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Information technology — Open systems interconnection

Part 6: The Directory: Selected attribute types

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National foreword

This British Standard is the UK implementation of ISO/IEC 9594-6:2020. It supersedes BS ISO/IEC 9594-6:2017, which is withdrawn.

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INTERNATIONAL STANDARD

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Information technology — Open systems interconnection —

Part 6:
The Directory: Selected attribute types

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Foreword

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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 (see www.iso.org/directives).

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This document was prepared by ITU-T as ITU-T X.520 (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 9594-6:2017), which has been technically revised.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This Recommendation | International Standard, together with 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 a number of attribute types which may be found useful across a range of applications of the Directory, as well as a number of standard attribute syntaxes and matching rules. One particular use for many of the attributes defined herein is in the formation of names, particularly for the classes of objects defined in Rec. ITU-T X.521 | ISO/IEC 9594-7.

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.

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

Annex A, which is an integral part of this Recommendation | International Standard, provides the ASN.1 notation for the complete module which defines the attributes, attribute syntaxes and matching rules.

Annex C, which is not an integral part of this Recommendation | International Standard, provides a table of attribute types, for easy reference.

Annex D, which is not an integral part of this Recommendation | International Standard, provides an example of upper bounds value constraints. These constraints are not reflected in these Directory Specifications, but are provided as a reference for those implementations applying these constraints.

Annex E, which is not an integral part of this Recommendation | International Standard, lists alphabetically the attributes and matching rules defined in this Directory Specification.

Annex F, which is not an integral part of this Recommendation | International Standard, gives examples relevant to the definition of zonal matching.

Annex G, which is not an integral part of this Recommendation | International Standard, describes how a directory distinguished name may be based on object identifiers and on Uniform Resource Names (URNs).

Annex H, which is not an integral part of this Recommendation | International Standard, describes an alternative way of generating directory distinguished based on object identifiers. It contains information retrieved from Rec. ITU-T X.660 | ISO/IEC 9834-1.

Annex I, 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: Selected attribute types

SECTION 1 – GENERAL

1 Scope

This Recommendation | International Standard defines a number of attribute types and matching rules which may be found useful across a range of applications of the Directory.

Attribute types and matching rules fall into three categories, as described below.

Some attribute types and matching rules are used by a wide variety of applications or are understood and/or used by the Directory itself.

NOTE 1 – It is recommended that an attribute type or matching rule defined in this Recommendation | International Standard be used, in preference to the generation of a new one, whenever it is appropriate for the application.

NOTE 2 – The attribute and context types definitions by this Recommendation | International Standard have some associated semantics. Such specifications should not be used in situations where these semantics do not apply.

Some attribute types and matching rules are internationally standardized, but are application-specific. These are defined in the standards associated with the application concerned.

Any administrative authority can define its own attribute types and matching rules for any purpose. These are not internationally standardized, and are available to others beyond the administrative authority which created them only through bilateral agreement.

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.500 (2019) | ISO/IEC 9594-1:2020, *Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services*.
- Recommendation ITU-T X.501 (2019) | ISO/IEC 9594-2:2020, *Information technology – Open Systems Interconnection – The Directory: Models*.
- 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.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*.

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- Recommendation ITU-T X.660 (2011) | ISO/IEC 9834-1:2012, *Information technology –Procedures for the operation of object identifier registration authorities: General procedures and top arcs of the international object identifier tree*.
- Recommendation ITU-T X.667 (2012) | ISO/IEC 9834-8:2014, *Information technology –Procedures for the operation of object identifier registration authorities: Generation of universally unique identifiers and their use in object identifiers*.
- Recommendation ITU-T X.668 (2008) | ISO/IEC 9834-9:2008, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: Registration of object identifier arcs for applications and services using tag-based identification*.
- 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)*.

2.2 Other references

- Recommendation ITU-T E.123 (2001), *Notation for national and international telephone numbers, e-mail addresses and web addresses*.
- Recommendation ITU-T E.164 (2010), *The international public telecommunication numbering plan*.
- Recommendation ITU-T F.1 (1998), *Operational provisions for the international public telegram service*.
- Recommendation ITU-T F.31 (1988), *Telegram retransmission system*.
- Recommendation ITU-T F.401 (1992), *Message handling services: Naming and addressing for public message handling services*.
- Recommendation ITU-T T.30 (2005), *Procedures for document facsimile transmission in the general switched telephone network*.
- Recommendation ITU-T T.51 (1992), *Latin based coded character sets for telematic services*.
- Recommendation ITU-T T.62 (1993), *Control procedures for teletex and Group 4 facsimile services*.
- Recommendation ITU-T X.121 (2000), *International numbering plan for public data networks*.
- ISO 3166-1:2013, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*.
- ISO 3166-3:2013, *Codes for the representation of names of countries and their subdivisions – Part 3: Code for formerly used names of countries*.
- ISO 639-2:1998, *Codes for the representation of names of languages – Part 2: Alpha-3 code*.
- ISO/IEC/IEEE 9945:2009, *Information technology – Portable Operating System Interface (POSIX) – Base Specifications, Issue 7*.
- ISO/IEC 15897:2011, *Information technology – User interfaces – Procedures for the registration of cultural elements.*
- IETF RFC 3406 (2002), *Uniform Resource Names (URN) Namespace Definition Mechanisms*.
- IETF RFC 3454 (2002), *Preparation of Internationalized Strings ("stringprep")*.
- IETF RFC 3492 (2003), *Punycode: A Bootstring encoding of Unicode for Internationalized Domain Names in Applications (IDNA)*.
- IETF RFC 3641 (2003), *Generic String Encoding Rules (GSER) for ASN.1 Types*.
- IETF RFC 3642 (2003), *Common Elements of Generic String Encoding Rules (GSER) Encodings*.
- IETF RFC 3672 (2003), *Subentries in the Lightweight Directory Access Protocol (LDAP)*.
- IETF RFC 3986 (2005), *Uniform Resource Identifier (URI): Generic Syntax*.

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– IETF RFC 4512 (2006), *Lightweight Directory Access Protocol (LDAP): Directory Information Models*.
– IETF RFC 4514 (2006); *Lightweight Directory Access Protocol (LDAP): String Representation of Distinguished Names*.
– IETF RFC 4517 (2006), *Lightweight Directory Access Protocol (LDAP): Syntaxes and Matching Rules*.
– IETF RFC 4520 (2006), *Internet Assigned Numbers Authority (IANA) Considerations for the Lightweight Directory Access Protocol (LDAP)*.
– IETF RFC 4792 (2007), *Encoding Instructions for the Generic String Encoding Rules (GSER).*
– IETF RFC 5890 (2010), *Internationalized Domain Names for Applications (IDNA): Definitions and Document Framework*.
– IETF RFC 5892 (2010), *The Unicode Code Points and Internationalized Domain Names for Applications (IDNA)*.
– National Imagery and Mapping Agency (NIMA): TR 8350.2 (1984), *Department of Defense World Geodetic System*, third edition.
– The Unicode Consortium. *The Unicode Standard, Version 4.0.0*, defined by: *The Unicode Standard, Version 4.0* (Reading, MA: Addison-Wesley, 2003. ISBN 0-321-18578-1).
– *Unicode Standard Annex #15: Unicode Normalization Forms*, by Mark Davis and Martin Dürst. An integral part of *The Unicode Standard, Version 4.0*.

2.3 ISO/IEC Standards

– ISO/IEC 10646:2017, *Information technology – Universal Coded Character Set (UCS)*.

3 Definitions

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

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

a) *attribute type*;
b) *context*;
c) *matching rule*;
d) *object class*.

4 Abbreviations

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

AFI	Application Family Identifier
EPC	Electronic Product Code
FQDN	Fully-Qualified Domain Name
GSER	Generic String Encoding Rules
IDN	Internationalized Domain Name
LDAP	Lightweight Directory Access Protocol
LDH	Letters, Digits, Hyphen
RFID	Radio Frequency Identification
RDN	Relative Distinguished Name
UII	Unique Item Identifier
URL	Uniform Resource Locator
URN	Uniform Resource Name
UTM	Universal Transverse Mercator
UUID	Universally Unique Identifier

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5 Conventions

The term "Directory Specification" (as in "this Directory Specification") shall be taken to mean Rec. ITU-T X.520 | ISO/IEC 9594-6. The term "Directory Specifications" shall be taken to mean the Rec. ITU-T X.500 | ISO/IEC 9594-1, Rec. ITU-T X.501 | ISO/IEC 9594-2, Rec. ITU-T X.511 | ISO/IEC 9594-3, Rec. ITU-T X.518 | ISO/IEC 9594-4, Rec. ITU-T X.519 | ISO/IEC 9594-5, Rec. ITU-T X.520 | ISO/IEC 9594-6, Rec ITU-T X.521 | ISO/IEC 9594-7 and Rec. ITU-T X.525 | ISO/IEC 9594-9.

If an International Standard or ITU-T Recommendation is referenced within normal text without an indication of the edition, the edition shall be taken to be the latest one as specified in the normative references clause.

Prior to year 2020, the parts making up the Directory Specifications progressed together and can therefore collectively be identified as the Directory Specifications of a specific edition using the format: Rec. ITU-T X.5** (yyyy) | ISO/IEC 9594-*:yyyy (e.g.; Rec ITU-T X.5** (1993) | ISO/IEC 9594-*:1995).

This Directory Specification makes extensive use of Abstract Syntax Notation One (ASN.1) for the formal specification of data types and values, as it is specified in Rec. ITU-T X.680 | ISO/IEC 8824-1, ITU-T X.681 | ISO/IEC 8824-2, ITU-T X.682 | ISO/IEC 8824-3, ITU-T X.683 | ISO/IEC 8824-4 and Rec. ITU-T X.690 | ISO/IEC 8825-1.

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.

Attribute types, matching rules and context types are defined in this Recommendation | International Standard by use of the **`ATTRIBUTE`**, **`MATCHING-RULE`** and **`CONTEXT`** information object classes defined in Rec. ITU-T X.501 | ISO/IEC 9594-2.

Examples of the use of the attribute types are described using an informal notation, where attribute type and value pairs are represented by an acronym for the attribute type, followed by an equals sign ("="), followed by the example value for the attribute.

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SECTION 2 – SELECTED ATTRIBUTE TYPES

6 Definition of selected attribute types

This Directory Specification defines a number of attribute types which may be found useful across a range of applications of the Directory.

