 25   | Overview .....                                                     | 140 |
| 25.1 | Definitions .....                                                  | 140 |
| 25.2 | Introduction .....                                                 | 140 |
| 26   | Operational bindings .....                                         | 140 |
| 26.1 | General .....                                                      | 140 |
| 26.2 | Application of the operational framework .....                     | 141 |
| 26.3 | States of cooperation .....                                        | 142 |
| 27   | Operational binding specification and management .....             | 143 |
| 27.1 | Operational binding type specification .....                       | 143 |
| 27.2 | Operational binding management .....                               | 144 |
| 27.3 | Operational binding specification templates .....                  | 145 |
| 28   | Operations for operational binding management .....                | 147 |
| 28.1 | Application-context definition .....                               | 147 |
| 28.2 | Establish Operational Binding operation .....                      | 147 |
| 28.3 | Modify Operational Binding operation .....                         | 150 |
| 28.4 | Terminate Operational Binding operation .....                      | 152 |
| 28.5 | Operational Binding Error .....                                    | 153 |
| 28.6 | Operational Binding Management Bind and Unbind .....               | 155 |
|      | SECTION 12 – INTERWORKING WITH LDAP .....                          | 156 |
| 29   | Overview .....                                                     | 156 |
| 29.1 | Definitions .....                                                  | 156 |
| 29.2 | Introduction .....                                                 | 156 |
| 30   | LDAP interworking model .....                                      | 156 |
| 30.1 | LDAP interworking scenarios .....                                  | 156 |
| 30.2 | Overview of bound DSA handling LDAP operations .....               | 157 |
| 30.3 | General LDAP requestor characteristics .....                       | 157 |
| 30.4 | LDAP extension mechanisms .....                                    | 158 |
| 31   | LDAP specific system schema .....                                  | 158 |
| 31.1 | Operational Attribute types from IETF RFC 4512 .....               | 158 |
|      | Annex A – Object identifier usage .....                            | 161 |
|      | Annex B – Information framework in ASN.1 .....                     | 165 |
|      | Annex C – Subschema administration in ASN.1 .....                  | 177 |
|      | Annex D – Service administration in ASN.1 .....                    | 182 |
|      | Annex E – Basic Access Control in ASN.1 .....                      | 186 |
|      | Annex F – DSA operational attribute types in ASN.1 .....           | 190 |
|      | Annex G – Operational binding management in ASN.1 .....            | 193 |
|      | Annex H – Enhanced security in ASN.1 .....                         | 198 |

|                                                                                       |     |
|---------------------------------------------------------------------------------------|-----|
| Annex I – LDAP system schema.....                                                     | 201 |
| Annex J – The mathematics of trees.....                                               | 203 |
| Annex K – Name design criteria.....                                                   | 204 |
| Annex L – Examples of various aspects of schema.....                                  | 206 |
| L.1 Example of an attribute hierarchy .....                                           | 206 |
| L.2 Example of a subtree specification.....                                           | 206 |
| L.3 Schema specification.....                                                         | 207 |
| L.4 DIT content rules.....                                                            | 208 |
| L.5 DIT context use .....                                                             | 209 |
| Annex M – Overview of basic access control permissions.....                           | 210 |
| M.1 Introduction.....                                                                 | 210 |
| M.2 Permissions required for operations .....                                         | 210 |
| M.3 Permissions affecting error.....                                                  | 211 |
| M.4 Entry level permissions .....                                                     | 211 |
| M.5 Entry level permissions .....                                                     | 212 |
| Annex N – Examples of access control .....                                            | 213 |
| N.1 Introduction.....                                                                 | 213 |
| N.2 Design principles for Basic Access Control.....                                   | 213 |
| N.3 Introduction to example .....                                                     | 214 |
| N.4 Policy affecting the definition of specific and inner areas .....                 | 215 |
| N.5 Policy affecting the definition of Directory Access Control Domains (DACDs) ..... | 216 |
| N.6 Policy expressed in prescriptiveACI attributes .....                              | 219 |
| N.7 Policy expressed in subentryACI attributes .....                                  | 224 |
| N.8 Policy expressed in entryACI attributes.....                                      | 225 |
| N.9 ACDF examples.....                                                                | 225 |
| N.10 Rule-based access control .....                                                  | 227 |
| Annex O – DSE type combinations.....                                                  | 228 |
| Annex P – Modelling of knowledge .....                                                | 230 |
| Annex Q – Subfilters .....                                                            | 235 |
| Annex R – Compound entry name patterns and their use.....                             | 236 |
| Annex S – Naming concepts and considerations .....                                    | 238 |
| S.1 History tells us .....                                                            | 238 |
| S.2 A new look at name resolution.....                                                | 238 |
| Annex T – Alphabetical index of definitions.....                                      | 244 |
| Annex U – Amendments and corrigenda.....                                              | 247 |

## 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 eight edition technically revises and enhances the seventh edition of this Recommendation | International Standard.

This eight 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 this eight 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, 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.

<https://standards.iteh.ai/iso-iec-9594-2-2017>

<https://standards.iteh.ai/catalog/standards/iso/d4a7696d-3534-43fd-b8e9-a02753d050e0/iso-iec-9594-2-2017>



**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 (2016) | ISO/IEC 9594-1:2017, *Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services.*
- Recommendation ITU-T X.509 (2016) | ISO/IEC 9594-8:2017, *Information technology – Open Systems Interconnection – The Directory: Public-key and attribute certificate frameworks.*
- Recommendation ITU-T X.511 (2016) | ISO/IEC 9594-3:2017, *Information technology – Open Systems Interconnection – The Directory: Abstract service definition.*
- Recommendation ITU-T X.518 (2016) | ISO/IEC 9594-4:2017, *Information technology – Open Systems Interconnection – The Directory: Procedures for distributed operation.*
- Recommendation ITU-T X.519 (2016) | ISO/IEC 9594-5:2017, *Information technology – Open Systems Interconnection – The Directory: Protocol specifications.*
- Recommendation ITU-T X.520 (2016) | ISO/IEC 9594-6:2017, *Information technology – Open Systems Interconnection – The Directory: Selected attribute types.*
- Recommendation ITU-T X.521 (2016) | ISO/IEC 9594-7:2017, *Information technology – Open Systems Interconnection – The Directory: Selected object classes.*
- Recommendation ITU-T X.525 (2016) | ISO/IEC 9594-9:2017, *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.*

#### 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.*