INTERNATIONAL STANDARD

**ISO/IEC 8824-1**

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# Information technology -- Abstract Syntax Notation One (ASN.1): Specification of basic notation

*Technologies de l'information — Notation de syntaxe abstraite numéro un (ASN.1): Spécification de la notation de base*

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ISO/IEC 8824-1:2015(E)

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## Foreword

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

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

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

This fifth edition cancels and replaces the fourth edition of ISO/IEC 8824-1:2008 which has been technically revised. It also incorporates ISO/IEC 8824-1:2008/Cor.1:2012 and ISO/IEC 8824-5:2008.Cor.2:2014.

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International Telecommunication Union

# ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
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# X.680

(08/2015)

SERIES X: DATA NETWORKS, OPEN SYSTEM COMMUNICATIONS AND SECURITY

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Recommendation ITU-T X.680

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**INTERNATIONAL STANDARD ISO/IEC 8824-1**
**RECOMMENDATION ITU-T X.680**

# Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation


## Summary

Recommendation ITU-T X.680 | ISO/IEC 8824-1 provides a notation called Abstract Syntax Notation One (ASN.1) for defining the syntax of information data. It defines a number of simple data types and specifies a notation for referencing these types and for specifying values of these types.

The ASN.1 notations can be applied whenever it is necessary to define the abstract syntax of information without constraining in any way how the information is encoded for transmission.


## History

| Edition | Recommendation | Approval | Study Group | Unique ID* |
|---|---|---|---|---|
| 1.0 | ITU-T X.680 | 1994-07-01 | 7 | 11.1002/1000/3040 |
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| 1.3 | ITU-T X.680 (1994) Technical Cor. 2 | 1997-12-12 | 7 | 11.1002/1000/4180 |
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| 2.2 | ITU-T X.680 (1997) Amd. 1 | 1999-06-18 | 7 | 11.1002/1000/4698 |
| 2.3 | ITU-T X.680 (1997) Amd. 2 | 1999-06-18 | 7 | 11.1002/1000/4699 |
| 2.4 | ITU-T X.680 (1997) Technical Cor. 2 | 2000-03-31 | 7 | 11.1002/1000/5046 |
| 2.5 | ITU-T X.680 (1997) Technical Cor. 3 | 2001-02-02 | 7 | 11.1002/1000/5331 |
| 2.6 | ITU-T X.680 (1997) Technical Cor. 4 | 2001-03-15 | 7 | 11.1002/1000/5332 |
| 2.7 | ITU-T X.680 (1997) Amd. 3 | 2001-10-29 | 7 | 11.1002/1000/5562 |
| 2.8 | ITU-T X.680 (1997) Amd. 4 | 2001-10-29 | 7 | 11.1002/1000/5563 |
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| 3.1 | ITU-T X.680 (2002) Amd. 1 | 2003-10-29 | 17 | 11.1002/1000/7019 |
| 3.2 | ITU-T X.680 (2002) Amd. 2 | 2004-08-29 | 17 | 11.1002/1000/7291 |
| 3.3 | ITU-T X.680 (2002) Technical Cor. 1 | 2005-05-14 | 17 | 11.1002/1000/8512 |
| 3.4 | ITU-T X.680 (2002) Amd. 3 | 2006-06-13 | 17 | 11.1002/1000/8836 |
| 3.5 | ITU-T X.680 (2002) Amd. 4 | 2007-05-29 | 17 | 11.1002/1000/9105 |
| 4.0 | ITU-T X.680 | 2008-11-13 | 17 | 11.1002/1000/9604 |
| 4.1 | ITU-T X.680 (2008) Cor. 1 | 2011-10-14 | 17 | 11.1002/1000/11376 |
| 4.2 | ITU-T X.680 (2008) Cor. 2 | 2014-03-01 | 17 | 11.1002/1000/12144 |
| 5.0 | ITU-T X.680 | 2015-08-13 | 17 | 11.1002/1000/12479 |

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

## FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

## NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

## INTELLECTUAL PROPERTY RIGHTS

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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## Introduction

This Recommendation | International Standard presents a standard notation for the definition of data types and values. A *data type* (or *type* for short) is a category of information (for example, numeric, textual, still image or video information). A *data value* (or *value* for short) is an instance of such a type. This Recommendation | International Standard defines several basic types and their corresponding values, and rules for combining them into more complex types and values.

