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**Information technology — ASN.1  
encoding rules: XML Encoding Rules  
(XER)**

*Technologies de l'information — Règles de codage ASN.1: Règles de  
codage XML (XER)*

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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 third edition cancels and replaces the second edition of ISO/IEC 8825-4:2008 which has been technically revised. It also incorporates ISO/IEC 8825-4:2008/Cor.1:2012 and ISO/IEC 8825-4:2008/Cor.2:2014.

ISO/IEC 8825-4 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.693 (08/2015).



**ITU-T**

TELECOMMUNICATION  
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(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 – ASN.1 encoding rules:  
XML Encoding Rules (XER)**

Recommendation ITU-T X.693

ITU-T X-SERIES RECOMMENDATIONS  
DATA NETWORKS, OPEN SYSTEM COMMUNICATIONS AND SECURITY

PUBLIC DATA NETWORKS

Services and facilities	X.1–X.19
Interfaces	X.20–X.49
Transmission, signalling and switching	X.50–X.89
Network aspects	X.90–X.149
Maintenance	X.150–X.179
Administrative arrangements	X.180–X.199

OPEN SYSTEMS INTERCONNECTION

Model and notation	X.200–X.209
Service definitions	X.210–X.219
Connection-mode protocol specifications	X.220–X.229
Connectionless-mode protocol specifications	X.230–X.239
PICS proformas	X.240–X.259
Protocol Identification	X.260–X.269
Security Protocols	X.270–X.279
Layer Managed Objects	X.280–X.289
Conformance testing	X.290–X.299

INTERWORKING BETWEEN NETWORKS

General	X.300–X.349
Satellite data transmission systems	X.350–X.369
IP-based networks	X.370–X.379

MESSAGE HANDLING SYSTEMS

	X.400–X.499
--	-------------

DIRECTORY	X.500–X.599
-----------	-------------

OSI NETWORKING AND SYSTEM ASPECTS

Networking	X.600–X.629
Efficiency	X.630–X.639
Quality of service	X.640–X.649
Naming, Addressing and Registration	X.650–X.679
<b>Abstract Syntax Notation One (ASN.1)</b>	<b>X.680–X.699</b>

OSI MANAGEMENT

Systems management framework and architecture	X.700–X.709
Management communication service and protocol	X.710–X.719
Structure of management information	X.720–X.729
Management functions and ODMA functions	X.730–X.799
SECURITY	X.800–X.849

OSI APPLICATIONS

Commitment, concurrency and recovery	X.850–X.859
Transaction processing	X.860–X.879
Remote operations	X.880–X.889
Generic applications of ASN.1	X.890–X.899

OPEN DISTRIBUTED PROCESSING

	X.900–X.999
--	-------------

INFORMATION AND NETWORK SECURITY	X.1000–X.1099
----------------------------------	---------------

SECURE APPLICATIONS AND SERVICES	X.1100–X.1199
----------------------------------	---------------

CYBERSPACE SECURITY	X.1200–X.1299
---------------------	---------------

SECURE APPLICATIONS AND SERVICES	X.1300–X.1399
----------------------------------	---------------

CYBERSECURITY INFORMATION EXCHANGE	X.1500–X.1599
------------------------------------	---------------

CLOUD COMPUTING SECURITY	X.1600–X.1699
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For further details, please refer to the list of ITU-T Recommendations.

**Information technology – ASN.1 encoding rules:  
XML Encoding Rules (XER)**

## Summary

Recommendation ITU-T X.693 | ISO/IEC 8825-4 specifies rules for encoding values of ASN.1 types using the Extensible Markup Language (XML).

## History

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2.2	ITU-T X.693 (2008) Cor. 2	2014-03-01	17	<a href="http://handle.itu.int/11.1002/1000/12148">11.1002/1000/12148</a>
3.0	ITU-T X.693	2015-08-13	17	<a href="http://handle.itu.int/11.1002/1000/12489">11.1002/1000/12489</a>

\* 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

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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.