Many of the attribute types defined in this Directory Specification are based on a common ASN.1 syntax:

```
UnboundedDirectoryString ::= CHOICE {
  teletexString    TeletexString(SIZE (1..MAX)),
  printableString  PrintableString(SIZE (1..MAX)),
  bmpString        BMPString(SIZE (1..MAX)),
  universalString  UniversalString(SIZE (1..MAX)),
  uTF8String       UTF8String(SIZE (1..MAX)) }
```

A few attribute types are based on the following data type:

```
DirectoryString{INTEGER:maxSize} ::= CHOICE {
  teletexString    TeletexString(SIZE (1..maxSize,...)),
  printableString  PrintableString(SIZE (1..maxSize,...)),
  bmpString        BMPString(SIZE (1..maxSize,...)),
  universalString  UniversalString(SIZE (1..maxSize,...)),
  uTF8String       UTF8String(SIZE (1..maxSize,...)) }
```

NOTE 1 – The above syntaxes are also used in other parts of these Directory Specifications.

NOTE 2 – The use of **TeletexString** is deprecated.

6.1 System attribute types

6.1.1 Knowledge information

A value of the **knowledgeInformation** attribute type holds a human readable accumulated description of knowledge mastered by a specific DSA.

NOTE – This attribute is now obsolete.

```
knowledgeInformation ATTRIBUTE ::= {
  WITH SYNTAX              UnboundedDirectoryString
  EQUALITY MATCHING RULE   caseIgnoreMatch
  OBSOLETE                 TRUE
  ID                       id-at-knowledgeInformation }
```

6.2 Labelling attribute types

These attributes type are concerned with information about objects which has been explicitly associated with the objects by a labelling process.

6.2.1 Name

The **name** attribute type is the attribute supertype from which string attribute types typically used for naming may be formed.

```
name ATTRIBUTE ::= {
  WITH SYNTAX              UnboundedDirectoryString
  EQUALITY MATCHING RULE   caseIgnoreMatch
  SUBSTRINGS MATCHING RULE caseIgnoreSubstringsMatch
  LDAP-SYNTAX              directoryString.&id
  LDAP-NAME                {"name"}
  ID                       id-at-name }
```

6.2.2 Common name

A value of the **commonName** attribute type holds an identification of an object. A common name is not a directory name in itself; it is a (possibly ambiguous) name by which the object is commonly known in some limited scope (such as an organization) and conforms to the naming conventions of the country or culture with which it is associated.

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An attribute value for Common Name is a string chosen by either the person or organization it describes or the organization responsible for the object it describes for devices and application entities. For example, a typical name of a person in an English-speaking country comprises a personal title (e.g., Mr., Ms., Rd, Professor, Sir, Lord), a first name, middle name(s), last name, generation qualifier (if any, e.g., Jr.) and decorations and awards (if any, e.g., QC).

Examples

CN = "Mr. Robin Lachlan McLeod BSc(Hons) CEng MIEE";

CN = "Divisional Coordination Committee";

CN = "High Speed Modem".

Any variants should be associated with the named object as separate and alternative attribute values.

Other common variants should also be admitted, e.g., use of a middle name as a preferred first name; use of "Bill" in place of "William", etc.

```
commonName ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"cn","commonName"}
  ID                        id-at-commonName }
```

6.2.3 Surname

An attribute of the type **surname** specifies the linguistic construct which normally is inherited by an individual from the individual's parent or assumed by marriage, and by which the individual is commonly known.

An attribute value for Surname is a string, e.g., "McLeod".

```
surname ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"sn"}
  ID                        id-at-surname }
```

6.2.4 Given Name

The *Given Name* attribute type specifies the linguistic construct which is normally given to an individual by the individual's parent, or is chosen by the individual, or by which the individual is commonly known.

An attribute value for Given Name is a string, e.g., "David" or "Jean-Paul".

```
givenName ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"givenName"}
  ID                        id-at-givenName }
```

6.2.5 Initials

The *Initials* attribute type contains the initials of some or all of an individual's names, but not the surname(s).

An attribute value for Initials is a string, e.g., "D" or "D." or "J.P.".

```
initials ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"initials"}
  ID                        id-at-initials }
```

6.2.6 Generation Qualifier

The *Generation Qualifier* attribute type contains a string which is used to provide generation information to qualify an individual's name.

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An attribute value for Generation Qualifier is a string, e.g., "Jr." or "II".

```
generationQualifier ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"generationQualifier"}
  ID                        id-at-generationQualifier }
```

6.2.7 Unique Identifier

The *Unique Identifier* attribute type specifies an identifier which may be used to distinguish between object references when a distinguished name has been reused. It may be, for example, an encoded object identifier, certificate, date, timestamp, or some other form of certification on the validity of the distinguished name.

An attribute value for Unique Identifier is a bit string.

```
uniqueIdentifier ATTRIBUTE ::= {
  WITH SYNTAX               UniqueIdentifier
  EQUALITY MATCHING RULE    bitStringMatch
  LDAP-SYNTAX               bitString.&id
  LDAP-NAME                 {"x500UniqueIdentifier"}
  ID                        id-at-uniqueIdentifier }

UniqueIdentifier ::= BIT STRING
```

6.2.8 DN Qualifier

The *DN Qualifier* attribute type specifies disambiguating information to add to the relative distinguished name of an entry. It is intended to be used for entries held in multiple DSAs which would otherwise have the same name, and that its value be the same in a given DSA for all entries to which this information has been added.

```
dnQualifier ATTRIBUTE ::= {
  WITH SYNTAX               PrintableString
  EQUALITY MATCHING RULE    caseIgnoreMatch
  ORDERING MATCHING RULE    caseIgnoreOrderingMatch
  SUBSTRINGS MATCHING RULE  caseIgnoreSubstringsMatch
  LDAP-SYNTAX               printableString.&id
  LDAP-NAME                 {"dnQualifier"}
  ID                        id-at-dnQualifier }
```

6.2.9 Serial Number

The *Serial Number* attribute type specifies an identifier or the serial number of an object.

An attribute value for Serial Number is a printable string.

```
serialNumber ATTRIBUTE ::= {
  WITH SYNTAX               PrintableString(SIZE (1..MAX))
  EQUALITY MATCHING RULE    caseIgnoreMatch
  SUBSTRINGS MATCHING RULE  caseIgnoreSubstringsMatch
  LDAP-SYNTAX               printableString.&id
  LDAP-NAME                 {"serialNumber"}
  ID                        id-at-serialNumber }
```

6.2.10 Pseudonym

The *Pseudonym* attribute type specifies a pseudonym for an object. It is used for naming an object when it is to be made clear that its name is a pseudonym.

```
pseudonym ATTRIBUTE ::= {
  SUBTYPE OF               name
  WITH SYNTAX              UnboundedDirectoryString
  ID                       id-at-pseudonym }
```

6.2.11 Universal Unique Identifier Pair

The *Universal Unique Identifier Pair* attribute type specifies a pair of Universal Unique Identifiers (UUID), as specified in Rec. ITU-T X.667 | ISO/IEC 9834-8. The pair collectively represents an issuer/subject relationship, the nature of which is outside the scope of this Directory Specification. The initial UUID in the pair represents the issuer, and the trailing

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UUID in the pair represents the subject of the issuer/subject relationship. An example of such a relationship is a user account.

```
uUIDPair ATTRIBUTE ::= {
  WITH SYNTAX              UUIDPair
  EQUALITY MATCHING RULE   uUIDPairMatch
  ID                       id-
at-uuidpair }

UUIDPair ::= SEQUENCE {
  issuerUUID   UUID,
  subjectUUID  UUID,
  ... }

UUID ::= OCTET STRING(SIZE (16)) -- UUID format only
```

6.2.12 URI

A value of attribute type **uri** holds a uniform resource identifier (URI) as defined in IETF RFC 3986.

```
uri ATTRIBUTE ::= {
  WITH SYNTAX               URI
  EQUALITY MATCHING RULE    uriMatch
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"uri"}
  ID                        id-at-uri }

URI ::= UTF8String
```

6.2.13 URN

A value of attribute type **urn** holds a uniform resource name (URN) as defined in IETF RFC 3406.

```
urn ATTRIBUTE ::= {
  SUBTYPE OF                uri
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"urn"}
  ID                        id-at-urn }
```

6.2.14 URL

A value of attribute type **url** holds a uniform resource locator (URL).

```
url ATTRIBUTE ::= {
  SUBTYPE OF                uri
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"url"}
  ID                        id-at-url }
```

6.2.15 Domain name

A value of attribute type **dnsName** is used for holding a DNS domain name, which may be an internationalized domain name (IDN).

```
dnsName ATTRIBUTE ::= {
  WITH SYNTAX              DomainName
  EQUALITY MATCHING RULE   dnsNameMatch
  LDAP-SYNTAX              dnsString.&id
  LDAP-NAME                {"DNS name"}
  ID                       id-at-dnsName }

DomainName ::= UTF8String (CONSTRAINED BY { -- Conforms to the format of a
(internationalized) domain name. -- })
```

A value of the **DomainName** data type shall be in the syntax, as specified by section 2.3.1 of IETF RFC 5890 meaning that a domain name is a sequence of labels in the letters, digits, hyphen (LDH) format separated by dots.

A label may be in three formats:

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a) All characters in the label are from the Basic Latin collection as defined by ISO/IEC 10646 (i.e., having code points in the ranges 002D, 0030-0039, 0041-005A and 0061-007A) and it does not start with "xn--". The maximum length is 63 octets.

b) It is an A-label as defined in IETF RFC 5890, i.e., it starts with the "xn--" and is a U-label converted to valid ASCII characters as in item a) using the Punycode algorithm defined by IETF RFC 3492. The converted string shall be maximum 59 octets. To be valid, it shall be possible for an A-label to be converted to a valid U-label.

NOTE 1 – An A-label is normally not human readable.

c) It is a U-label as defined in IETF RFC 5890, i.e., it contains characters outside the Basic Latin collection. A valid U-label shall not include any characters that are not included in the restricted Unicode repertoire as defined by IETF RFC 5892 and it shall be convertible to a valid A-label as defined in item b). A valid U-label may be more than 63 octets.

NOTE 2 – In a constraint environment, it is recommended to use a domain name whenever possible, according to item a).

NOTE 3 – When used as a naming attribute, a unique distinguished name may be constructed using only this attribute type.

An attribute of type **dnsName** to be used as a distinguished name in a public-key certificate or in an attribute certificate shall be a fully-qualified domain name (FQDN), i.e., it shall identify a particular entity. An FQDN may have an asterisk ('*') as an additional leftmost label, which is a substitute (wildcard) for all labels at the next levels of subdomains of the domain identified by the FQDN without the asterisk. An attribute of type **dnsName** holding an FQDN with a wildcard label may in some cases be used in the **subject** component of an end-entity public-key certificate.

6.2.16 Internationalized email address attribute type

A value of attribute type **intEmail** is used for holding an internationalized email address.

```
intEmail ATTRIBUTE ::= {
  WITH SYNTAX              IntEmail
  EQUALITY MATCHING RULE   intEmailMatch
  SINGLE VALUE             TRUE
  LDAP-SYNTAX              intMailString.&id
  LDAP-NAME                {"Internationalized Email"}
  ID                       id-at-intEmail }

IntEmail ::= UTF8String (CONSTRAINED BY { -- Conforms to the format of an
(internationalized) email address. -- })
```

The requirements of the labels of the domain part of an internationalized email address are as specified for domain names (see clause 6.2.15), except that an asterisk ('*') shall not be used as label.

