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

**AMENDMENT 1: Rules of extensibility  
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*Technologies de l'information — Notation de syntaxe abstraite numéro 1  
(ASN.1): Spécifications des notations de base*  
*AMENDEMENT 1: Règles pour l'extensibilité*

INTERNATIONAL

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## Contents

	<i>Page</i>
1 Scope .....	1
2 Normative references .....	1
2.1 Identical Recommendations   International Standards .....	1
3 Changes to Introduction .....	1
4 Changes to Definitions .....	2
5 The ASN.1 model of type extension .....	2
6 Extensibility requirements on encoding rules .....	2
7 Changes to Module Definition .....	3
8 Change to production for ValueSet .....	4
9 Change to definition of types and values .....	4
10 Changes to ENUMERATED .....	4
11 Changes to SEQUENCE .....	4
12 Changes to SET .....	5
13 Changes to CHOICE .....	5
14 Changes to Constrained Types .....	6
15 Changes to exception identifier .....	6
16 Changes to element set specification .....	6
Annex A – Tutorial annex on the ASN.1 model of type extension .....	8

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## Foreword

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

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. 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.

Amendment 1 to International Standard ISO/IEC 8824-1:1995 was prepared by Joint Technical Committee ISO/IEC JTC 1, Information technology, Subcommittee SC 21, *Open systems interconnection, data management and open distributed processing*, in collaboration with ITU-T. The identical text is published as ITU-T Rec. X.680/Amd.1.

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## Introduction

This Recommendation | International Standard documents the changes to ITU-T Rec. X.680 | ISO/IEC 8824-1 needed to support the ASN.1 Rules of Extensibility.

The ASN.1 Rules of Extensibility describes how to write an ASN.1 module in such a way as to allow a phased migration to a new version of an ASN.1 specification. The new version may differ from the previous version by new components being added to a SET, SEQUENCE or CHOICE, new enumerations being added to an enumerated type, and constraints on a subtype specification being relaxed. A phased migration to the new version of the ASN.1 specification allows communicating peers throughout a network to simultaneously have differing knowledge of the set of values allowed in the abstract syntax, yet be able to communicate without the knowledge by any peer that its peer has a different understanding of what the set of values in the abstract syntax is.

For example, initially peers A, B, C and D may have identical views of the types of values that can be exchanged. Assuming that the ASN.1 specification that describes these values was originally defined with extensibility in mind, it can be extended by adding new components to a SEQUENCE, for example, thereby creating a new version of the ASN.1 specification. Peers A and B may immediately adopt the new version, while peers C and D continue using the old version, yet all four peers can continue communicating with one another without difficulty because the SEQUENCE was originally defined as being extensible. When peers A and B exchange a value of the newly extended SEQUENCE they will both see values for the new components that were added to the SEQUENCE (provided they are sent). When peer A (or B) sends a message containing the newly added components to peer C (or D), the message will appear to C at the abstract level (i.e. after the message has been decoded) without any of the newly added components; only the original components in the SEQUENCE will be seen. When peer C (or D) sends a message to peer A (or B), the message will (of course) not contain any of the new components, however, it will appear to A as though a peer using the same version of the ASN.1 specification as A (e.g. B) had sent the message with all of the new components missing. Peers C and D continue to exchange messages with each other the way they always did.

## INTERNATIONAL STANDARD

## ITU-T RECOMMENDATION

**INFORMATION TECHNOLOGY – ABSTRACT SYNTAX NOTATION ONE (ASN.1):  
SPECIFICATION OF BASIC NOTATION**

**AMENDMENT 1  
(to Rec. X.680 | ISO/IEC 8824-1)**

**Rules of extensibility**

## 1 Scope

This Recommendation | International Standard documents the changes to ITU-T Rec. X.680 | ISO/IEC 8824-1 needed to support the ASN.1 Rules of Extensibility.

## 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 editions of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunications Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

### 2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.680 (1994) | ISO/IEC 8824-1:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*
- ITU-T Recommendation X.682 (1994) | ISO/IEC 8824-3:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification.*
- ITU-T Recommendation X.683 (1994) | ISO/IEC 8824-4:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications.*
- ITU-T Recommendation X.690 (1994) | ISO/IEC 8825-1:1995, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*
- ITU-T Recommendation X.691 (1995) | ISO/IEC 8825-2:1996, *Information technology – ASN.1 encoding rules – Specification of Packed Encoding Rules (PER).*

## 3 Changes to Introduction

*{Add the following text to the Introduction of ITU-T Rec. X.680 | ISO/IEC 8824-1 immediately before the existing paragraph which begins “Clauses 8 to 31”:]*

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.

