INTERNATIONAL STANDARD

ISO/IEC 8825-5

Third edition
2015-11-15

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

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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.

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).

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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

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ITU-T X-SERIES RECOMMENDATIONS

DATA NETWORKS, OPEN SYSTEM COMMUNICATIONS AND SECURITY

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

INTERNATIONAL STANDARD ISO/IEC 8825-5
RECOMMENDATION ITU-T X.694

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

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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/.

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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.

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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-infoset-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.*

3   Definitions

3.1   Imported definitions

3.1.1   This Recommendation | International Standard uses the terms defined in Rec. ITU-T X.680 | ISO/IEC 8824-1 and in Rec. ITU-T X.693 | ISO/IEC 8825-4.

  NOTE – In particular, the terms "final XER encoding instructions", "type prefix" and "XER encoding control section" are defined in the above-mentioned Recommendations | International Standards.

3.1.2   This Recommendation | International Standard also uses the terms defined in W3C XML Schema and W3C XML Information Set.

  NOTE 1 – It is believed that these terms do not conflict with the terms referenced in 3.1.1. If such a conflict occurs, the definition of the term in 3.1.1 applies.

  NOTE 2 – In particular, the terms "schema component" and "property (of a schema component)" are defined in W3C XML Schema, and the terms "element information item" and "attribute information item" are defined in W3C XML Information Set.

  NOTE 3 – The terms "top-level **simple type definition**" and "top-level **complex type definition**" do not include XSD built-in types, when used in this Recommendation | International Standard.

3.2 Additional definitions

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

3.2.1 **XSD namespace**: A namespace with a URI of "http://www.w3.org/2001/XMLSchema".

3.2.2 **XSI namespace**: A namespace with a URI of "http://www.w3.org/2001/XMLSchema-instance".

3.2.3 **XML namespace**: A namespace with a URI of "http://www.w3.org/XML/1998/namespace".

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply:

ASN.1   Abstract Syntax Notation One

BER   (ASN.1) Basic Encoding Rules

DER   (ASN.1) Distinguished Encoding Rules

PER   (ASN.1) Packed Encoding Rules

URI   (IETF) Uniform Resource Identifier

XER   (ASN.1) XML Encoding Rules

XML   (W3C) Extensible Markup Language

XSD   (W3C) XML Schema

5 Notation

5.1 This Recommendation | International Standard references the notation defined by Rec. ITU-T X.680 | ISO/IEC 8824-1, Rec. ITU-T X.682 | ISO/IEC 8824-3, W3C XML 1.0 and W3C XML Schema.

5.2 When it is necessary in the body of this Recommendation | International Standard to specify, either formally or in examples, the assignment of XER encoding instructions, the type prefix notation is generally used (but see 6.3 and 6.4). In Annex A, an XER encoding control section is used.

5.3 In this Recommendation | International Standard, **bold Courier** is used for ASN.1 notation and **bold Arial** is used for XSD notation and for XSD terms and concepts.

5.4 The XSD Schemas used in the examples in this Recommendation | International Standard use the prefix **xsd:** to identify the XSD namespace.

6 Purpose and extent of standardization

6.1 The mapping to ASN.1 that is specified in this Recommendation | International Standard ensures that:

a) any resulting ASN.1 modules generated by tools conforming to this Recommendation | International Standard (from the same XSD Schema) define the same (structured) abstract values;

b) all BASIC-XER, CXER, EXTENDED-XER, and binary encodings of that resulting ASN.1 specification will produce the same encodings (subject to encoder's options); and

c) all XML documents that conform to the source XSD Schema are valid EXTENDED-XER encodings of abstract values of that ASN.1 specification.

6.2 There are many aspects of an ASN.1 definition (such as the use of white-space, or of encoding control sections or type prefixes) that affect neither the abstract values being defined nor the XER or binary encodings of those values. Such aspects of the ASN.1 definition are generally not standardized in this Recommendation | International Standard.

6.3 There are many different ways in ASN.1 of assigning an XER encoding instruction to a type, including:

a) use of a type prefix for every encoding instruction to be assigned; or

b) use of an encoding control section, with a separate encoding instruction for each required assignment; or

c) use of an encoding control section, with a single encoding instruction making a global assignment, possibly supplemented by use of a negating encoding instruction for specific types.

6.4 This Recommendation | International Standard specifies when a final XER encoding instruction shall be present, and uses the syntax of 6.3 a) in most of its examples. However, the use of the different options in 6.3 is not standardized,