If neither the local part nor the domain part both holds non-ASCII characters, then the **mail** attribute type specified in clause 6.17.3 should be used.

If only the local part uses ASCII cgaracters, the A-label should be used for the domain name allowing the **mail** attribute type to be used.

6.2.17 Jabber identifier attribute type

A value of attribute type **jid** is used for holding a jabber identifier as specified in IETF RFC 7633.

```
jid ATTRIBUTE ::= {
  WITH SYNTAX              Jid
  EQUALITY MATCHING RULE   jidMatch
  SINGLE VALUE             TRUE
  LDAP-SYNTAX              jidString.&id
  LDAP-NAME                {"Jabber identifier"}
  ID                       id-at-jid }

Jid ::= UTF8String (CONSTRAINED BY { /* Conforms to the format of a jabber identifier.
*/ })
```

6.2.18 Object identifier attribute type

A value of attribute type **objectIdentifier** is used for holding an object identifier.

```
objectIdentifier ATTRIBUTE ::= {
  WITH SYNTAX              OBJECT IDENTIFIER
```

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```
  EQUALITY MATCHING RULE  objectIdentifierMatch
  SINGLE VALUE            TRUE
  LDAP-SYNTAX             oid.&id
  LDAP-NAME               {"Object Identifier"}
  ID                      id-at-objectIdentifier }
```

When an object is identified by an object identifier, a value of this attribute type may be used as the only RDN in a distinguished name that uniquely identifies the object.

6.3 Geographical attribute types

These attribute types are concerned with geographical positions or regions with which objects are associated.

6.3.1 Country Name

A value of the **countryName** attribute type specifies a country. When used as a component of a directory name, it identifies the country in which the named object is physically located or with which it is associated in some other important way.

An attribute value for country name is a string chosen from ISO 3166-1 alpha-2.

```
countryName ATTRIBUTE ::= {
  SUBTYPE OF               name
  WITH SYNTAX              CountryName
  SINGLE VALUE             TRUE
  LDAP-SYNTAX              countryString.&id
  LDAP-NAME                {"c"}
  ID                       id-at-countryName }

CountryName ::= PrintableString(SIZE (2)) (CONSTRAINED BY { -- ISO 3166 alpha-2 codes
only -- })
```

6.3.2 Country code with three characters

A value of **countryCode3c** attribute type specifies a country. When used as a component of a directory name, it identifies the country in which the named object is physically located or with which it is associated in some other important way.

An attribute value for **countryCode3c** is a string chosen from ISO 3166-1 alpha-3.

```
countryCode3c ATTRIBUTE ::= {
  SUBTYPE OF               name
  WITH SYNTAX              CountryCode3c
  SINGLE VALUE             TRUE
  LDAP-SYNTAX              countryString3c.&id
  LDAP-NAME                {"c3"}
  ID                       id-at-countryCode3c }

CountryCode3c ::= PrintableString(SIZE (3)) (CONSTRAINED BY { -- ISO 3166 alpha-3 codes
only -- })
```

6.3.3 Numeric character country code

A value of **countryCode3n** attribute type specifies a country. When used as a component of a directory name, it identifies the country in which the named object is physically located or with which it is associated in some other important way.

An attribute value for **countryCode3n** is a string chosen from ISO 3166-1 numeric-3.

```
countryCode3n ATTRIBUTE ::= {
  SUBTYPE OF               name
  WITH SYNTAX              CountryCode3n
  SINGLE VALUE             TRUE
  LDAP-SYNTAX              countryString3n.&id
  LDAP-NAME                {"n3"}
  ID                       id-at-countryCode3n }

CountryCode3n ::= NumericString(SIZE (3)) (CONSTRAINED BY { -- ISO 3166 numeric-3 codes
only -- })
```


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6.3.4 Locality Name

The *Locality Name* attribute type specifies a locality. When used as a component of a directory name, it identifies a geographical area or locality in which the named object is physically located or with which it is associated in some other important way.

An attribute value for Locality Name is a string, e.g., L = "Edinburgh".

```
localityName ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"l"}
  ID                        id-at-localityName }
```

The *Collective Locality Name* attribute type specifies a locality name for a collection of entries.

```
collectiveLocalityName ATTRIBUTE ::= {
SUBTYPE OF localityName
COLLECTIVE TRUE
LDAP-SYNTAX directoryString.&id
LDAP-NAME {"c-l"}
ID id-at-collectiveLocalityName }
```

6.3.5 State or Province Name

The *State or Province Name* attribute type specifies a state or province. When used as a component of a directory name, it identifies a geographical subdivision in which the named object is physically located or with which it is associated in some other important way.

An attribute value for State or Province Name is a string, e.g., S = "Ohio".

```
stateOrProvinceName ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"st"}
  ID                        id-at-stateOrProvinceName }
```

The *Collective State or Province Name* attribute type specifies a state or province name for a collection of entries.

```
collectiveStateOrProvinceName ATTRIBUTE ::= {
  SUBTYPE OF                stateOrProvinceName
  COLLECTIVE                TRUE
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"c-st"}
  ID                        id-at-collectiveStateOrProvinceName }
```

6.3.6 Street Address

The *Street Address* attribute type specifies a site for the local distribution and physical delivery in a postal address, i.e., the street name, place, avenue and house number. When used as a component of a directory name, it identifies the street address at which the named object is located or with which it is associated in some other important way.

An attribute value for Street Address is a string, e.g., "Arnulfstraße 60".

```
streetAddress ATTRIBUTE ::= {
  WITH SYNTAX               UnboundedDirectoryString
  EQUALITY MATCHING RULE    caseIgnoreMatch
  SUBSTRINGS MATCHING RULE  caseIgnoreSubstringsMatch
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"street"}
  ID                        id-at-streetAddress }
```

The *Collective Street Address* attribute type specifies a street address for a collection of entries.

```
collectiveStreetAddress ATTRIBUTE ::= {
  SUBTYPE OF                streetAddress
  COLLECTIVE                TRUE
  LDAP-SYNTAX               directoryString.&id
```

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```
  LDAP-NAME                 {"c-street"}
  ID                        id-at-collectiveStreetAddress }
```

6.3.7 House Identifier

The *House Identifier* attribute type specifies a linguistic construct used to identify a particular building, for example a house number or house name relative to a street, avenue, town or city etc.

An attribute value for House Identifier is a string, e.g., "14".

```
houseIdentifier ATTRIBUTE ::= {
  WITH SYNTAX               UnboundedDirectoryString
  EQUALITY MATCHING RULE    caseIgnoreMatch
  SUBSTRINGS MATCHING RULE  caseIgnoreSubstringsMatch
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"houseIdentifier"}
  ID                        id-at-houseIdentifier }
```

6.3.8 UTM coordinates attribute type

An attribute of type **utmCoordinates** gives the coordinates in the Universal Transverse Mercator (UTM) coordinate system.

```
utmCoordinates  ATTRIBUTE  ::=  {
  WITH SYNTAX               UtmCoordinates
  SINGLE VALUE              TRUE
  ID                        id-at-utmCoordinates }

UtmCoordinates ::= SEQUENCE {
  zone       PrintableString,
  easting    NumericString,
  northing   NumericString }
```

The **zone** component gives the value of the UTM zone. It consists of a single letter followed by up to two numeric characters.

The **easting** component gives the easting values in metres.

The **northing** component gives the northing value in metres.

6.4 Organizational attribute types

These attribute types are concerned with organizations and can be used to describe objects in terms of organizations with which they are associated.

6.4.1 Organization Name

The *Organization Name* attribute type specifies an organization. When used as a component of a directory name, it identifies an organization with which the named object is affiliated.

An attribute value for **OrganizationName** is a string chosen by the organization (e.g., O = "Scottish Telecommunications plc"). Any variants should be associated with the named Organization as separate and alternative attribute values.

```
organizationName ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"o"}
  ID                        id-at-organizationName }
```

The *Collective Organization Name* attribute type specifies an organization name for a collection of entries.

```
collectiveOrganizationName ATTRIBUTE ::= {
  SUBTYPE OF                organizationName
  COLLECTIVE                TRUE
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"c-o"}
  ID                        id-at-collectiveOrganizationName }
```


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6.4.2 Organizational Unit Name

The *Organizational Unit Name* attribute type specifies an organizational unit. When used as a component of a directory name, it identifies an organizational unit with which the named object is affiliated.

The designated organizational unit is understood to be part of an organization designated by an **organizationName** attribute. It follows that if an Organizational Unit Name attribute is used in a directory name, it shall be associated with an **organizationName** attribute.

An attribute value for Organizational Unit Name is a string chosen by the organization of which it is part (e.g., OU = "Technology Division"). Note that the commonly used abbreviation "TD" would be a separate and alternative attribute value.

Example

O = "Scottel", OU = "TD"

```
organizationalUnitName ATTRIBUTE ::= {
  SUBTYPE OF                 name
  WITH SYNTAX                UnboundedDirectoryString
  LDAP-SYNTAX                directoryString.&id
  LDAP-NAME                  {"ou"}
  ID                         id-at-organizationalUnitName }
```

The *Collective Organizational Unit Name* attribute type specifies an organizational unit name for a collection of entries.

```
collectiveOrganizationalUnitName ATTRIBUTE ::= {
  SUBTYPE OF                 organizationalUnitName
  COLLECTIVE                 TRUE
  LDAP-SYNTAX                directoryString.&id
  LDAP-NAME                  {"c-ou"}
  ID                         id-at-collectiveOrganizationalUnitName }
```

6.4.3 Title

The *Title* attribute type specifies the designated position or function of the object within an organization.

An attribute value for Title is a string.

Example

T = "Manager, Distributed Applications"

```
title ATTRIBUTE ::= {
  SUBTYPE OF                 name
  WITH SYNTAX                UnboundedDirectoryString
  LDAP-SYNTAX                directoryString.&id
  LDAP-NAME                  {"title"}
  ID                         id-at-title }
```

6.4.4 Organization identifier

An attribute of type **organizationIdentifier** holds an identification of an organization different from the organization name.

```
organizationIdentifier ATTRIBUTE ::= {
  WITH SYNTAX                UnboundedDirectoryString
  EQUALITY MATCHING RULE     caseIgnoreMatch
  SUBSTRINGS MATCHING RULE   caseIgnoreSubstringsMatch
  SINGLE VALUE               TRUE
  LDAP-SYNTAX                directoryString.&id
  LDAP-NAME                  {"organizationIdentifier"}
  ID                         id-at-organizationIdentifier }
```

6.5 Explanatory attribute types

These attribute types are concerned with explanations (e.g., in a natural language) of something about an object.