## 4 Changes to Definitions

*{Add the following new definitions to ITU-T Rec. X.680 | ISO/IEC 8824-1, maintaining the alphabetical order of definitions in ITU-T Rec. X.680 | ISO/IEC 8824-1. Note that the alphabetic character appearing in the clause numbers below will be changed to an appropriate numeric character when the definitions are added to the base document:}*

**3.8.a extension series:** A series of ASN.1 types which can be ordered in such a way that each successive type in the series is formed by the addition of text to the end of the type notation of the immediately preceding type in the series.

NOTE – Both nested and unnested types can be extended.

**3.8.b extension marker:** A syntactic flag (an ellipsis) that is included in all types that form part of an extension series.

**3.8.c extension root:** An extensible type that is the first type in an extension series. It carries the extension marker with no additional notation other than comments and whitespace between the extension marker and the matching “}” or “)”.

NOTE – Only an extension root can be the first type in an extension series.

**3.8.d extension addition:** One of the added notations in an extension series. For set types and sequence types, each extension addition is the addition of a single element. For enumerated types it is the addition of a single further enumeration. For choice types it is the addition of a single further choice. For a constraint it is the addition of a subtype element.

NOTE – Extension additions are both textually ordered (following the extension marker) and logically ordered (having increasing tags or enumeration values).

**3.8.e extension-related:** Two types that have the same extension root, and where one was created by adding zero or more extension additions to the other.

**3.8.f extensible type:** A type with an extension marker.

**3.8.g extensible constraint:** A subtype constraint with an extension marker.

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## 5 The ASN.1 model of type extension

*{Add this text as a new clause before clause 6 of ITU-T Rec. X.680 | ISO/IEC 8824-1, using the same clause heading as this clause.}*

When decoding an extensible type, a decoder may detect:

- a) the absence of expected extension additions in a sequence or set type; or
- b) the presence of arbitrary unexpected extension additions above those defined (if any) in a sequence or set type, or of an unknown alternative in a choice type, or an unknown enumeration in an enumerated type, or of an unexpected length or value of a type whose constraint is extensible.

In formal terms, an abstract syntax defined by the extensible type "X" contains not only the values of type "X", but also the values of all types that are extension-related to "X". Thus, the decoding process never signals an error when either of the above situations (a or b) is detected. The action that is taken in each situation is a matter for the application layer designer to specify.

NOTE – Frequently the action will be to ignore the presence of unexpected additional extensions, and to use a default value or a "missing" indicator for expected extension additions that are absent.

Unexpected extension additions detected by a decoder in an extensible type can later be included in a subsequent encoding of that type (for transmission back to the sender, or to some third party), provided that the same transfer syntax is used on the subsequent transmission.

## 6 Extensibility requirements on encoding rules

*{Add this text as a new clause to ITU-T Rec. X.680 | ISO/IEC 8824-1 before clause 6 and after the newly added clause above, using the same clause heading as this clause:}*

**6.1** All ASN.1 encoding rules shall allow the encoding of values of an extensible type "X" in such a way that they can be decoded using an extensible type "Y" that is extension-related to "X". Further, the encoding rules shall allow the values that were decoded using "Y" to be re-encoded (using "Y") and decoded using a third extensible type "Z" that is extension related to "Y" (and hence "X" also).

NOTE – Types "X", "Y" and "Z" may appear in any order in the extension series.

If a value of an extensible type "X" is encoded and then relayed (directly or through a relaying application using extension-related type "Z") to another application that decodes the value using extensible type "Y" that is extension-related to "X", then the decoder using type "Y" obtains an abstract value composed of:

- a) n abstract value of the extension root type;
- b) n abstract value of each extension addition that is present in both "X" and "Y";
- c) delimited encoding for each extension addition (if any) that is in "X" but not in "Y".

The encodings in c) shall be capable of being included in a later encoding of a value of "Y", if so required by the application. That encoding shall be a valid encoding of a value of "X".