In some protocol architectures, each message is specified as the binary value of a sequence of octets. However, standards-writers need to define quite complex data types to carry their messages, without concern for their binary representation. In order to specify these data types, they require a notation that does not necessarily determine the representation of each value. ASN.1 is such a notation. This notation is supplemented by the specification of one or more algorithms called *encoding rules* that determine the value of the octets that carry the application semantics (called the *transfer syntax*). Rec. ITU-T X.690 | ISO/IEC 8825-1, Rec. ITU-T X.691 | ISO/IEC 8825-2 and Rec. ITU-T X.693 | ISO/IEC 8825-4 specify three families of standardized encoding rules, called *Basic Encoding Rules (BER)*, *Packed Encoding Rules (PER)*, and *XML Encoding Rules (XER)*.

Some users wish to redefine their legacy protocols using ASN.1, but cannot use standardized encoding rules because they need to retain their existing binary representations. Other users wish to have more complete control over the exact layout of the bits on the wire (the transfer syntax). These requirements are addressed by Rec. ITU-T X.692 | ISO/IEC 8825-3 which specifies an *Encoding Control Notation (ECN)* for ASN.1. ECN enables designers to formally specify the abstract syntax of a protocol using ASN.1, but to then (if they so wish) take complete or partial control of the bits on the wire by writing an accompanying ECN specification (which may reference standardized Encoding Rules for some parts of the encoding).

A very general technique for defining a complicated type at the abstract level is to define a small number of *simple types* by defining all possible values of the simple types, then combining these simple types in various ways. Some of the ways of defining new types are as follows:

a) given an (ordered) list of existing types, a value can be formed as an (ordered) sequence of values, one from each of the existing types; the collection of all possible values obtained in this way is a new type (if the existing types in the list are all distinct, this mechanism can be extended to allow omission of some values from the list);

b) given an unordered set of (distinct) existing types, a value can be formed as an (unordered) set of values, one from each of the existing types; the collection of all possible unordered sets of values obtained in this way is a new type (the mechanism can again be extended to allow omission of some values);

c) given a single existing type, a value can be formed as an (ordered) list or (unordered) set of zero, one or more values of the existing type; the collection of all possible lists or sets of values obtained in this way is a new type;

d) given a list of (distinct) types, a value can be chosen from any one of them; the set of all possible values obtained in this way is a new type;

e) given a type, a new type can be formed as a subset of it by using some structure or order relationship among the values.

An important aspect of combining types in this way is that encoding rules should recognize the combining constructs, providing unambiguous encodings of the collection of values of the basic types. Thus, every basic type defined using the notation specified in this Recommendation | International Standard is assigned a *tag* to aid in the unambiguous encoding of values.

Tags are mainly intended for machine use, and are not essential for the human notation defined in this Recommendation | International Standard. Where, however, it is necessary to require that certain types be distinct, this is expressed by requiring that they have distinct tags. The allocation of tags is therefore an important part of the use of this notation, but (since 1994) it is possible to specify the automatic allocation of tags.

NOTE 1 – Within this Recommendation | International Standard, tag values are assigned to all simple types and construction mechanisms. The restrictions placed on the use of the notation ensure that tags can be used in transfer for unambiguous identification of values.