6.5.1 Description

The *Description* attribute type specifies text that describes the associated object.

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For example, the object "Standards Interest" might have the associated description "distribution list for exchange of information about intra-company standards development".

An attribute value for Description is a string.

```
description ATTRIBUTE ::= {
  WITH SYNTAX               UnboundedDirectoryString
  EQUALITY MATCHING RULE    caseIgnoreMatch
  SUBSTRINGS MATCHING RULE  caseIgnoreSubstringsMatch
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"description"}
  ID                        id-at-description }
```

6.5.2 Search Guide

The *Search Guide* attribute type specifies information of suggested search criteria which may be included in some entries expected to be a convenient base-object for the search operation, e.g., country or organization.

Search criteria consist of an optional identifier for the type of object sought and combinations of attribute types and logical operators to be used in the construction of a filter. It is possible to specify for each search criteria item the matching level, e.g., approximate match.

The Search Guide attribute may recur to reflect the various types of requests, e.g., search for a Residential Person or an Organizational Person, which may be fulfilled from the given base-object where the Search Guide is read.

```
searchGuide ATTRIBUTE ::= {
  WITH SYNTAX               Guide
  LDAP-SYNTAX               guide.&id
  LDAP-NAME                 {"searchGuide"}
  ID                        id-at-searchGuide }

Guide ::= SET {
  objectClass  [0]  OBJECT-CLASS.&id OPTIONAL,
  criteria     [1]  Criteria,
  ... }

Criteria ::= CHOICE {
  type  [0]  CriteriaItem,
  and   [1]  SET OF Criteria,
  or    [2]  SET OF Criteria,
  not   [3]  Criteria,
  ... }

CriteriaItem ::= CHOICE {
  equality          [0]  AttributeType,
  substrings        [1]  AttributeType,
  greaterOrEqual    [2]  AttributeType,
  lessOrEqual       [3]  AttributeType,
  approximateMatch  [4]  AttributeType,
  ... }
```

Example

The following is a potential value of the Search Guide attribute that could be stored in entries of object class Locality to indicate how entries of object class Residential Person might be found:

```
residential-person-guide Guide ::= {
  objectClass residentialPerson.&id,
  criteria and : {
    type : substrings : commonName.&id,
    type : substrings : streetAddress.&id } }
```

The construction of a filter from this value of Guide is straightforward.

Step (1) produces the intermediate Filter value:

```
intermediate-filter Filter ::=
  and : {
    item : substrings  {
      type  commonName.&id,
```


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```
      strings { any : teletexString : "Dubois" }},
      item : substrings  {
        type streetAddress.&id,
        strings { any : teletexString  "Hugo" } } }
```

Step (2) produces a filter for matching Residential Person entries in the subtree:

```
residential-person-filter Filter ::=
  and : {
    item :equality : {
      type  objectClass.&id,
      assertion  residentialPerson.&id },
      intermediateFilter }
```

6.5.3 Enhanced Search Guide

The *Enhanced Search Guide* attribute provides an enhancement of the **searchGuide** attribute, adding information about the recommended search depth for searches among subordinate objects of a given object class.

```
enhancedSearchGuide ATTRIBUTE ::= {
  WITH SYNTAX              EnhancedGuide
  LDAP-SYNTAX              enhancedGuide.&id
  LDAP-NAME                {"enhancedSearchGuide"}
  ID                       id-at-enhancedSearchGuide }

EnhancedGuide ::= SEQUENCE {
  objectClass  [0]  OBJECT-CLASS.&id,
  criteria     [1]  Criteria,
  subset       [2]  INTEGER {
    baseObject   (0),
    oneLevel     (1),
    wholeSubtree (2)} DEFAULT oneLevel,
  ... }
```

6.5.4 Business Category

The *Business Category* attribute type specifies information concerning the occupation of some common objects, e.g., people. For example, this attribute provides the facility to interrogate the Directory about people sharing the same occupation.

```
businessCategory ATTRIBUTE ::= {
  WITH SYNTAX              UnboundedDirectoryString
  EQUALITY MATCHING RULE   caseIgnoreMatch
  SUBSTRINGS MATCHING RULE caseIgnoreSubstringsMatch
  LDAP-SYNTAX              directoryString.&id
  LDAP-NAME                {"businessCategory"}
  ID                       id-at-businessCategory }
```

6.6 Postal addressing attribute types

These attribute types are concerned with information required for physical postal delivery to an object.

6.6.1 Postal Address

The *Postal Address* attribute type specifies the address information required for the physical delivery of postal messages by the postal authority to the named object.

An attribute value for Postal Address will be typically composed of selected attributes from the MHS Unformatted Postal O/R Address version 1 according to Rec. ITU-T F.401 and limited to 6 lines of 30 characters each, including a postal country name. Normally the information contained in such an address could include an addressee's name, street address, city, state or province, postal code and possibly a Post Office Box number depending on the specific requirements of the named object.

```
postalAddress ATTRIBUTE ::= {
  WITH SYNTAX              PostalAddress
  EQUALITY MATCHING RULE   caseIgnoreListMatch
  SUBSTRINGS MATCHING RULE caseIgnoreListSubstringsMatch
  LDAP-SYNTAX              postalAddr.&id
  LDAP-NAME                {"postalAddress"}
```

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```
  ID                        id-at-postalAddress }
PostalAddress ::= SEQUENCE SIZE (1..MAX) OF UnboundedDirectoryString
```

The *Collective Postal Address* attribute type specifies a postal address for a collection of entries.

```
collectivePostalAddress ATTRIBUTE ::= {
  SUBTYPE OF                postalAddress
  COLLECTIVE                TRUE
  LDAP-SYNTAX               postalAddr.&id
  LDAP-NAME                 {"c-PostalAddress"}
  ID                        id-at-collectivePostalAddress }
```

6.6.2 Postal Code

The *Postal Code* attribute type specifies the postal code of the named object. If this attribute value is present, it will be part of the object's postal address.

An attribute value for Postal Code is a string.

```
postalCode ATTRIBUTE ::= {
  WITH SYNTAX               UnboundedDirectoryString
  EQUALITY MATCHING RULE    caseIgnoreMatch
  SUBSTRINGS MATCHING RULE caseIgnoreSubstringsMatch
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"postalCode"}
  ID                        id-at-postalCode }
```

The *Collective Postal Code* attribute type specifies a postal code for a collection of entries.

```
collectivePostalCode ATTRIBUTE ::= {
  SUBTYPE OF                postalCode
  COLLECTIVE                TRUE
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"c-PostalCode"}
  ID                        id-at-collectivePostalCode }
```

6.6.3 Post Office Box

The *Post Office Box* attribute type specifies the Post Office Box by which the object will receive physical postal delivery. If present, the attribute value is part of the object's postal address.

```
postOfficeBox ATTRIBUTE ::= {
  WITH SYNTAX               UnboundedDirectoryString
  EQUALITY MATCHING RULE    caseIgnoreMatch
  SUBSTRINGS MATCHING RULE caseIgnoreSubstringsMatch
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"postOfficeBox"}
  ID                        id-at-postOfficeBox }
```

The *Collective Post Office Box* attribute type specifies a post office box for a collection of entries.

```
collectivePostOfficeBox ATTRIBUTE ::= {
  SUBTYPE OF                postOfficeBox
  COLLECTIVE                TRUE
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"c-PostOfficeBox"}
  ID                        id-at-collectivePostOfficeBox }
```

6.6.4 Physical delivery office name

The *Physical Delivery Office Name* attribute type specifies the name of the city, village, etc., where a physical delivery office is situated.

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An attribute value for Physical Delivery Office Name is a string.

```
physicalDeliveryOfficeName ATTRIBUTE ::= {
  WITH SYNTAX               UnboundedDirectoryString
  EQUALITY MATCHING RULE    caseIgnoreMatch
  SUBSTRINGS MATCHING RULE  caseIgnoreSubstringsMatch
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"physicalDeliveryOfficeName"}
  ID                        id-at-physicalDeliveryOfficeName }
```

The *Collective Physical Delivery Office Name* attribute type specifies a physical delivery office name for a collection of entries.

```
collectivePhysicalDeliveryOfficeName ATTRIBUTE ::= {
  SUBTYPE OF                physicalDeliveryOfficeName
  COLLECTIVE                TRUE
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"c-PhysicalDeliveryOfficeName"}
  ID                        id-at-collectivePhysicalDeliveryOfficeName }
```

6.7 Telecommunications addressing attribute types

These attribute types are concerned with addressing information needed to communicate with the object using telecommunication means.

6.7.1 Telephone number

A value of the **telephoneNumber** attribute type is used for holding a telephone number associated with an object.

An attribute value for Telephone Number is a string that shall comply with the internationally agreed format for showing international telephone numbers, as indicated in clause 2.5 of Rec. ITU-T E.123 (e.g., "+ 44 582 10101"). However, it is allowed to insert hyphens (-) in addition to the + sign, spaces and figures. Other characters from the **PrintableString** repertoire shall not be used.

```
telephoneNumber ATTRIBUTE ::= {
  WITH SYNTAX               TelephoneNumber
  EQUALITY MATCHING RULE    telephoneNumberMatch
  SUBSTRINGS MATCHING RULE  telephoneNumberSubstringsMatch
  LDAP-SYNTAX               printableString.&id
  LDAP-NAME                 {"telephoneNumber"}
  ID                        id-at-telephoneNumber }

TelephoneNumber ::= PrintableString(SIZE (1..ub-telephone-number))
-- String complying with Rec. ITU-T E.123 only

ub-telephone-number INTEGER ::= 32
```

A value of the **collectiveTelephoneNumber** attribute type is used for holding a telephone number for a collection of entries.

```
collectiveTelephoneNumber ATTRIBUTE ::= {
  SUBTYPE OF                telephoneNumber
  COLLECTIVE                TRUE
  LDAP-SYNTAX               printableString.&id
  LDAP-NAME                 {"c-TelephoneNumber"}
  ID                        id-at-collectiveTelephoneNumber }
```

6.7.2 Telex Number

The *Telex Number* attribute type specifies the telex number, country code, and answerback code of a telex terminal associated with an object.

```
telexNumber ATTRIBUTE ::= {
  WITH SYNTAX               TelexNumber
  LDAP-SYNTAX               telexNr.&id
  LDAP-NAME                 {"telexNumber"}
  ID                        id-at-telexNumber }

TelexNumber ::= SEQUENCE {
```

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```
  telexNumber  PrintableString(SIZE (1..ub-telex-number)),
  countryCode  PrintableString(SIZE (1..ub-country-code)),
  answerback   PrintableString(SIZE (1..ub-answerback)),
  ... }

ub-telex-number INTEGER ::= 14
ub-country-code INTEGER ::= 4
ub-answerback   INTEGER ::= 8
```

The *Collective Telex Number* attribute type specifies a telex number for a collection of entries.