**Tutorial example:** If system A is using an extensible root type (type "X") that is a sequence type or a set type with an extension addition of an optional integer type, while system B is using an extension-related type (type "Y") that has two extension additions where each is an optional integer type, then transmission by B of a value of "Y" which omits the integer value of the first extension addition and includes the second must not be confused by A with the presence of the first (only) extension addition of "X" that it knows about. Moreover, A must be able to re-encode the value of "X" with a value present for the first integer type, followed by the second integer value received from B, if so required by the application protocol.

**6.2** All ASN.1 encoding rules shall specify the encoding and decoding of the value of an enumerated type and a choice type in such a way that if a transmitted value is in the set of extension additions held in common by the encoder and the decoder, then it is successfully decoded, otherwise it shall be possible for the decoder to delimit the encoding of it and to identify it as a value of an (unknown) extension addition.

**6.3** All ASN.1 encoding rules shall specify the encoding and decoding of types with extensible constraints in such a way that if a transmitted value is in the set of extension additions held in common by the encoder and the decoder, then it is successfully decoded, otherwise it shall be possible for the decoder to delimit the encoding of and to identify it as a value of an (unknown) extension addition.

In all cases, the presence of extension additions shall not affect the ability to recognize later material when a type with an extension marker is nested inside some other type.

NOTE – All variants of the Basic Encoding Rules of ASN.1 and the Packed Encoding Rules of ASN.1 satisfy all these requirements.

## 7 Changes to Module Definition

{Change the productions in 10.1 of ITU-T Rec. X.680 | ISO/IEC 8824-1 to read:}

```

ModuleDefinition ::=
  ModuleIdentifier
  DEFINITIONS
  TagDefault
  ExtensionDefault
  " ::= "
  BEGIN
  ModuleBody
  END

ExtensionDefault ::=
  EXTENSIBILITY IMPLIED | empty

```

{All other productions in 10.1 remain the same}

{Insert a new clause after 10.3 in ITU-T Rec. X.680 | ISO/IEC 8824-1:}

**10.3 bis** The "EXTENSIBILITY IMPLIED" option is equivalent to the textual insertion of an extension marker (...) in the definition of each type in the module for which it is permitted. The absence of "EXTENSIBILITY IMPLIED" means that extensibility is only provided for those types within the module where an extension marker is explicitly present.

NOTE – "EXTENSIBILITY IMPLIED" affects only types. It has no effect on object sets.



## 8 Change to production for ValueSet

{Replace the production for ValueSet in 13.5 of ITU-T Rec. X.680 | ISO/IEC 8824-1 with:}

ValueSet ::= "{" ElementSetSpecs "}"

## 9 Change to definition of types and values

{Insert a (new) 14.12 in ITU-T Rec. X.680 | ISO/IEC 8824-1:}

**14.12** The implied or explicit presence of an extension marker in the definition of a type has no effect on the value notation. That is, the value notation for a type with an extension marker is exactly the same as if the extension marker was absent.

## 10 Changes to ENUMERATED

{Change the production in clause 17 in ITU-T Rec. X.680 | ISO/IEC 8824-1 to read:}

EnumeratedType ::= ENUMERATED "{" Enumerations "}"  
 Enumerations ::= RootEnumeration |  
                   RootEnumeration "," "..." |  
                   RootEnumeration "," "..." "," AdditionalEnumeration

RootEnumeration ::= Enumeration

AdditionalEnumeration ::= Enumeration

{"Enumeration" is defined as it is now.}

{Change Note 2 of 17.1 to read:}

2 The numeric values inside the "NamedNumber"s in the "RootEnumeration" are not necessarily ordered or contiguous, and the numeric values inside the "NamedNumber"s in the "AdditionalEnumeration" are not necessarily contiguous.

{Add the following text after 17.3:}

**17.3 bis** The value of each new "AdditionalEnumeration" shall be greater than all previously defined "AdditionalEnumeration"s in the type.