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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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# CONTENTS

	<i>Page</i>
1 SCOPE .....	1
2 NORMATIVE REFERENCES .....	1
2.1 IDENTICAL RECOMMENDATIONS   INTERNATIONAL STANDARDS.....	1
2.2 ADDITIONAL REFERENCES .....	2
3 DEFINITIONS .....	2
3.1 ASN.1 BASIC ENCODING RULES (BER) .....	2
3.2 ADDITIONAL DEFINITIONS .....	2
4 ABBREVIATIONS.....	4
5 ENCODINGS SPECIFIED BY THIS RECOMMENDATION   INTERNATIONAL STANDARD...	4
6 ENCODING INSTRUCTIONS SPECIFIED BY THIS RECOMMENDATION   INTERNATIONAL STANDARD .....	5
7 CONFORMANCE .....	5
8 BASIC XML ENCODING RULES .....	5
8.1 PRODUCTION OF A COMPLETE BASIC-XER ENCODING.....	5
8.2 THE XML PROLOG .....	6
8.3 THE XML DOCUMENT ELEMENT .....	6
8.4 ENCODING OF THE EXTERNAL TYPE .....	7
8.5 ENCODING OF THE OPEN TYPE.....	7
8.6 DECODING OF TYPES WITH EXTENSION MARKERS .....	7
9 CANONICAL XML ENCODING RULES.....	7
9.1 GENERAL RULES FOR CANONICAL XER .....	7
9.2 REAL VALUES.....	8
9.3 BITSTRING VALUE .....	8
9.4 OCTETSTRING VALUE .....	8
9.5 SEQUENCE VALUE .....	8
9.6 SET VALUE .....	8
9.7 SET-OF VALUE.....	9
9.8 OBJECT IDENTIFIER VALUE.....	9
9.9 RELATIVE OBJECT IDENTIFIER VALUE .....	9
9.10 GENERALIZEDTIME .....	9
9.11 UTCTIME.....	9
9.12 OPEN TYPE VALUE.....	10
9.13 THE TIME TYPE AND THE USEFUL TIME TYPES.....	10
10 EXTENDED XML ENCODING RULES.....	10
10.1 GENERAL .....	10
10.2 EXTENDED-XER CONFORMANCE .....	11
10.3 STRUCTURE OF AN EXTENDED-XER ENCODING.....	13
11 NOTATION, CHARACTER SET AND LEXICAL ITEMS USED IN XER ENCODING INSTRUCTIONS .....	14