It is also possible to assign encoding instructions to a type in order to affect the encoding of that type. This can be done either by a type prefix placed before a type definition or use of a type reference, or by an encoding control section placed at the end of an ASN.1 module. The generic syntax of type prefixes and encoding control sections is specified in this Recommendation | International Standard, and includes an encoding reference to identify the encoding rules that are

modified by the encoding instruction. The semantics and detailed syntax of encoding instructions are specified in the encoding rules Recommendation | International Standard identified by the encoding reference.

An ASN.1 specification will initially be produced with a set of fully defined ASN.1 types. At a later stage, however, it may be necessary to change those types (usually by the addition of extra components in a sequence or set type). If this is to be possible in such a way that implementations using the old type definitions can interwork with implementations using the new type definitions in a defined way, encoding rules need to provide appropriate support. The ASN.1 notation supports the inclusion of an *extension marker* on a number of types. This signals to encoding rules the intention of the designer that this type is one of a series of related types (i.e., versions of the same initial type) called an *extension series*, and that the encoding rules are required to enable information transfer between implementations using different types that are related by being part of the same extension series.

Clauses 11 to 33 (inclusive) define the simple types supported by ASN.1, and specify the notation to be used for referencing simple types and for defining new types using them. Clauses 11 to 33 also specify notations to be used for specifying values of types defined using ASN.1. Two value notations are provided. The first is called the basic ASN.1 value notation, and has been part of the ASN.1 notation since its first introduction. The second is called the XML ASN.1 Value Notation, and provides a value notation using Extensible Markup Language (XML).

NOTE 2 – The XML Value Notation provides a means of representing ASN.1 values using XML. Thus, an ASN.1 type definition also specifies the structure and content of an XML element. This makes ASN.1 a simple schema language for XML.

Clauses 36 to 37 (inclusive) define the types supported by ASN.1 for carrying within them the complete encoding of ASN.1 types.

Clause 38 and Annex B define the types that provide support for ISO 8601.

Clauses 39 to 44 (inclusive) define the character string types.

Clauses 45 to 48 (inclusive) define certain types which are considered to be of general utility, but which require no additional encoding rules.

Clauses 49 to 51 (inclusive) define a notation which enables subtypes to be defined from the values of a parent type.

Clause 52 defines a notation which allows ASN.1 types specified in a "version 1" specification to be identified as likely to be extended in "version 2", and for additions made in subsequent versions to be separately listed and identified with their version number.

Clause 53 defines a notation which allows ASN.1 type definitions to contain an indication of the intended error handling if encodings are received for values which lie outside those specified in the current standardized definition.

Annex A forms an integral part of this Recommendation | International Standard, and specifies ASN.1 regular expressions.

Annex B forms an integral part of this Recommendation | International Standard, and defines an ASN.1 module containing the definition of a set of time types providing the full functionality of ISO 8601. These types can be imported from this ASN.1 module by an application designer if the useful time types specified in clause 38 are not adequate for the application.

Annex C forms an integral part of this Recommendation | International Standard, and specifies rules for type and value compatibility.

Annex D forms an integral part of this Recommendation | International Standard, and records object identifier and object descriptor values assigned in the ASN.1 series of Recommendations | International Standards.

Annex E forms an integral part of this Recommendation | International Standard and specifies the currently defined encoding references and the Recommendation | International Standard that defines the semantics and detailed syntax of encoding instructions with those encoding references.

Annex F does not form an integral part of this Recommendation | International Standard, and references the specification of the top-level arcs of the International Object Identifier tree and the use of that tree to form an OID internationalized resource identifier which can be used as an IRI or URI registered as the "oid" scheme with IANA.

Annex G does not form an integral part of this Recommendation | International Standard, and provides examples and hints on the use of the ASN.1 notation.

Annex H does not form an integral part of this Recommendation | International Standard, and provides a tutorial on ASN.1 character strings.

Annex I does not form an integral part of this Recommendation | International Standard, and provides a tutorial on the ASN.1 model of type extension.

Annex J does not form an integral part of this Recommendation | International Standard and provides a tutorial introduction to ISO 8601 and to the **TIME** type. It is recommended that this be read before the normative text.

