
**Information technology — ASN.1
encoding rules: Mapping W3C XML
schema definitions into ASN.1**

*Technologies de l'information — Règles de codage ASN.1: Mappage en
ASN.1 des définitions de schéma XML du W3C*



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2015

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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.

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 8825-5:2008 which has been technically revised. It also incorporates ISO/IEC 8825-5:2008/Cor.1:2012 and ISO/IEC 8825-5:2008/Cor.2:2014.

ISO/IEC 8825-5 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.694 (08/2015).

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

X.694

(08/2015)

SERIES X: DATA NETWORKS, OPEN SYSTEM
COMMUNICATIONS AND SECURITY

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

**Information technology – ASN.1 encoding rules:
Mapping W3C XML schema definitions into
ASN.1**

Recommendation ITU-T X.694

ITU-T



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	
DIRECTORY	
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
Abstract Syntax Notation One (ASN.1)	X.680–X.699
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	
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	
INFORMATION AND NETWORK SECURITY	
SECURE APPLICATIONS AND SERVICES	
CYBERSPACE SECURITY	
SECURE APPLICATIONS AND SERVICES	
CYBERSECURITY INFORMATION EXCHANGE	
CLOUD COMPUTING SECURITY	

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

Information technology – ASN.1 encoding rules: Mapping W3C XML schema definitions into ASN.1

Summary

Recommendation ITU-T X.694 | ISO/IEC 8825-5 defines rules for mapping an XSD Schema (a schema conforming to the W3C XML Schema specification) to an ASN.1 schema in order to use ASN.1 encoding rules such as the Basic Encoding Rules (BER), the Distinguished Encoding Rules (DER), the Packed Encoding Rules (PER) or the XML Encoding Rules (XER) for the transfer of information defined by the XSD Schema.

The use of this Recommendation | International Standard with the ASN.1 Extended XML Encoding Rules (EXTENDED-XER) provides the same XML representation of values as that defined by the original XSD Schema, but also provides the ability to encode the specified XML with an efficient binary representation (binary XML). An XML document can be converted to binary XML (for storage or transfer) using the ASN.1 generated by this mapping, and the resulting binary can be converted back to the same XML document for further XML processing.

Two versions of the mapping are defined. Version 1 of the mapping was published in 2004, and a Corrigendum was subsequently issued renaming the types **DATE-TIME** and **DURATION** in Annex A (in order to avoid conflict with the **DATE-TIME** and **DURATION** types defined in Rec. ITU-T X.680 | ISO/IEC 8824-1). The Version 2 mapping is more efficient in two areas: the ASN.1 time types are used rather than VisibleString for mappings of dates and times; the FastInfoset specification (Rec. ITU-T X.891 | ISO/IEC 24824-1) is used for the mapping of XSD wild-cards. Both these changes to the mapping provide much more compact binary encodings for the XML specified by the XSD.

NOTE – The specification of the Version 1 mapping (with applicable corrections) will be maintained in the next edition of this Recommendation | International Standard, but it is expected that subsequent editions will document only the Version 2 mapping.

Application of the ASN.1 extended XML Encoding Rules to both versions of the mapping will produce the same XML (which is the same as that specified by the XSD). However, application of other ASN.1 encoding rules to the Version 1 mapping results in a verbose character-based encoding of date and time types and of XSD wild-cards, whilst application of the Version 2 mapping results in a more compact binary encoding using ASN.1 time types and the FastInfoset specification.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T X.694	2004-01-13	17	11.1002/1000/7106
1.1	ITU-T X.694 (2004) Technical Cor. 1	2005-11-29	17	11.1002/1000/8639
1.2	ITU-T X.694 (2004) Amd. 1	2007-05-29	17	11.1002/1000/9111
2.0	ITU-T X.694	2008-11-13	17	11.1002/1000/9612
2.1	ITU-T X.694 (2008) Cor. 1	2011-10-14	17	11.1002/1000/11382
2.2	ITU-T X.694 (2008) Cor. 2	2014-03-01	17	11.1002/1000/12149
3.0	ITU-T X.694	2015-08-13	17	11.1002/1000/12486

* 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

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

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/>.