12	KEYWORDS .....	14
13	ASSIGNING AN XER ENCODING INSTRUCTION TO AN ASN.1 TYPE USING A TYPE PREFIX .....	15
14	ASSIGNING AN XER ENCODING INSTRUCTION USING AN XER ENCODING CONTROL SECTION .....	18
	14.1 THE ENCODING INSTRUCTION ASSIGNMENT LIST .....	18
	14.2 IDENTIFICATION OF THE TARGETS FOR AN XER ENCODING INSTRUCTION USING A TARGET LIST .....	18
	14.2.1 GENERAL RULES .....	18
	14.2.2 TARGET IDENTIFICATION USING AN ASN.1 TYPE REFERENCE AND IDENTIFIERS .....	21
	14.2.3 TARGET IDENTIFICATION USING A BUILT-IN TYPE NAME .....	22
	14.2.4 USE OF IDENTIFIERS IN CONTEXT .....	23
	14.2.5 USE OF IMPORTED TYPES IDENTIFICATION .....	24
15	MULTIPLE ASSIGNMENT OF XER ENCODING INSTRUCTIONS .....	24
	15.1 ORDER IN WHICH MULTIPLE ASSIGNMENTS ARE CONSIDERED .....	24
	15.2 EFFECT OF ASSIGNING A NEGATING ENCODING INSTRUCTION .....	25
	15.3 MULTIPLE ASSIGNMENT OF ENCODING INSTRUCTIONS WITH MULTIPLE CATEGORIES .....	25
	15.4 MULTIPLE ASSIGNMENT OF XER ENCODING INSTRUCTIONS OF THE SAME CATEGORY .....	25
	15.5 PERMITTED COMBINATIONS OF FINAL ENCODING INSTRUCTIONS .....	26
16	XER ENCODING INSTRUCTION SUPPORT FOR XML NAMESPACES AND QUALIFIED NAMES .....	27
17	SPECIFICATION OF EXTENDED-XER ENCODINGS .....	28
	17.1 THE XML DOCUMENT ELEMENT .....	29
	17.2 THE "TYPENAMEORMODIFIEDTYPENAME" PRODUCTION .....	29
	17.3 THE "ATTRIBUTELIST" PRODUCTION .....	29
	17.4 THE "EXTENDEDXMLVALUE" PRODUCTION .....	29
	17.5 THE "EXTENDEDXMLCHOICEVALUE" PRODUCTION .....	31
	17.6 THE "EXTENDEDXMLSEQUENCEVALUE" AND "EXTENDEDXMLSETVALUE" PRODUCTIONS .....	31
	17.7 THE "EXTENDEDXMLSEQUENCEOFVALUE" AND "EXTENDEDXMLSETOFVALUE" PRODUCTIONS .....	32
	17.8 THE "MODIFIEDXMLINTEGERVALUE" PRODUCTION .....	33
	17.9 THE "MODIFIEDXMLREALVALUE" PRODUCTION .....	34
18	THE ANY-ATTRIBUTES ENCODING INSTRUCTION .....	34
	18.1 GENERAL .....	34
	18.2 RESTRICTIONS .....	35
	18.3 EFFECT ON ENCODINGS .....	36
19	THE ANY-ELEMENT ENCODING INSTRUCTION .....	36
	19.1 GENERAL .....	36
	19.2 RESTRICTIONS .....	36
	19.3 EFFECT ON ENCODINGS .....	37
20	THE ATTRIBUTE ENCODING INSTRUCTION .....	38
	20.1 GENERAL .....	38

	20.2 RESTRICTIONS .....	38
	20.3 EFFECT ON ENCODINGS.....	38
21	THE BASE64 ENCODING INSTRUCTION.....	40
	21.1 GENERAL .....	40
	21.2 RESTRICTIONS .....	40
	21.3 EFFECT ON ENCODINGS.....	40
22	THE DECIMAL ENCODING INSTRUCTION .....	41
	22.1 GENERAL .....	41
	22.2 RESTRICTIONS .....	41
	22.3 EFFECT ON ENCODINGS.....	42
23	THE DEFAULT-FOR-EMPTY ENCODING INSTRUCTION .....	42
	23.1 GENERAL .....	42
	23.2 RESTRICTIONS .....	43
	23.3 EFFECT ON ENCODINGS.....	44
24	THE ELEMENT ENCODING INSTRUCTION .....	44
	24.1 GENERAL .....	44
	24.2 RESTRICTIONS .....	44
	24.3 EFFECT ON ENCODINGS.....	44
25	THE EMBED-VALUES ENCODING INSTRUCTION .....	44
	25.1 GENERAL .....	44
	25.2 RESTRICTIONS .....	45
	25.3 EFFECT ON ENCODINGS.....	45
26	THE GLOBAL-DEFAULTS ENCODING INSTRUCTION .....	46
	26.1 GENERAL .....	46
	26.2 RESTRICTIONS .....	46
	26.3 EFFECT ON ENCODINGS.....	46
27	THE LIST ENCODING INSTRUCTION .....	47
	27.1 GENERAL .....	47
	27.2 RESTRICTIONS .....	47
	27.3 EFFECT ON ENCODINGS.....	47
28	THE NAME ENCODING INSTRUCTION .....	48
	28.1 GENERAL .....	48
	28.2 RESTRICTIONS .....	49
	28.3 EFFECT ON ENCODINGS.....	49
29	THE NAMESPACE ENCODING INSTRUCTION .....	50
	29.1 GENERAL .....	50
	29.2 RESTRICTIONS .....	50
	29.3 EFFECT ON ENCODINGS.....	51
30	THE PI-OR-COMMENT ENCODING INSTRUCTION .....	51
	30.1 GENERAL .....	51
	30.2 RESTRICTIONS .....	52
	30.3 EFFECT ON THE ENCODINGS.....	52
31	THE TEXT ENCODING INSTRUCTION.....	52