Annex K does not form an integral part of this Recommendation | International Standard and provides information on how to identify the time properties of an abstract value from an instance of value notation.

Annex L does not form an integral part of this Recommendation | International Standard, and provides a summary of ASN.1 using the notation of clause 5.

**INTERNATIONAL STANDARD**
**ITU-T RECOMMENDATION**

# Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation

## 1 Scope

This Recommendation | International Standard provides a standard notation called Abstract Syntax Notation One (ASN.1) that is used for the definition of data types, values, and constraints on data types.

This Recommendation | International Standard:

- defines a number of simple types, with their tags, and specifies a notation for referencing these types and for specifying values of these types;
- defines mechanisms for constructing new types from more basic types, and specifies a notation for defining such types and assigning them tags, and for specifying values of these types;
- defines character sets (by reference to other Recommendations and/or International Standards) for use within ASN.1.

The ASN.1 notation can be applied whenever it is necessary to define the abstract syntax of information.

The ASN.1 notation is referenced by other standards which define encoding rules for the ASN.1 types.

## 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.

NOTE – This Recommendation | International Standard is based on ISO/IEC 10646:2003 and the Unicode standard version 3.2.0:2002. It cannot be applied using later versions of these two standards.

### 2.1 Identical Recommendations | International Standards

- Recommendation ITU-T X.660 (2008) | ISO/IEC 9834-1:2008, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI Registration Authorities: General procedures and top arcs of the ASN.1 International Object Identifier tree*.
- 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)*.
- Recommendation ITU-T X.691 (2015) | ISO/IEC 8825-2:2015, *Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)*.

- Recommendation ITU-T X.692 (2015) | ISO/IEC 8825-3:2015, *Information technology – ASN.1 encoding rules: Specification of Encoding Control Notation (ECN)*.
- Recommendation ITU-T X.693 (2015) | ISO/IEC 8825-4:2015, *Information technology – ASN.1 encoding rules: XML Encoding Rules (XER)*.
- Recommendation ITU-T X.695 (2015) | ISO/IEC 8825-6:2015, *Information technology – ASN.1 encoding rules: Registration and application of PER encoding instructions*.

## 2.2 Additional references

- Recommendation ITU-R TF.460-5 (1997), *Standard-frequency and time-signal emissions.*
- CCITT Recommendation T.100 (1988), *International information exchange for interactive videotex.*
- Recommendation ITU-T T.101 (1994), *International interworking for videotex services.*
- ISO *International Register of Coded Character Sets to be used with Escape Sequences*.
- ISO/IEC 646:1991, *Information technology – ISO 7-bit coded character set for information interchange*.
- ISO/IEC 2022:1994, *Information technology – Character code structure and extension techniques*.
- ISO/IEC 6523:1998, *Data interchange – Structures for the identification of organizations*.
- ISO/IEC 7350:1991, *Information technology – Registration of repertoires of graphic characters from ISO/IEC 10367*.
- ISO 8601:2004, *Data elements and interchange formats – Information interchange – Representation of dates and times*.
- ISO/IEC 10646:2003, *Information technology – Universal Multiple-Octet Coded Character Set (UCS)*.
- The Unicode Standard, Version 3.2.0:2002. The Unicode Consortium. (Reading, MA, Addison-Wesley)

  NOTE 1 – The above reference is included because it provides names for control characters and specifies categories of characters.
- W3C XML 1.0:2000, *Extensible Markup Language (XML) 1.0 (Second Edition), W3C Recommendation, Copyright © [6 October 2000] World Wide Web Consortium, (Massachusetts Institute of Technology, Institut National de Recherche en Informatique et en Automatique, Keio University), http://www.w3.org/TR/2000/REC-xml-20001006.*

NOTE 2 – The reference to a document within this Recommendation | International Standard does not give it, as a stand-alone document, the status of a Recommendation or International Standard.