```
collectiveTelexNumber ATTRIBUTE ::= {
  SUBTYPE OF                telexNumber
  COLLECTIVE                TRUE
  LDAP-SYNTAX               telexNr.&id
  LDAP-NAME                 {"c-TelexNumber"}
  ID                        id-at-collectiveTelexNumber }
```

6.7.3 Teletex Terminal Identifier

Since CCITT Rec. F.200 has been withdrawn and has not been replaced, the use of the ***teletexTerminalIdentifier*** *and the* ***collectiveTeletexTerminalIdentifier*** *attribute types are deprecated.*

The *Teletex Terminal Identifier* attribute type specifies the Teletex terminal identifier (and, optionally, parameters) for a teletex terminal associated with an object.

An attribute value for Teletex Terminal Identifier is a string which complies with CCITT Rec. F.200 and an optional set whose components are according to Rec. ITU-T T.62.

```
-- teletexTerminalIdentifier ATTRIBUTE ::= {
--   WITH SYNTAX         TeletexTerminalIdentifier
--   ID                  id-at-teletexTerminalIdentifier }

-- TeletexTerminalIdentifier ::= SEQUENCE {
--   teletexTerminal     PrintableString (SIZE(1..ub-teletex-terminal-id)),
--   parameters          TeletexNonBasicParameters OPTIONAL }
```

The *Collective Teletex Terminal Identifier* attribute type specifies a Teletex terminal identifier for a collection of entries.

```
-- collectiveTeletexTerminalIdentifier ATTRIBUTE ::= {
--   SUBTYPE OF          teletexTerminalIdentifier
--   COLLECTIVE          TRUE
--   ID                  id-at-collectiveTeletexTerminalIdentifier }
```

6.7.4 Facsimile telephone number

The *Facsimile Telephone Number* attribute type specifies a telephone number for a facsimile terminal (and optionally its parameters) associated with an object.

An attribute value for the Facsimile Telephone Number is a string that complies with the internationally agreed format for showing international telephone numbers, Rec. ITU-T E.123 (e.g., "+81 3 347 7418") and an optional bit string (formatted according to Rec. ITU-T T.30).

```
facsimileTelephoneNumber ATTRIBUTE ::= {
  WITH SYNTAX               FacsimileTelephoneNumber
  EQUALITY MATCHING RULE    facsimileNumberMatch
  SUBSTRINGS MATCHING RULE  facsimileNumberSubstringsMatch
  LDAP-SYNTAX               facsimileTelephoneNr.&id
  LDAP-NAME                 {"facsimileTelephoneNumber"}
  ID                        id-at-facsimileTelephoneNumber }

FacsimileTelephoneNumber ::= SEQUENCE {
  telephoneNumber  TelephoneNumber,
  parameters       G3FacsimileNonBasicParameters OPTIONAL,
  ... }
```

The *Collective Facsimile Telephone Number* attribute type specifies a facsimile telephone number for a collection of entries.

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```
collectiveFacsimileTelephoneNumber ATTRIBUTE ::= {
  SUBTYPE OF                facsimileTelephoneNumber
  COLLECTIVE                TRUE
  LDAP-SYNTAX               facsimileTelephoneNr.&id
  LDAP-NAME                 {"c-FacsimileTelephoneNumber"}
  ID                        id-at-collectiveFacsimileTelephoneNumber }
```

6.7.5 X.121 Address

The *X.121 Address* attribute type specifies an address as defined by Rec. ITU-T X.121 associated with an object.

```
x121Address ATTRIBUTE ::= {
  WITH SYNTAX               X121Address
  EQUALITY MATCHING RULE    numericStringMatch
  SUBSTRINGS MATCHING RULE numericStringSubstringsMatch
  LDAP-SYNTAX               numericString.&id
  LDAP-NAME                 {"x121Address"}
  ID                        id-at-x121Address }

X121Address ::= NumericString(SIZE (1..ub-x121-address))
-- String as defined by Rec. ITU-T X.121

ub-x121-address INTEGER ::= 15
```

6.7.6 International ISDN Number

The *International ISDN Number* attribute type specifies an international ISDN number associated with an object.

An attribute value for International ISDN Number is a string which complies with the internationally agreed format for ISDN addresses given in Rec. ITU-T E.164.

```
internationalISDNNumber ATTRIBUTE ::= {
  WITH SYNTAX               InternationalISDNNumber
  EQUALITY MATCHING RULE    numericStringMatch
  SUBSTRINGS MATCHING RULE numericStringSubstringsMatch
  LDAP-SYNTAX               numericString.&id
  LDAP-NAME                 {"internationalISDNNumber"}
  ID                        id-at-internationalISDNNumber }

InternationalISDNNumber ::=
  NumericString(SIZE (1..ub-international-isdn-number))
-- String complying with Rec. ITU-T E.164 only

ub-international-isdn-number INTEGER ::= 16
```

The *Collective International ISDN Number* attribute type specifies an international ISDN number for a collection of entries.

```
collectiveInternationalISDNNumber ATTRIBUTE ::= {
  SUBTYPE OF                internationalISDNNumber
  COLLECTIVE                TRUE
  LDAP-SYNTAX               numericString.&id
  LDAP-NAME                 {"c-InternationalISDNNumber"}
  ID                        id-at-collectiveInternationalISDNNumber }
```

6.7.7 Registered Address

The *Registered Address* attribute type specifies a mnemonic for an address associated with an object at a particular city location. The mnemonic is registered in the country in which the city is located and is used in the provision of the Public Telegram Service (according to Rec. ITU-T F.1).

```
registeredAddress ATTRIBUTE ::= {
  SUBTYPE OF                postalAddress
  WITH SYNTAX               PostalAddress
  LDAP-SYNTAX               postalAddr.&id
  LDAP-NAME                 {"registeredAddress"}
  ID                        id-at-registeredAddress }
```

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6.7.8 Destination indicator

The *Destination Indicator* attribute type specifies (according to Rec. ITU-T F.1 and Rec. ITU-T F.31) the country and city associated with the object (the addressee) needed to provide the Public Telegram Service.

An attribute value for Destination Indicator is a string.

```
destinationIndicator ATTRIBUTE ::= {
  WITH SYNTAX               DestinationIndicator
  EQUALITY MATCHING RULE    caseIgnoreMatch
  SUBSTRINGS MATCHING RULE  caseIgnoreSubstringsMatch
  LDAP-SYNTAX               printableString.&id
  LDAP-NAME                 {"destinationIndicator"}
  ID                        id-at-destinationIndicator }

DestinationIndicator ::= PrintableString(SIZE (1..MAX))
-- alphabetical characters only
```

6.7.9 Communications Service

The *Communications Service* attribute type specifies the type of service(s) associated with a communications address.

```
communicationsService ATTRIBUTE ::= {
  WITH SYNTAX               CommunicationsService
  EQUALITY MATCHING RULE    objectIdentifierMatch
  LDAP-SYNTAX               oid.&id
  LDAP-NAME                 {"communicationsService"}
  ID                        id-at-communicationsService }

CommunicationsService ::= OBJECT IDENTIFIER
```

This attribute describes the class of service that the Communications Address provides access to, for example, telephone (voice), facsimile, electronic mail, SMS (short messaging service), EDI, file transfer, etc.

Allocation of object identifiers for the identification of services is done outside this Directory Specification.

6.7.10 Communications Network

The *Communications Network* attribute type specifies the type of network for which a communications address is used.

```
communicationsNetwork ATTRIBUTE ::= {
  WITH SYNTAX               CommunicationsNetwork
  EQUALITY MATCHING RULE    objectIdentifierMatch
  SINGLE VALUE              TRUE
  LDAP-SYNTAX               oid.&id
  LDAP-NAME                 {"communicationsNetwork"}
  ID                        id-at-communicationsNetwork }

CommunicationsNetwork ::= OBJECT IDENTIFIER
```

This attribute describes the type of network where the Communications Address is allocated. For example, a Public Switched Telephone Network (PSTN), an ISDN network, or a GSM mobile phone network. It could also be an application oriented network, e.g., a banking network.

Allocation of object identifiers for the identification of networks is done outside this Directory Specification.

6.8 Preferences attribute types

These attribute types are concerned with the preferences of an object.

6.8.1 Preferred Delivery Method

The *Preferred Delivery Method* attribute type specifies the object's priority order regarding the method to be used for communicating with it.

```
preferredDeliveryMethod ATTRIBUTE ::= {
  WITH SYNTAX               PreferredDeliveryMethod
  SINGLE VALUE              TRUE
  LDAP-SYNTAX               deliveryMethod.&id
  LDAP-NAME                 {"preferredDeliveryMethod"}
```


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```
  ID                        id-at-preferredDeliveryMethod }

PreferredDeliveryMethod ::= SEQUENCE OF INTEGER {
  any-delivery-method   (0),
  mhs-delivery          (1),
  physical-delivery     (2),
  telex-delivery        (3),
  teletex-delivery      (4),
  g3-facsimile-delivery (5),
  g4-facsimile-delivery (6),
  ia5-terminal-delivery (7),
  videotex-delivery     (8),
  telephone-delivery    (9) }
```

6.9 OSI application attribute types

These attribute types are concerned with information regarding objects in the OSI Application Layer.

6.9.1 Presentation Address

The *Presentation Address* attribute type specifies a presentation-address associated with an object representing an application-entity.

An attribute value for Presentation Address is a presentation-address as defined in Rec. ITU-T X.519 | ISO/IEC 9594-5.

```
presentationAddress ATTRIBUTE ::= {
  WITH SYNTAX               PresentationAddress
  EQUALITY MATCHING RULE    presentationAddressMatch
  SINGLE VALUE              TRUE
  LDAP-SYNTAX               presentationAddr.&id
  LDAP-NAME                 {"presentationAddress"}
  ID                        id-at-presentationAddress }

PresentationAddress ::= SEQUENCE {
  pSelector    [0]  OCTET STRING OPTIONAL,
  sSelector    [1]  OCTET STRING OPTIONAL,
  tSelector    [2]  OCTET STRING OPTIONAL,
  nAddresses   [3]  SET SIZE (1..MAX) OF OCTET STRING,
  ... }
```

6.9.2 Supported Application Context

The *Supported Application Context* attribute type specifies the object identifier(s) of application context(s) that the object (an OSI application-entity) supports.

```
supportedApplicationContext ATTRIBUTE ::= {
  WITH SYNTAX               OBJECT IDENTIFIER
  EQUALITY MATCHING RULE    objectIdentifierMatch
  LDAP-SYNTAX               oid.&id
  LDAP-NAME                 {"supportedApplicationContext"}
  ID                        id-at-supportedApplicationContext }
```

6.9.3 Protocol Information

The *Protocol Information* attribute type associates protocol information with each network address in the Presentation Address attribute.

For each **nAddress**, the protocol component identifies the protocol or profile for the network and transport layers.