	31.1 GENERAL .....	52
	31.2 RESTRICTIONS .....	53
	31.3 EFFECT ON ENCODINGS.....	53
32	THE UNTAGGED ENCODING INSTRUCTION .....	54
	32.1 GENERAL .....	54
	32.2 RESTRICTIONS .....	55
	32.3 EFFECT ON ENCODINGS.....	55
33	THE USE-NIL ENCODING INSTRUCTION .....	56
	33.1 GENERAL .....	56
	33.2 RESTRICTIONS .....	56
	33.3 EFFECT ON ENCODINGS.....	57
34	THE USE-NUMBER ENCODING INSTRUCTION .....	57
	34.1 GENERAL .....	57
	34.2 RESTRICTIONS .....	57
	34.3 EFFECT ON ENCODINGS.....	57
35	THE USE-ORDER ENCODING INSTRUCTION.....	58
	35.1 GENERAL .....	58
	35.2 RESTRICTIONS .....	58
	35.3 EFFECT ON ENCODINGS.....	59
36	THE USE-QNAME ENCODING INSTRUCTION.....	59
	36.1 GENERAL .....	59
	36.2 RESTRICTIONS .....	59
	36.3 EFFECT ON ENCODINGS.....	60
37	THE USE-TYPE ENCODING INSTRUCTION .....	60
	37.1 GENERAL .....	60
	37.2 RESTRICTIONS .....	60
	37.3 EFFECT ON ENCODINGS.....	61
38	THE USE-UNION ENCODING INSTRUCTION .....	61
	38.1 GENERAL .....	61
	38.2 RESTRICTIONS .....	61
	38.3 EFFECT ON ENCODINGS.....	62
39	THE WHITESPACE ENCODING INSTRUCTION.....	63
	39.1 GENERAL .....	63
	39.2 RESTRICTIONS .....	63
	39.3 EFFECT ON ENCODINGS.....	64
40	IDENTIFICATION OF THE ENCODING RULES .....	64
	ANNEX A – EXAMPLES OF BASIC-XER AND CXER ENCODINGS.....	65
	A.1 ASN.1 DESCRIPTION OF THE RECORD STRUCTURE .....	65
	A.2 ASN.1 DESCRIPTION OF A RECORD VALUE.....	65
	A.3 BASIC XML REPRESENTATION OF THIS RECORD VALUE .....	65
	A.4 CANONICAL XML REPRESENTATION OF THIS RECORD VALUE.....	66
	ANNEX B – PARTIAL XML CONTENT AND DETERMINISTIC ENCODINGS.....	67
	B.1 PARTIAL XML CONTENT .....	67

B.2 RECOMMENDED RESTRICTIONS ON ENCODINGS PRODUCING PARTIAL XML ELEMENT CONTENT .....	67
ANNEX C – EXAMPLES OF EXTENDED-XER ENCODINGS USING XER ENCODING INSTRUCTIONS.....	70
C.1 INTRODUCTION .....	70
C.2 SIMPLE EXAMPLES.....	70
C.2.1 A BASE-BALL CARD .....	70
C.2.2 AN EMPLOYEE.....	71
C.3 MORE COMPLEX EXAMPLES .....	71
C.3.1 USING A UNION OF TWO SIMPLE TYPES.....	71
C.3.2 USING A TYPE IDENTIFICATION ATTRIBUTE.....	72
C.3.3 USING ENUMERATION VALUES .....	72
C.3.4 USING AN EMPTY ENCODING FOR A DEFAULT VALUE.....	72
C.3.5 USING EMBEDDED-VALUES FOR NOTIFICATION OF A PAYMENT DUE.....	72

# 1 Introduction

Rec. ITU-T X.680 | ISO/IEC 8824-1, Rec. ITU-T X.681 | ISO/IEC 8824-2, Rec. ITU-T X.682 | ISO/IEC 8824-3, Rec. ITU-T X.683 | ISO/IEC 8824-4 together describe Abstract Syntax Notation One (ASN.1), a notation for the definition of messages to be exchanged between peer applications.