© ITU 2015

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

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	Imported definitions 2
3.2	Additional definitions 3
4	Abbreviations 3
5	Notation 3
6	Purpose and extent of standardization 3
7	Mapping XSD Schemas 4
8	Ignored schema components and properties 5
9	ASN.1 modules 6
10	Name conversion 6
10.1	General 6
10.2	Generating ASN.1 type definitions that are references to ASN.1 type assignments 7
10.3	Generating identifiers and type reference names 7
10.4	Order of the mapping 9
11	Mapping uses of XSD built-in types 10
12	Mapping facets 10
12.1	The length, minLength, and maxLength facets 11
12.2	The pattern facet 11
12.3	The whiteSpace facet 11
12.4	The enumeration facet 12
12.5	Other facets 14
13	Mapping simple type definitions 14
14	Mapping element declarations 16
15	Mapping attribute declarations 17
16	Mapping values of simple type definitions 17
17	Mapping model group definitions 17
18	Mapping model groups 17
19	Mapping particles 18
20	Mapping complex type definitions 19
21	Mapping wildcards 20
22	Mapping attribute uses 22
23	Mapping uses of simple and complex type definitions (general case) 22
24	Mapping special uses of simple and complex type definitions (substitutable) 23
25	Mapping special uses of simple and complex type definitions (substitutable, nillable) 24
26	Mapping special uses of simple type definitions (nillable) 25
27	Mapping special uses of complex type definitions (nillable) 26
28	Mapping special uses of element declarations (head of element substitution group) 27
29	Generating special ASN.1 type assignments for types used in element declarations 27
30	Generating special ASN.1 type assignments for types belonging to a derivation hierarchy 29
31	Generating special ASN.1 type assignments for element substitution groups 29
	Annex A – ASN.1 type definitions corresponding to XSD built-in types for the Version 1 mapping 30
	Annex B – ASN.1 type definitions corresponding to XSD built-in types for the Version 2 mapping 34

	<i>Page</i>
Annex C – Identification of the XSD module	38
Annex D – Examples of mappings	39
D.1 A Schema using simple type definitions	39
D.2 The corresponding ASN.1 definitions.....	40
D.3 Further examples.....	41
Annex E – Use of the mapping to provide binary encodings for W3C XML Schema.....	61
E.1 Encoding XSD Schemas	61
E.2 Transfer without using the XSD Schema for Schemas	61
E.3 Transfer using the XSD Schema for Schemas	61

Introduction

This Recommendation | International Standard specifies Version 1 and Version 2 of a mapping from a W3C XML Schema definition (an XSD Schema) into an ASN.1 schema. The mappings can be applied to any XSD Schema. Both mappings specify the generation of one or more ASN.1 modules containing type definitions, together with ASN.1 XER encoding instructions. These are jointly described as an ASN.1 schema for XML documents. This ASN.1 schema (produced by either Version of the mapping), when used with the ASN.1 Extended XML Encoding Rules (EXTENDED-XER), can be used to generate and to validate the same set of W3C XML 1.0 documents as the original XSD Schema. The resulting ASN.1 types and encodings support the same semantic content as the XSD Schema. Thus ASN.1 tools can be used interchangeably with XSD tools for the generation and processing of the specified XML documents.

Other standardized ASN.1 encoding rules, such as the Distinguished Encoding Rules (DER) or the Packed Encoding Rules (PER), can be used in conjunction with this standardized mapping, but produce encodings for Version 2 of the mapping that differ from (and are less verbose than) those produced by Version 1 for XSD constructs involving dates and times or wildcards.

The combination of this Recommendation | International Standard with ASN.1 Encoding Rules provides fully-standardized and vendor-independent compact and canonical binary encodings for data originally defined using an XSD Schema.

The ASN.1 schema provides a clear separation between the specification of the information content of messages (their abstract syntax) and the precise form of the XML document (for example, use of attributes instead of elements). This results in both a clearer and generally a less verbose schema than the original XSD Schema.

