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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 en XML (XER)

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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.

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 Rec. X.693.

ISO/IEC 8825 consists of the following parts, under the general title *Information technology — ASN.1 encoding rules*:

— *Part 1: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

— *Part 2: Specification of Packed Encoding Rules (PER)*

— *Part 3: Specification of Encoding Control Notation (ECN)*

— *Part 4: XML Encoding Rules (XER)*

— *Part 5: Mapping W3C XML schema definitions into ASN.1*

Introduction

The publications ITU-T Rec. X.680 | ISO/IEC 8824-1, ITU-T Rec. X.681 | ISO/IEC 8824-2, ITU-T Rec. X.682 | ISO/IEC 8824-3, ITU-T Rec. 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 ITU-T Rec. X.680 | ISO/IEC 8824-1 and ITU-T Rec. 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 two sets of encoding rules that use the Extensible Markup Language (XML). These are called the XML Encoding Rules (XER) for ASN.1, and both produce an XML document compliant to W3C XML 1.0. The first set is called the Basic XML Encoding Rules. The second set is called the Canonical XML Encoding Rules 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.)

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 (XER) that may be used to derive a transfer syntax for values of types defined in ITU-T Rec. X.680 | ISO/IEC 8824-1 and ITU-T Rec. X.681 | ISO/IEC 8824-2. This Recommendation | International Standard also specifies a set of Canonical XML Encoding Rules which provide constraints on the Basic XML Encoding Rules and produce a unique encoding for any given ASN.1 value. 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 ITU-T Rec. X.680 | ISO/IEC 8824-1.

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.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.680 (2002) | ISO/IEC 8824-1:2002, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.
- ITU-T Recommendation X.681 (2002) | ISO/IEC 8824-2:2002, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification*.
- ITU-T Recommendation X.682 (2002) | ISO/IEC 8824-3:2002, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification.*
- ITU-T Recommendation X.683 (2002) | ISO/IEC 8824-4:2002, *Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications*.
- ITU-T Recommendation X.690 (2002) | ISO/IEC 8825-1:2002, *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 (2002) | ISO/IEC 8825-2:2002, *Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)*.

2.2 Additional references

- ISO/IEC 10646-1:1993, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Part 1: Architecture and Basic Multilingual Plane.*

– ISO/IEC 10646-1:1993/Amd.2:1996, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Part 1: Architecture and Basic Multilingual Plane – Amendment 2: UCS Transformation Format 8 (UTF-8)*.

– 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*.

NOTE – 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 following definitions apply.

3.1 Basic Encoding Rules

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. 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 canonical encoding: A complete encoding of an abstract value obtained by the application of encoding rules that have no implementation-dependent options. Such rules result in the definition of a 1-1 mapping between unambiguous and unique encodings and values in the abstract syntax.

3.2.3 valid XML document (for an ASN.1 schema): An XML document which is well-formed (see W3C XML 1.0) and whose content conforms to the XER specification for the encoding of the ASN.1 type specified by an ASN.1 schema.

3.2.4 XML document: A sequence of characters which conforms to W3C XML 1.0 definition of document.

4 Abbreviations

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

ASN.1	Abstract Syntax Notation One
PDU	Protocol Data Unit
UCS	Universal Multiple-Octet Coded Character Set
UTC	Coordinated Universal Time
UTF-8	UCS Transformation Format, 8-bit form
XML	Extensible Markup Language
XER	XML Encoding Rules

5 Notation

This Recommendation | International Standard references the notation defined by ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 5.

Encodings specified by this Recommendation | International Standard

6.1 This Recommendation | International Standard specifies two sets of encoding rules:

– Basic XML Encoding Rules (BASIC-XER).

– Canonical XML Encoding Rules (CANONICAL-XER).

NOTE – Where this Recommendation | International Standard uses "XER" without qualification, the text applies to both BASIC-XER and CANONICAL-XER.

6.2 The most general set of encoding rules specified in this Recommendation | International Standard is BASIC-XER, which does not in general produce a canonical encoding.

6.3 A second set of encoding rules specified in this Recommendation | International Standard is CANONICAL-XER, which produces encodings that are canonical. This is defined as a restriction of implementation-dependent choices in the BASIC-XER encoding.

NOTE 1 – Any implementation conforming to CANONICAL-XER for encoding is conformant to BASIC-XER for encoding. Any implementation conforming to BASIC-XER for decoding is conformant to CANONICAL-XER for decoding. Thus, encodings made according to CANONICAL-XER are encodings that are permitted by BASIC-XER.

NOTE 2 – CANONICAL-XER produces encodings that have applications when authenticators need to be applied to abstract values.

6.4 If a type encoded with CANONICAL-XER contains **`EMBEDDED PDV`**, **`EXTERNAL`** or **`CHARACTER STRING`** types, then the outer encoding ceases to be canonical unless the encoding used for all the **`EMBEDDED PDV`**, **`EXTERNAL`** and **`CHARACTER STRING`** types is canonical.

7 Conformance

7.1 Dynamic conformance for the Basic XML Encoding Rules is specified by clause 8, and dynamic conformance for the Canonical XML Encoding Rules is specified by clause 9 inclusive.

7.2 Static conformance is specified by those standards which specify the application of one or more of these encoding rules.

7.3 Alternative encodings are permitted by the Basic XML Encoding Rules as an encoder's option. Decoders that claim conformance to XER shall support all alternatives.

7.4 No alternative encodings are permitted by the Canonical XML Encoding Rules for the encoding of an ASN.1 value.

8 Basic XML encoding rules

8.1 Production of a complete XER encoding

8.1.1 A conforming XER encoding is a valid XML document which shall consist of:

a) an XML prolog (which may be empty) as specified in 8.2;

b) an XML document element which is the complete encoding of a value of a single ASN.1 type as specified in 8.3.

8.1.2 The specification in 8.2 to 8.4 completely defines the XER encoding.

NOTE – Other constructs of W3C XML 1.0, such as processing instructions and comments are not allowed by those subclauses, and can never appear in an XER encoding.

8.1.3 The XML document shall be encoded using UTF-8 to produce a string of octets which forms the encoding specified in this Recommendation | International Standard. The ASN.1 object identifier for these encoding rules is specified in clause 10.

8.1.4 Where this Recommendation | International Standard uses the term "white-space", this means one or more of the following characters: HORIZONTAL TABULATION (9), LINE FEED (10), CARRIAGE RETURN (13),