This Recommendation | International Standard defines encoding rules that may be applied to values of ASN.1 types defined using the notation specified in Rec. ITU-T X.680 | ISO/IEC 8824-1 and Rec. ITU-T X.681 | ISO/IEC 8824-2. Application of these encoding rules produces a transfer syntax for such values. It is implicit in the specification of these encoding rules that they are also to be used for decoding.

There is more than one set of encoding rules that can be applied to values of ASN.1 types. This Recommendation | International Standard defines three sets of encoding rules that use the Extensible Markup Language (XML). These encoding rules all produce an XML document compliant to W3C XML 1.0. The first set is called the Basic XML Encoding Rules (BASIC-XER). The second set is called the Canonical XML Encoding Rules (CANONICAL-XER, or CXER) because there is only one way of encoding an ASN.1 value using these encoding rules. (Canonical encoding rules are generally used for applications using security-related features such as digital signatures.) The third set is called the extended XML Encoding Rules (EXTENDED-XER). The extended XML Encoding Rules allow additional encoders options, and take account of encoding instructions that specify variations of the BASIC-XER encodings in order to support specific styles of XML documents (see below). The extended XML Encoding Rules are not canonical, and there is no canonical form for these rules defined in this Recommendation | International Standard.

There are many aspects of an XML representation of data (such as the use of XML attributes instead of child elements, or the use of white-space delimited lists) whose use is a matter of style and XML designer choice. If a type defined in an ASN.1 specification is encoded by BASIC-XER or by CXER, then there is a single fixed style used for the XML representation, with no user control of stylistic features. This Recommendation | International Standard specifies the syntax and semantics of XER encoding instructions which specify the stylistic features of the XML in an EXTENDED-XER encoding. XER encoding instructions can also be used to determine the possible insertion of XML processing instructions in an EXTENDED-XER encoding. XER encoding instructions are ignored by BASIC-XER and by CXER, but are used by EXTENDED-XER.

NOTE – "Stylistic features", such as use of attributes or white-space delimited lists, can also affect the size of an encoding and the ease with which it can be processed, so use of such features is not just a matter of style. Where such issues are important, EXTENDED-XER with encoding instructions may be preferred over BASIC-XER or CXER.

Clause 8 specifies the BASIC-XER encoding of ASN.1 types.

Clause 9 specifies the CXER encoding of ASN.1 types.

Clause 10 specifies the EXTENDED-XER encoding of ASN.1 types, referencing later clauses which define the XER encoding instructions.

Clauses 11 to 14 list and categorize the XER encoding instructions and specify the syntax for their assignment to an ASN.1 type or component using either an XER type prefix (see Rec. ITU-T X.680 | ISO/IEC 8824-1, 31.3) or an XER encoding control section (see Rec. ITU-T X.680 | ISO/IEC 8824-1, clause 54).

Clause 15 defines the order of precedence if XER encoding instructions are present in both an XER type prefix and in an XER encoding control section.

Clause 16 specifies the XER encoding instruction support for XML namespaces when using EXTENDED-XER.

Clause 17 specifies EXTENDED-XER encodings.

Clauses 18 to 39 specify:

- a) the syntax of each XER encoding instruction used in a type prefix or an XER encoding control section;
- b) restrictions on the XER encoding instructions that can be associated with a particular ASN.1 type (resulting from inheritance and multiple assignments);
- c) modifications to the XER encoding rules that are required in an EXTENDED-XER encoding when an XER encoding instruction is applied.

Annex A is informative and contains examples of BASIC-XER and CXER encodings.