```
protocolInformation ATTRIBUTE ::= {
  WITH SYNTAX               ProtocolInformation
  EQUALITY MATCHING RULE    protocolInformationMatch
  ID                        id-at-protocolInformation }

ProtocolInformation ::= SEQUENCE {
  nAddress   OCTET STRING,
  profiles   SET OF OBJECT IDENTIFIER }
```

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6.10 Relational attribute types

These attribute types are concerned with information regarding the objects which are related to a particular object in certain ways.

6.10.1 Distinguished Name

A value of the attribute type **distinguishedName** is used for holding a distinguished name specifying the name of an object.

```
distinguishedName ATTRIBUTE ::= {
  WITH SYNTAX               DistinguishedName
  EQUALITY MATCHING RULE    distinguishedNameMatch
  LDAP-SYNTAX               dn.&id
  LDAP-NAME                 {"distinguishedName"}
  ID                        id-at-distinguishedName }
```

The **distinguishedNameMatch** matching rule is specified in Rec. ITU-T X.501 | ISO/IEC 9594-2.

6.10.2 Member

The *Member* attribute type specifies a group of names associated with the object.

An attribute value for Member is a distinguished name.

```
member ATTRIBUTE ::= {
  SUBTYPE OF                distinguishedName
  LDAP-SYNTAX               dn.&id
  LDAP-NAME                 {"member"}
  ID                        id-at-member }
```

6.10.3 Unique Member

The *Unique Member* attribute type specifies a group of unique names associated with an object. A unique name is a name that is optionally disambiguated by the inclusion of its unique identifier.

An attribute value for Unique Member is a distinguished name accompanied by an optional unique identifier.

```
uniqueMember ATTRIBUTE ::= {
  WITH SYNTAX               NameAndOptionalUID
  EQUALITY MATCHING RULE    uniqueMemberMatch
  LDAP-SYNTAX               nameAndOptionalUID.&id
  LDAP-NAME                 {"uniqueMember"}
  ID                        id-at-uniqueMember }

NameAndOptionalUID ::= SEQUENCE {
  dn   DistinguishedName,
  uid  UniqueIdentifier OPTIONAL,
  ... }
```

6.10.4 Owner

The *Owner* attribute type specifies the name of an object which has some responsibility for the associated object.

An attribute value for Owner is a distinguished name (which could represent a group of names) and can recur.

```
owner ATTRIBUTE ::= {
  SUBTYPE OF                distinguishedName
  LDAP-SYNTAX               dn.&id
  LDAP-NAME                 {"owner"}
 ID                        id-at-owner }
```

6.10.5 Role Occupant

The *Role Occupant* attribute type specifies the name of an object which fulfils an organizational role.

An attribute value for Role Occupant is a distinguished name.

```
roleOccupant ATTRIBUTE ::= {
  SUBTYPE OF                distinguishedName
  LDAP-SYNTAX               dn.&id
```


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```
  LDAP-NAME                 {"roleOccupant"}
  ID                        id-at-roleOccupant }
```

6.10.6 See Also

The *See Also* attribute type specifies names of other Directory objects which may be other aspects (in some sense) of the same real world object.

An attribute value for *See Also* is a distinguished name.

```
seeAlso ATTRIBUTE ::= {
  SUBTYPE OF                distinguishedName
  LDAP-SYNTAX               dn.&id
  LDAP-NAME                 {"seeAlso"}
  ID                        id-at-seeAlso }
```

6.11 Domain attribute types

6.11.1 DMD Name

The *DMD Name* attribute type specifies a DMD. When used as a component of a directory name, it identifies a DMD which manages the named object.

An attribute value for DMD Name is a string chosen by the DMD.

```
dmdName ATTRIBUTE ::= {
  SUBTYPE OF                name
  WITH SYNTAX               UnboundedDirectoryString
  ID                        id-at-dmdName }
```

6.12 Hierarchical attribute types

Hierarchical attribute types are used for mapping the hierarchical structure of object identifiers and Uniform Resource Names (URNs) into a Directory Distinguished Name.

6.12.1 Top level object identifier arc

An attribute of the **oidC1** attribute type specifies the value for the top level arc of an object identifier. An attribute of this type shall take the value 0, 1 or 2. It is intended to be used as a naming attribute in an entry of **oidC1obj** object class and of **oidRoot** object class.

```
oidC1 ATTRIBUTE ::= {
  WITH SYNTAX               INTEGER
  EQUALITY MATCHING RULE    integerMatch
  SINGLE VALUE              TRUE
  ID                        id-oidC1 }
```

This attribute type has been moved from Rec. ITU-T X.660 | ISO/IEC 9834-1. The object identifier **id-oidC1** is allocated from the object identifier arc of Rec. ITU-T X.660 | ISO/IEC 9834-1.

6.12.2 Second level object identifier arc

An attribute of the **oidC2** attribute type specifies the value for the second level arc of an object identifier. An attribute of this type is intended to be used as a naming attribute in an entry of **oidC2obj** object class and of **oidRoot** object class.

```
oidC2 ATTRIBUTE ::= {
  WITH SYNTAX               INTEGER
  EQUALITY MATCHING RULE    integerMatch
  SINGLE VALUE              TRUE
  ID                        id-oidC2 }
```

This attribute type has been moved from Rec. ITU-T X.660 | ISO/IEC 9834-1. The object identifier **id-oidC2** is allocated from the object identifier arc of Rec. ITU-T X.660 | ISO/IEC 9834-1.

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6.12.3 Lower level object identifier arc attribute type

An attribute of the **oidC** attribute type specifies the value for a third level or lower level arcs of an object identifier. An attribute of this type is intended to be used as a naming attribute in an entry of **oidCobj** object class and of **oidRoot** object class.

```
oidC ATTRIBUTE ::= {
  WITH SYNTAX              INTEGER
  EQUALITY MATCHING RULE   integerMatch
  SINGLE VALUE             TRUE
  ID                       id-oidC }
```

This attribute type has been moved from Rec. ITU-T X.660 | ISO/IEC 9834-1. The object identifier **id-oidC** is allocated from the object identifier arc of Rec. ITU-T X.660 | ISO/IEC 9834-1.

6.12.4 URN component attribute type

An attribute of the **urnC** attribute type is used for holding a URN component when creating a DIT subtree representation of a URN. An attribute of this type is the naming attribute of an entry of the **urnCobj** structural object class.

```
urnC ATTRIBUTE ::= {
  WITH SYNTAX              PrintableString
  EQUALITY MATCHING RULE   caseExactMatch
  SINGLE VALUE             TRUE
  LDAP-SYNTAX               printableSting.&id
  LDAP-NAME                 {"urnC"}
  ID                       id-at-urnC }
```

The subtree root for a class of URNs shall have an attribute of this type which shall hold the URN name space component, as defined by the Internet Assigned Numbers Authority (IANA).

6.13 Attributes for applications using tag-based identification

Attribute types defined by this clause provide support for applications using tag-based identification.

6.13.1 Tag OID

An attribute of type **tagOid** is used for holding an object identifier. This object identifier indicates the type of UII following the object identifier in the ID tag (e.g., an RFID tag).

```
tagOid ATTRIBUTE ::= {
  WITH SYNTAX               OBJECT IDENTIFIER
  EQUALITY MATCHING RULE    objectIdentifierMatch
  SINGLE VALUE              TRUE
  LDAP-SYNTAX               oid.&id
  LDAP-NAME                 {"tagOid"}
  ID                        id-at-tagOid }
```

6.13.2 UII Format

The *UII Format* attribute type specifies how a UII bit string may be partitioned into components.

```
uiiFormat ATTRIBUTE ::= {
  WITH SYNTAX               UiiFormat
  SINGLE VALUE              TRUE
  LDAP-SYNTAX               uiiForm.&id
  LDAP-NAME                 {"uiiFormat"}
  ID                        id-at-uiiFormat }

UiiFormat ::= SEQUENCE {
  baseObject  URI,
  subset      ENUMERATE {
    baseObject   (0),
    oneLevel     (1),
    wholeSubtree (2) } DEFAULT baseObject,
  next        CHOICE {
    length      INTEGER,
    filter      UiiFilter } }
```


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```
UiiFilter ::= CHOICE {
  item   [0]  UiiItem,
  and    [1]  SET OF UiiFilter,
  or     [2]  SET OF UiiFilter,
  not    [3]  UiiFilter }

UiiItem ::= SEQUENCE {
  type   ATTRIBUTE.&id OPTIONAL,
  length INTEGER       OPTIONAL }
```

The **baseObject** component shall contain the URN corresponding to the base object of the search. If this component is absent, the search is suggested to start at the root.

The **subset** component recommends how to fill the **subset** component of the **Filter** in a subsequent Search operation. **baseObject** specifies that the search shall only be performed against the base object. **oneLevel** specifies that only the entries immediately subordinate to the base object are to be searched. **wholeSubtree** specifies that all entries in the subtree which have the base object as a root are to be searched.

The **next** component gives some information about the next field of the UII:

– The choice **length** subcomponent shall be taken if the length of the following UII field has a fixed length and the subcomponent signals the length in characters.

– The choice **filter** shall be taken if the following UII field does not have a fixed length. It provides guidance as to how filter items should be constructed to explore the actual length of the next UII field. The **UiiFilter** data type has a recursive structure similar to the structure of the **Filter** data type as defined by Rec. ITU-T X.511 allowing for specification of a filter of arbitrary complexity.

  The recommendation for a particular filter item is given by the **UiiItem** data type:

  i) the **type** subcomponent specifies the attribute type to be used in the attribute value assertion; and

  ii) the **length** subcomponent specifies how many characters to be used as the value of the attribute value assertion.

6.13.3 UII in URN attribute type

An attribute of **uiiInUrn** type holds a Unique Item Identifier (UII) encoded in a unique URN format.

```
uiiInUrn ATTRIBUTE ::= {
  SUBTYPE OF                urn
  SINGLE VALUE              TRUE
  ID                        id-at-uiiInUrn }
```

6.13.4 Content URL

An attribute of **contentURL** is used for holding the URL of the information content associated with an EPC or a UII.

```
contentUrl ATTRIBUTE ::= {
  SUBTYPE OF                url
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"contentUrl"}
  ID                        id-at-contentUrl }
```

6.13.5 UII attribute type

The *UII* attribute type is used for holding a bit-encoded Unique Item Identifier (UII) allocated within the ISO environment.