Annex A forms an integral part of this Recommendation | International Standard, and is an ASN.1 module containing a set of ASN.1 type assignments that correspond to each of the XSD built-in types for Version 1 of the mapping. Mappings of XSD Schemas into ASN.1 schemas either import the type reference names of those type assignments or include the type definitions in-line.

Annex B also forms an integral part of this Recommendation | International Standard and provides the ASN.1 module for Version 2 of the mapping.

Annex C does not form an integral part of this Recommendation | International Standard, and summarizes the object identifier, OID internationalized resource identifier and object descriptor values assigned in this Recommendation | International Standard. Annex D does not form an integral part of this Recommendation | International Standard, and gives examples of the mapping of XSD Schemas into ASN.1 schemas.

Annex E does not form an integral part of this Recommendation | International Standard, and describes the use of the mapping defined in this Recommendation | International Standard, in conjunction with standardized ASN.1 Encoding Rules, to provide compact and canonical encodings for data defined using an XSD Schema.

**INTERNATIONAL STANDARD
ITU-T RECOMMENDATION**

**Information technology – ASN.1 encoding rules: Mapping W3C XML
schema definitions into ASN.1**

1 Scope

This Recommendation | International Standard specifies two Versions of a mapping from any XSD Schema into an ASN.1 schema. The ASN.1 schema for both Versions support the same semantics and validate the same set of XML documents.

This Recommendation | International Standard specifies the final XER encoding instructions that are to be applied as part of the defined mapping to ASN.1 types, but does not specify which syntactic form is to be used for the specification of those final XER encoding instructions, or the order or manner of their assignment.

NOTE – Implementers of tools generating these mappings may choose any syntactic form or order of assignment that results in the specified final XER encoding instructions being applied. Examples in this Recommendation | International Standard generally use the type prefix form, but use of an XER Encoding Control Section may be preferred for the mapping of a complete XSD Schema, as a matter of style.

There are different ways (syntactically) of assigning XER encoding instructions for use in EXTENDED-XER encodings (for example, use of ASN.1 type prefix encoding instructions or use of an XER encoding control section). The choice of these syntactic forms is a matter of style and is outside the scope of this Recommendation | International Standard.

2 Normative references

The following Recommendations | International Standards and W3C specifications 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, International Standards and W3C specifications 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, International Standards and W3C specifications 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. The W3C maintains a list of currently valid W3C specifications. 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.

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

NOTE – The complete set of ASN.1 Recommendations | International Standards are listed below, as they can all be applicable in particular uses of this Recommendation | International Standard. Where these are not directly referenced in the body of this Recommendation | International Standard, a † symbol is added to the reference.

- 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).* †

- 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.891 (2005) | ISO/IEC 24824-1:2007, *Information technology – Generic Applications of ASN.1: Fast Infoset*.

2.2 Additional references

- 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)*.
- 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>.
- W3C XML Information Set:2001, *XML Information Set*, W3C Recommendation, Copyright © [24 October 2001] World Wide Web Consortium (Massachusetts Institute of Technology, Institut National de Recherche en Informatique et en Automatique, Keio University), <http://www.w3.org/TR/2001/REC-xml-info-20011024>.
- W3C XML Schema:2001, *XML Schema Part 1: Structures*, W3C Recommendation, Copyright © [2 May 2001] World Wide Web Consortium, (Massachusetts Institute of Technology, Institut National de Recherche en Informatique et en Automatique, Keio University), <http://www.w3.org/TR/2001/REC-xmlschema-1-20010502>.
- W3C XML Schema:2001, *XML Schema Part 2: Datatypes*, W3C Recommendation, Copyright © [2 May 2001] World Wide Web Consortium, (Massachusetts Institute of Technology, Institut National de Recherche en Informatique et en Automatique, Keio University), <http://www.w3.org/TR/2001/REC-xmlschema-2-20010502>.
NOTE – When the reference "W3C XML Schema" is used in this Recommendation | International Standard, it refers to W3C XML Schema Part 1 and W3C XML Schema Part 2.
- IETF RFC 2396 (1998), *Uniform Resource Identifiers (URI): Generic Syntax*.
- IETF RFC 1766 (1995), *Tags for the Identification of Languages*.