Annex B is informative and contains a description of the partial XML content that is produced when constructions such as sequence and sequence-of have their surrounding tags removed, together with restrictions on EXTENDED-XER specifications that enable easy determination of the ASN.1 component that an XML element is associated with.

Annex C is informative and contains examples of XER encoding instructions and of the corresponding EXTENDED-XER encodings.

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**INTERNATIONAL STANDARD  
ITU-T RECOMMENDATION**

**Information technology –  
ASN.1 encoding rules:  
XML Encoding Rules (XER)**

## **1 Scope**

This Recommendation | International Standard specifies a set of basic XML Encoding Rules (BASIC-XER) that may be used to derive a transfer syntax for values of types defined in Rec. ITU-T X.680 | ISO/IEC 8824-1 and Rec. ITU-T X.681 | ISO/IEC 8824-2. This Recommendation | International Standard also specifies a set of Canonical XML Encoding Rules (CXER) which provide constraints on the basic XML Encoding Rules and produce a unique encoding for any given ASN.1 value. This Recommendation | International Standard further specifies a set of extended XML Encoding Rules (EXTENDED-XER) which adds further encoders options, and also allows the ASN.1 specifier to vary the encoding that would be produced by BASIC-XER. It is implicit in the specification of these encoding rules that they are also used for decoding.

The encoding rules specified in this Recommendation | International Standard:

- are used at the time of communication;
- are intended for use in circumstances where displaying of values and/or processing them using commonly available XML tools (such as browsers) is the major concern in the choice of encoding rules;
- allow the extension of an abstract syntax by addition of extra values for all forms of extensibility described in Rec. ITU-T X.680 | ISO/IEC 8824-1.

This Recommendation | International Standard also specifies the syntax and semantics of XER encoding instructions, and the rules for their assignment and combination. XER encoding instructions can be used to control the EXTENDED-XER encoding for specific 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.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)*.

- 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)*.

## 2.2 Additional references

- IETF RFC 2045 (1996), *Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies*.
- IETF RFC 2141 (1997), *URN Syntax*.
- IETF RFC 2396 (1998), *Uniform Resource Identifiers (URI): Generic Syntax*.
- IETF RFC 3061 (2001), *A URN Namespace of Object Identifiers*.
- ISO/IEC 10646:2003, *Information technology – Universal Multiple-Octet Coded Character Set (UCS)*.
- The Unicode Standard, Version 3.2.0, The Unicode Consortium. (Reading, MA, Addison-Wesley)  
NOTE 1 – The graphics characters (and their encodings) defined by the above reference are identical to those defined by ISO/IEC 10646, but the above reference is included because it also specifies the names of control 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>.
- W3C XML Namespaces:1999, *Namespaces in XML*, W3C Recommendation, Copyright © [14 January 1999] World Wide Web Consortium, (Massachusetts Institute of Technology, Institut National de Recherche en Informatique et en Automatique, Keio University), <http://www.w3.org/TR/1999/REC-xml-names-19990114>.

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.

## 3 Definitions

For the purposes of this Recommendation | International Standard, the definitions of Rec. ITU-T X.680 | ISO/IEC 8824-1 and the following definitions apply.

### 3.1 ASN.1 Basic Encoding Rules (BER)

This Recommendation | International Standard makes use of the following terms defined in Rec. ITU-T X.690 | ISO/IEC 8825-1:

- a) data value;
- b) dynamic conformance;
- c) encoding (of a data value);
- d) receiver;
- e) sender;
- f) static conformance.

### 3.2 Additional definitions

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

**3.2.1 ASN.1 schema:** The definition of the content and structure of data using an ASN.1 type definition.

NOTE – This enables encoding rules to produce binary encodings of the values of an ASN.1 type, or encodings using XML.

**3.2.2 associated empty-element tag:** The XML empty-element tag that can replace an associated preceding tag and an associated following tag, when present.

NOTE – Some encoding instructions remove the associated tags of an "XMLValue".

**3.2.3 associated encoding instructions (for a type):** A set of XER encoding instructions associated with a type.