```
uii ATTRIBUTE ::= {
  WITH SYNTAX               BIT STRING
  EQUALITY MATCHING RULE    bitStringMatch
  LDAP-SYNTAX               bitString.&id
  LDAP-NAME                 {"uii"}
  ID                        id-at-uii }
```

6.13.6 EPC attribute type

An attribute of the **epc** attribute type is used for holding a bit-encoded Electronic Product Code (EPC).

```
epc ATTRIBUTE ::= {
  WITH SYNTAX               BIT STRING
```

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```
  SINGLE VALUE              TRUE
  EQUALITY MATCHING RULE    bitStringMatch
  LDAP-SYNTAX               bitString.&id
  LDAP-NAME                 {"epc"}
  ID                        id-at-epcUii }
```

6.13.7 Tag AFI attribute type

The *Tag AFI* attribute type is used for holding the Application Family Identifier (AFI) associated with a specific ISO UII type. AFIs are only allocated in the ISO environment. Together, an ISO UII and the associated AFI provide a global unique identification of an item.

```
tagAfi ATTRIBUTE ::= {
  WITH SYNTAX               OCTET STRING
  EQUALITY MATCHING RULE    octetStringMatch
  LDAP-SYNTAX               octetString.&id
  LDAP-NAME                 {"tagAfi"}
  ID                        id-at-isoTagAfi }
```

An AFI is typically one octet long, but provision is made for multi-octet AFIs.

6.13.8 EPC format attribute

An attribute of the **`epcFormat`** attribute type specifies how an EPC bit string may be partitioned into components.

```
epcFormat  ATTRIBUTE  ::=  {
  WITH SYNTAX               EpcFormat
  SINGLE VALUE              TRUE
  LDAP-SYNTAX               epcForm.&id
  LDAP-NAME                 {"epcFormat"}
  ID                        id-at-epcFormat }

EpcFormat ::= SEQUENCE {
  fields          SEQUENCE SIZE (1..MAX) OF SEQUENCE {
    bits            INTEGER,
    charField       CHOICE {
      characters  [0] INTEGER,
      maxValue    [1] INTEGER },
    result          ENUMERATED {
      numericPad      (0),
      numeric         (1),
      alpha7bits      (2) } DEFAULT numericPad,
  digitShift  [0] INTEGER                        OPTIONAL,
  checkCalc   [1] INTEGER                        OPTIONAL,
  urnPrefix       UTF8String                     OPTIONAL }
```

An attribute of the **`uiiFormat`** attribute type carries formatting information about the fields of a UII as retrieved from an RFID tag. It is intended to carry sufficient information to allow the RFID bit representation to be converted to a character representation. In addition, it allows conversion to a URN format, possibly to be used for a directory access.

Only the fields after the Header, the Filter field and the Partition field are considered when generating the character encoded UII or when creating a URN. It is assumed that the DUA/LDAP client has been able to identify these fields.

The attribute type syntax has the following components:

The **`fields`** component holds information about each of the EPC fields for which information is returned. For each field the following information is provided:

a) The **`bits`** subcomponent indicates how many bits the field occupies in the EPC.

b) The **`charField`** subcomponent is a choice of:

– The **`characters`** choice indicates how many characters to which the field shall be converted when decoding the EPC into a character representation. If it is a numeric character field and the result exceeds the indicated number of numeric characters, the EPC is invalid.

– The **`maxValue`** choice is only valid for a numeric field and indicates the maximum value allowed. If the value exceeds this value, the EPC is invalid.

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c) The **result** subcomponent shall indicate how the bit field shall be converted and shall take one of the following values:

– **numericPad** meaning that the bit string of the field shall be considered an unsigned integer that shall be converted to a numeric string. When this value is chosen, the **characters** alternative of the **charField** subcomponent shall be taken. If the number of numeric characters are less than the value of the **characters** choice, then the result shall be prefixed '0' numeric characters to get the length as indicated by the **characters** choice.

– **numeric** meaning that the bit string of the field shall be considered an unsigned integer that shall be converted to a numeric string. There shall be no leading zero numeric characters. However, if the bit string are all zero bits, the result shall be a single zero numeric character.

– **alpha7bits** meaning that the bit string of the field consists of 7 bits subfields each representing an ASCII character to be converted to an 8 bits ASCII character.

Based on the above information, the bit encoded UII can be converted to a character encoded format where the characters can be considered as numbered from one to maximum from the left.

The **digitShift** component is only relevant if a particular digit (numeric character) shall be shifted as part of the procedure when character encoding an EPC. The value shall indicate the position of the numeric character in the converted EPC to be shifted. If this component is present, the digit in question shall be moved to the front of the converted EPC. The moved digit is now character number one. However, if the intention is to produce a URN, the indicator digit shall not be moved.

NOTE – indicator digit is used as a common nomination for an indicator digit and an extension digit.

The **checkDigit** component shall only be present if a check digit shall be generated for the character encoded EPC. The check digit shall not be generated when producing a URN. The value shall indicate how many of the initial characters that are used for generating the check digit. All these characters shall be numeric characters (digits). The check digit is generated by taking the sum of the digits after having multiplied all the uneven numbered digits with 3 and then subtract the sum from the nearest equal or higher multiple of ten. The check digit shall be inserted right after the last digit that was used for generating the check digit.

If the DUA or LDAP client elects to translate the EPC into a URN based on this information, the converted fields shall be concatenated with a full stop ('.') inserted between the fields.

To make the URN globally unique, the string in the **urnPrefix** component may be used to prefix the result.

6.13.9 EPC in URN attribute type

An attribute of type **epcInUrn** specifies a Unique Item Identifier (UII) encoded in a unique URN format.

```
epcInUrn ATTRIBUTE ::= {
  SUBTYPE OF                urn
  SINGLE VALUE              TRUE
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"epcInUrn"}
  ID                        id-at-epcInUrn }
```

6.13.10 LDAP URL attribute type

An attribute of type **ldapUrl** is used for holding the URL of an LDAP system.

```
ldapUrl ATTRIBUTE ::= {
  SUBTYPE OF                url
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"ldapUrl"}
  ID                        id-at-ldapUrl }
```

6.13.11 Tag location

An attribute of type **tagLocation** is used for holding the position of a tag as expressed in coordinates.

```
tagLocation ATTRIBUTE ::= {
  SUBTYPE OF                utmCoordinates
  SINGLE VALUE              TRUE
  LDAP-SYNTAX               utmCoords.&id
  LDAP-NAME                 {"tagLocation"}
```

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```
  ID                          id-at-tagLocation }
```

6.14 Simple Authentication attributes held by object entries

6.14.1 Multi-valued user password attribute type

An attribute value of type **userPassword** contains a password of an object. Such a value is a string specified by the object. The attribute may hold both the current and previous password.

```
userPassword ATTRIBUTE ::= {
  WITH SYNTAX                 OCTET STRING(SIZE (0..MAX))
  EQUALITY MATCHING RULE      octetStringMatch
  LDAP-SYNTAX                 octetString.&id
  LDAP-NAME                   {"userPassword"}
  ID                          id-at-userPassword }
```

NOTE - This attribute type has been moved to here from Rec. ITU-T X.509 | ISO/IEC 9594-8. For compatibility reasons, this attribute type definition is kept in **AuthenticationFramework** module of Rec. ITU-T X.509 | ISO/IEC 9594-8.

6.14.2 Single-valued user password attribute

The **userPwd** attribute type contains either the clear text password or the encrypted password of an object. The Directory can store either variants but, implementations be aware that storing encrypted passwords is not always compatible with passing encrypted passwords in the protocol. The encrypted alternative may be used for passing the password in the bind or compare operations but this can only be safely used when the passwords are stored in the clear (see section 18.2.6.1 **userPwdMatch** for more details). The attribute value of the encrypted alternative is an octet string containing the encrypted value, with the encryption algorithm identifier, as well as parameters such as seeds. During password rollover, the old password value may be copied into the **userPwdRecentlyExpired** attribute value.

```
userPwd    ATTRIBUTE ::= {
  WITH SYNTAX                 UserPwd
  EQUALITY MATCHING RULE      userPwdMatch
  SINGLE VALUE                TRUE
  LDAP-SYNTAX                 userPwdDescription.&id
  LDAP-NAME                   {"userPwd"}
  ID                          id-at-userPwd }

UserPwd ::= CHOICE {
  clear                   UTF8String,
  encrypted               SEQUENCE {
    algorithmIdentifier     AlgorithmIdentifier{{SupportedAlgorithms}},
    encryptedString         OCTET STRING,
    ...},
  ...}
```

Annex B of Rec. ITU-T Rec. X.509 | ISO/IEC 9594-8 contains examples of some encryption methods.

6.14.3 Password Start Time attribute

The **pwdStartTime** operational attribute indicates when the password has been created for the object represented by the entry in which the attribute is present.

```
pwdStartTime ATTRIBUTE ::= {
  WITH SYNTAX                 GeneralizedTime
  EQUALITY MATCHING RULE      generalizedTimeMatch
  ORDERING MATCHING RULE      generalizedTimeOrderingMatch
  SINGLE VALUE                TRUE
  USAGE                       directoryOperation
  LDAP-SYNTAX                 generalizedTime.&id
  LDAP-NAME                   {"pwdStartTime"}
  ID                          id-oa-pwdStartTime }
```

6.14.4 Password expiry time attribute

The **pwdExpiryTime** operational attribute indicates when the password will expire for the object represented by the entry in which the attribute is present. This is an optional attribute that can be set by an administrator. If the attribute is missing, its default value is computed by the addition of the **pwdExpiryAge** to the **pwdStartTime** of the entry.