**17.3 ter** When a "NamedNumber" is used in defining an "AdditionalEnumeration" the value associated with it shall be different from the value of all previously defined "EnumerationItem"s (in this type) regardless of whether the previously defined "EnumerationItem"s occur in the enumeration root or not. For example:

A ::= ENUMERATED {a, b, ..., c(0)}	-- invalid, since both 'a' and 'c' equal 0
B ::= ENUMERATED {a, b, ..., c, d(2)}	-- invalid, since both 'c' and 'd' equal 2
C ::= ENUMERATED {a, b(3), ..., c(1)}	-- valid, 'c' = 1
D ::= ENUMERATED {a, b, ..., c(2)}	-- valid, 'c' = 2

**17.3 quater** The value associated with the first "AdditionalEnumeration" alternative that is an "identifier" (not a "NamedNumber") shall be the smallest value for which (a) an "EnumerationItem" is not defined in the "RootEnumeration" and (b) all preceding "EnumerationItem"s in the "AdditionalEnumeration" (if any) are smaller. For example, the following are all valid:

A ::= ENUMERATED {a, b, ..., c}	-- c = 2
B ::= ENUMERATED {a, b, c(0), ..., d}	-- d = 3
C ::= ENUMERATED {a, b, ..., c(3), d}	-- d = 4
D ::= ENUMERATED {a, z(25), ..., d}	-- d = 1

## 11 Changes to SEQUENCE

{Change the production in clause 22 in ITU-T Rec. X.680 | ISO/IEC 8824-1 to read:}

SequenceType ::= SEQUENCE "{" "}" |  
                   SEQUENCE "{" ExtensionAndException "}" |  
                   SEQUENCE "{" ComponentTypeLists "}"

ExtensionAndException ::= "..." | "..." ExceptionSpec



```

ComponentTypeLists ::= RootComponentTypeList |
    RootComponentTypeList "," ExtensionAndException |
    RootComponentTypeList "," ExtensionAndException "," AdditionalComponentTypeList |
    ExtensionAndException "," AdditionalComponentTypeList

```

```
RootComponentTypeList ::= ComponentTypeList
```

```
AdditionalComponentTypeList ::= ComponentTypeList
```

*{"ComponentTypeList" is defined as now.}*

NOTE – "ComponentType"s that are not marked OPTIONAL or DEFAULT in the "AdditionalComponentTypeList" should always be encoded, except when the presentation data value is being relayed from a sender that is using an earlier version of the abstract syntax in which the "ComponentType" is not defined.

*{Replace the **first sentence** of 22.4 with the following:}*

"Type" in the "COMPONENTS OF Type" notation shall be a sequence type that itself contains no extension marker, but it may include components that do.

*{Create a new clause after 22.4 with the following:}*

**22.4 bis** The "COMPONENTS OF Type" notation shall not be used in "AdditionalComponentTypeList".

## 12 Changes to SET

*{Change the production in clause 24 in ITU-T Rec. X.680 | ISO/IEC 8824-1 to read:}*

```

SetType ::= SET "{" "}" |
    SET "{" ExtensionAndException "}" |
    SET "{" ComponentTypeLists "}"

```

"ComponentTypeLists" is specified in 22.1.

*{Replace the **first sentence** of 24.2 with the following:}*

If a "Type" contains an extension marker and that "Type" is used as the "Type" in a "COMPONENTS OF Type", the extension marker is not visible to the "COMPONENTS OF Type". Thus, for the purposes of the "COMPONENTS OF Type" the "Type" is treated as though it was not defined with an extension marker.

*{Add the following text after 24.3:}*

**24.3 bis** The tag of each new "ComponentType" added to the "AdditionalComponentTypeList" shall be canonically greater (see 6.4) than those of the other components in the "AdditionalComponentTypeList", and shall occur last in the set type.

*{Modify clause 24.4 to say:}*

**24.4** Subclauses 22.2, 22.2 bis and 22.6-22.10 also apply to set types.

## 13 Changes to CHOICE

*{Change the production in clause 26 in ITU-T Rec. X.680 | ISO/IEC 8824-1 to read:}*

```

ChoiceType ::= CHOICE "{" AlternativeTypeLists "}"
AlternativeTypeLists ::=
    RootAlternativeTypeList |
    RootAlternativeTypeList "," ExtensionAndException |
    RootAlternativeTypeList "," ExtensionAndException "," AdditionalAlternativeTypeList

RootAlternativeTypeList ::= AlternativeTypeList

AdditionalAlternativeTypeList ::= AlternativeTypeList

```

*{"AlternativeTypeList" is defined as now.}*

*{Add the following text after 26.3:}*

**26.3 bis** The tag of each new "NamedType" added to the "AdditionalAlternativeTypeList" shall be canonically greater (see 6.4) than those of the other components of the "AdditionalAlternativeTypeList", and shall be the last "NamedType" in the choice type.