
**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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Published in Switzerland

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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.

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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.

ISO/IEC 8824-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*, in collaboration with ITU-T. The identical text is published as ITU-T X.680 (08/2015).

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International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.680

(08/2015)

SERIES X: DATA NETWORKS, OPEN SYSTEM
COMMUNICATIONS AND SECURITY

OSI networking and system aspects – Abstract Syntax
Notation One (ASN.1)

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

Recommendation ITU-T X.680



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For further details, please refer to the list of ITU-T Recommendations.

**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
1.1	ITU-T X.680 (1994) Amd. 1	1995-04-10	7	11.1002/1000/3041
1.2	ITU-T X.680 (1994) Technical Cor. 1	1995-11-21	7	11.1002/1000/3282
1.3	ITU-T X.680 (1994) Technical Cor. 2	1997-12-12	7	11.1002/1000/4180
1.4	ITU-T X.680 (1994) Amd. 1/Technical Cor.1	1997-12-12	7	11.1002/1000/4179
1.5	ITU-T X.680 (1994) Amd. 2	1997-12-12	7	11.1002/1000/4181
2.0	ITU-T X.680	1997-12-12	7	11.1002/1000/4449
2.1	ITU-T X.680 (1997) Technical Cor. 1	1999-06-18	7	11.1002/1000/4700
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
3.0	ITU-T X.680	2002-07-14	17	11.1002/1000/6085
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.

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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.