```
pwdExpiryTime ATTRIBUTE ::= {
```


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```
  WITH SYNTAX                GeneralizedTime
  EQUALITY MATCHING RULE     generalizedTimeMatch
  ORDERING MATCHING RULE     generalizedTimeOrderingMatch
  SINGLE VALUE               TRUE
  USAGE                      directoryOperation
  LDAP-SYNTAX                generalizedTime.&id
  LDAP-NAME                  {"pwdExpiryTime"}
  ID                         id-oa-pwdExpiryTime }
```

6.14.5 Password End Time attribute

The **pwdEndTime** operational attribute indicates when the password will be no longer valid for the object represented by the entry in which the attribute is present. This is an optional attribute that can be set by an administrator. If the attribute is missing, its default value is computed by the addition of the **pwdMaxAge** to the **pwdStartTime** of the entry.

```
pwdEndTime ATTRIBUTE ::= {
  WITH SYNTAX                GeneralizedTime
  EQUALITY MATCHING RULE     generalizedTimeMatch
  ORDERING MATCHING RULE     generalizedTimeOrderingMatch
  SINGLE VALUE               TRUE
  USAGE                      directoryOperation
  LDAP-SYNTAX                generalizedTime.&id
  LDAP-NAME                  {"pwdEndTime"}
  ID                         id-oa-pwdEndTime }
```

6.14.6 Password fails attribute

The **pwdFails** operational attribute specifies the current number of consecutive failed bind or compare attempts on the password attribute. The value of this attribute is incremented by one after a failed bind or compare attempt and is reset to zero after a successful bind or compare operation.

```
pwdFails ATTRIBUTE ::= {
  WITH SYNTAX                INTEGER (0..MAX)
  EQUALITY MATCHING RULE     integerMatch
  ORDERING MATCHING RULE     integerOrderingMatch
  SINGLE VALUE               TRUE
  USAGE                      dSAOperation
  LDAP-SYNTAX                integer.&id
  LDAP-NAME                  {"pwdFails"}
  ID                         id-oa-pwdFails }
```

6.14.7 Password failure time attribute

The **pwdFailureTime** operational attribute specifies the time of the last failed bind or compare attempts on the password attribute. This attribute is only significant when the pwdFails operational attribute contains a non zero value.

```
pwdFailureTime ATTRIBUTE ::= {
  WITH SYNTAX                GeneralizedTime
  EQUALITY MATCHING RULE     generalizedTimeMatch
  ORDERING MATCHING RULE     generalizedTimeOrderingMatch
  SINGLE VALUE               TRUE
  USAGE                      dSAOperation
  LDAP-SYNTAX                generalizedTime.&id
  LDAP-NAME                  {"pwdFailureTime"}
  ID                         id-oa-pwdFailureTime }
```

6.14.8 Password graces used attribute

The **pwdGracesUsed** operational attribute specifies the number of grace authentication attempts that have already been used with an expired password. The value of this attribute is set to 0 when the password is changed and incremented by one after successful authentication using an expired password. When the value is greater or equal to the **pwdGraces** attribute, the password is not usable again.

```
pwdGracesUsed ATTRIBUTE ::= {
  WITH SYNTAX                INTEGER (0..MAX)
  EQUALITY MATCHING RULE     integerMatch
  ORDERING MATCHING RULE     integerOrderingMatch
  SINGLE VALUE               TRUE
  USAGE                      dSAOperation
```

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```
  LDAP-SYNTAX                 integer.&id
  LDAP-NAME                   {"pwdGracesUsed"}
  ID                          id-oa-pwdGracesUsed }
```

6.14.9 User password history attribute

The **userPwdHistory** operational attribute is used to hold previous passwords for the user represented by the entry in which the attribute is present.

```
userPwdHistory ATTRIBUTE ::=
                      pwdHistory{userPwd,userPwdHistoryMatch,id-oa-userPwdHistory}
```

This attribute is multi-valued. Each value consists of a sequence of the time the password was put in the history and the password.

6.14.10 User password recently expired attribute

The **userPwdRecentlyExpired** attribute type contains the old user password after it has been replaced during the **pwdRecentlyExpiredDuration**. During this period, this password and the **userPwd** attribute are both considered to be valid. This attribute is removed when the **pwdRecentlyExpiredDuration** expires.

```
userPwdRecentlyExpired ATTRIBUTE ::=
                      pwdRecentlyExpired{userPwd,id-oa-userPwdRecentlyExpired}
```

6.15 Password policy attributes

Password policy attributes may be placed in an object entry and/or in a subentry. If an object entry holds such an attribute and is also within the scope of a password administration subentry, the value of the attribute in the object entry itself takes precedence.

6.15.1 Password modify entry allowed attribute

The **pwdModifyEntryAllowed** operational attribute specifies if the password or the encrypted password of an entry can be modified by an Administrator with a Modify Entry operation. If this attribute is missing, or the value is FALSE, the password or the encrypted password cannot be modified with a Modify Entry operation.

```
pwdModifyEntryAllowed ATTRIBUTE ::= {
  WITH SYNTAX                 BOOLEAN
  EQUALITY MATCHING RULE      booleanMatch
  SINGLE VALUE                TRUE
  USAGE                       directoryOperation
  LDAP-SYNTAX                 boolean.&id
  LDAP-NAME                   {"pwdModifyEntryAllowed"}
  ID                          id-oa-pwdModifyEntryAllowed }
```

6.15.2 Password change allowed attribute

The **pwdChangeAllowed** operational attribute specifies if the password or the encrypted password of an entry can be modified by the owner of that entry with a Change Password operation. If this attribute is missing or the value is FALSE, the password or the encrypted password cannot be modified with a Change Password operation.

```
pwdChangeAllowed ATTRIBUTE ::= {
  WITH SYNTAX                 BOOLEAN
  EQUALITY MATCHING RULE      booleanMatch
  SINGLE VALUE                TRUE
  USAGE                       directoryOperation
  LDAP-SYNTAX                 boolean.&id
  LDAP-NAME                   {"pwdChangeAllowed"}
  ID                          id-oa-pwdChangeAllowed }
```

6.15.3 Password maximum age attribute

The **pwdMaxAge** operational attribute holds the number of seconds after which a password will be no longer available. It shall have a value greater than zero.

If this attribute is missing, then the default value is infinity.

```
pwdMaxAge ATTRIBUTE ::= {
  WITH SYNTAX                 INTEGER (1 .. MAX)
  EQUALITY MATCHING RULE      integerMatch
```


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```
  ORDERING MATCHING RULE   integerOrderingMatch
  SINGLE VALUE             TRUE
  USAGE                    directoryOperation
  LDAP-SYNTAX              integer.&id
  LDAP-NAME                {"pwdMaxAge"}
  ID                       id-oa-pwdMaxAge }
```

6.15.4 Password expiry age attribute

The **pwdExpiryAge** operational attribute holds the number of seconds after which a modified password will expire. It shall have a value greater than zero.

If this attribute is missing, then the default value is infinity.

```
pwdExpiryAge ATTRIBUTE ::= {
  WITH SYNTAX              INTEGER (1 .. MAX)
  EQUALITY MATCHING RULE   integerMatch
  ORDERING MATCHING RULE   integerOrderingMatch
  SINGLE VALUE             TRUE
  USAGE                    directoryOperation
  LDAP-SYNTAX              integer.&id
  LDAP-NAME                {"pwdExpiryAge"}
  ID                       id-oa-pwdExpiryAge }
```

6.15.5 Password quality rule attribute types

6.15.5.1 Password minimum length attribute

This specifies the minimum length, in characters, which is acceptable for a password.

```
pwdMinLength ATTRIBUTE ::= {
  WITH SYNTAX              INTEGER (0..MAX)
  EQUALITY MATCHING RULE   integerMatch
  SINGLE VALUE             TRUE
  USAGE                    directoryOperation
  LDAP-SYNTAX              integer.&id
  LDAP-NAME                {"pwdMinLength"}
  ID                       id-oa-pwdMinLength }
```

6.15.5.2 Password vocabulary attribute

This specifies the type of words that are forbidden to be used for passwords. If a bit is set, the corresponding type of word is not allowed to be used on its own as a password.

```
pwdVocabulary ATTRIBUTE ::= {
  WITH SYNTAX              PwdVocabulary
  EQUALITY MATCHING RULE   bitStringMatch
  SINGLE VALUE             TRUE
  USAGE                    directoryOperation
  LDAP-SYNTAX              pwdVocabularyDescription.&id
  LDAP-NAME                {"pwdVocabulary"}
  ID                       id-oa-pwdVocabulary }

PwdVocabulary ::=  BIT STRING {
    noDictionaryWords    (0),
    noPersonNames        (1),
    noGeographicalNames  (2) }
```

6.15.5.3 Password alphabet attribute

This specifies the sets of characters that shall be used in creating a password. The password shall contain at least one character of each UTF8String of the value.

```
pwdAlphabet ATTRIBUTE ::= {
  WITH SYNTAX              PwdAlphabet
  SINGLE VALUE             TRUE
  USAGE                    directoryOperation
  LDAP-SYNTAX              pwdAlphabetDescription.&id
  LDAP-NAME                {"pwdAlphabet"}
  ID                       id-oa-pwdAlphabet }
```

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```
PwdAlphabet ::= SEQUENCE OF UTF8String
```

6.15.5.4 Password dictionaries attribute

This attributes points to one or more dictionaries containing words that are forbidden from being passwords on their own.

```
pwdDictionaries ATTRIBUTE ::= {
  SUBTYPE OF                uri
  USAGE                     directoryOperation
  LDAP-SYNTAX               directoryString.&id
  LDAP-NAME                 {"pwdDictionaries"}
  ID                        id-oa-pwdDictionaries }
```

6.15.6 Password expiry warning attribute

The **pwdExpiryWarning** operational attribute specifies a period in seconds before password expiration. During this period a warning indication shall be returned whenever an authenticating requester binds. If this attribute is missing, then a warning indication shall not be returned.

```
pwdExpiryWarning ATTRIBUTE ::= {
  WITH SYNTAX               INTEGER (1..MAX)
  EQUALITY MATCHING RULE    integerMatch
  ORDERING MATCHING RULE    integerOrderingMatch
  SINGLE VALUE              TRUE
  USAGE                     directoryOperation
  LDAP-SYNTAX               integer.&id
  LDAP-NAME                 {"pwdExpiryWarning"}
  ID                        id-oa-pwdExpiryWarning }
```

If the user does not attempt to bind during this period, the account should be locked, but the user should have a chance to change the password.

6.15.7 Password graces attribute

The **pwdGraces** operational attribute specifies the number of times an expired password can be used to authenticate. If this attribute is missing, authentication shall fail.

```
pwdGraces ATTRIBUTE ::= {
  WITH SYNTAX               INTEGER (0..MAX)
  EQUALITY MATCHING RULE    integerMatch
  ORDERING MATCHING RULE    integerOrderingMatch
  SINGLE VALUE              TRUE
  USAGE                     directoryOperation
  LDAP-SYNTAX               integer.&id
  LDAP-NAME                 {"pwdGraces"}
  ID                        id-oa-pwdGraces }
```

6.15.8 Password failure duration attribute

The **pwdFailureDuration** operational attribute holds the number of seconds a response to a failed bind or compare attempt should be delayed.

```
pwdFailureDuration ATTRIBUTE ::= {
  WITH SYNTAX               INTEGER (0..MAX)
  EQUALITY MATCHING RULE    integerMatch
  ORDERING MATCHING RULE    integerOrderingMatch
  SINGLE VALUE              TRUE
  USAGE                     directoryOperation
  LDAP-SYNTAX               integer.&id
  LDAP-NAME                 {"pwdFailureDuration"}
  ID                        id-oa-pwdFailureDuration }
```

6.15.9 Password lockout duration attribute

The **pwdLockoutDuration** operational attribute holds the number of seconds that the password cannot be used to authenticate due to too many successive failed bind or compare attempts (more than the limit specified by **pwdMaxFailures** operational attribute or its default). If this attribute is missing, the default time is infinity.

```
pwdLockoutDuration ATTRIBUTE ::= {
```


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