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ISO/IEC
8825-4

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

AMENDMENT 1: EXTENDED-XER

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

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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.

Amendment 1 to International Standard ISO/IEC 8825-4:2002 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 Amendment 1 to ITU-T Rec. X.693.

INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

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

Amendment 1

XER encoding instructions and EXTENDED-XER

NOTE – All new or changed text in this amendment is underlined in clauses being replaced (but not in new clauses). When merging all such text into the base Recommendation, the underlining is to be removed.

Replace the Introduction with the following:

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 the Recommendations | International Standards listed above. 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 ITU-T 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 ITU-T Rec. X.680 | ISO/IEC 8824-1, 30.3) or an XER encoding control section (see ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 50).

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 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.

Replace clause 1 with the following:

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 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 (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 ITU-T Rec. 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.

Replace subclause 2.1 with the following:

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.680 (2002)/Amd.1 (2003) | ISO/IEC 8824-1:2002/Amd.1:2003, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation – Amendment 1: Support for EXTENDED-XER*.

   – 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.681 (2002)/Amd.1 (2003) | ISO/IEC 8824-2:2002/Amd.1:2003, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification – Amendment 1: Support for EXTENDED-XER.*

–   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.690 (2002)/Amd.1 (2003) | ISO/IEC 8825-1:2002/Amd.1:2003, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER) – Amendment 1: Support for EXTENDED-XER.*

–   ITU-T Recommendation X.691 (2002) | ISO/IEC 8825-2:2002, *Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER).*

–   ITU-T Recommendation X.691 (2002)/Amd.1 (2003) | ISO/IEC 8825-2:2002/Amd.1:2003, *Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER) – Amendment 1: Support for EXTENDED-XER.*

–   ITU-T Recommendation X.692 (2002) | ISO/IEC 8825-3:2002, *Information technology – ASN.1 encoding rules: Specification of Encoding Control Notation (ECN).*

Replace subclause 2.2 with the following:

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 10646-1:2000, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Part 1: Architecture and Basic Multilingual Plane.*

–   The Unicode Standard, Version 3.2.0, The Unicode Consortium. (Reading, MA, Addison-Wesley)

> NOTE – The graphics characters (and their encodings) defined by the above reference are identical to those defined by ISO/IEC 10646-1, 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 – 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.

Replace clause 3 with the following:

3   Definitions

For the purposes of this Recommendation | International Standard, the definitions of ITU-T Rec. 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 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.

Insert four new subclauses 3.2.1 bis, 3.2.1 ter, 3.2.1 quat, and 3.2.1 quin as follows:

3.2.1 *bis* 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".

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

3.2.1 *quat* associated following tag: The XML end-tag following the "XMLValue" of a type in the absence of encoding instructions that remove the associated tags.

3.2.1 *quin* associated preceding tag: The XML start-tag preceding the "XMLValue" of a type in the absence of encoding instructions that remove the associated tags.

Insert 16 new subclauses 3.2.2 bis through, 3.2.2 septdec as follows:

3.2.2 *bis* canonical 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 CXER specification for the encoding of an ASN.1 type specified by an ASN.1 schema.

3.2.2 *ter* character-encodable type: An ASN.1 type to which an `ATTRIBUTE` encoding instruction can be applied (see 20.2.1).

3.2.2 *quat* control namespace: A namespace that is used to identify attributes that perform functions or carry values that control an EXTENDED-XER encoding.

> NOTE 1 – An example would be a type identification attribute. The control namespace defaults to the ASN.1 namespace specified in 16.9, but can be changed by the `GLOBAL-DEFAULTS` encoding instruction.

> NOTE 2 – The control namespace may also contain names for attributes that may be present, but which are ignored by EXTENDED-XER decoders (see 10.2.10). An example of such an attribute name could be **schemaLocation**.

3.2.2 *quin* enclosed (ASN.1) type: An ASN.1 type whose "XMLValue" in a BASIC-XER encoding is enclosed directly within the "XMLValue" of an ASN.1 type (the enclosing type).

> NOTE – All types in a BASIC-XER or EXTENDED-XER encoding are enclosed types unless they are used as the root type (see 10.3.1 b) in an encoding.

3.2.2 *sex* enclosing element (of an ASN.1 type): An "ExtendedXMLTypedValue", "ExtendedXMLChoiceValue", "ExtendedXMLNamedValue" or "ExtendedXMLDelimitedItem" that has as its "ExtendedXMLValue" the "ExtendedXMLValue" encoding of the type (see 17.1, 17.5, 17.6 and 17.7).

3.2.2 *sept* enclosing type (of an ASN.1 type): An ASN.1 type whose "XMLValue" in a BASIC-XER encoding directly encloses the "XMLValue" of an ASN.1 type (an enclosed type).

> NOTE – The enclosing type can be a sequence type, a set type, a choice type, a sequence-of type, a set-of type, an open type, or an octetstring or bitstring type (with a `CONTAINING` and without an `ENCODED BY`).

3.2.2 *oct* final encoding instructions (for a type): The set of XER encoding instructions associated with a type as a result of the complete ASN.1 specification, and which are applied in producing encodings of that type.

3.2.2 *non* **inherited encoding instructions**: XER encoding instructions that are associated with the type identified by a type reference.

3.2.2 *dec* **namespace-qualified name**: A name in an XML document that has an XML namespace prefix or is an XML element name in the scope of an XML default namespace declaration.

> NOTE – XML default namespace declarations affect only XML element names, not the names of attributes. A namespace prefix can be applied to either.

3.2.2 *unodec* **nil identification attribute**: An XML attribute that can appear on any element to identify whether the content has a **nil** value (see clause 33).

3.2.2 *duodec* **partial XML element content**: XML child elements defined by an ASN.1 type which is **UNTAGGED**, and which provides part of the XML element content generated by the enclosing type.

> NOTE – If the enclosing type is itself **UNTAGGED**, then that enclosing type may also be generating only partial XML element content.

3.2.2 *tredec* **prefixed encoding instructions**: XER encoding instructions that are assigned using a type prefix.

> NOTE – Prefixed encoding instructions can delete, replace, or add to the associated encoding instructions of a type**.**

3.2.2 *quatdec* **qualifying information**: Information supplied as part of the specification of a target for the assignment of an encoding instruction that identifies specific values of the target type.

3.2.2 *quindec* **targeted encoding instructions**: XER encoding instructions that are assigned using a target list in an XER encoding control section.

> NOTE – Targeted encoding instructions can delete, replace, or add to the associated encoding instructions of a type.

3.2.2 *sexdec* **type identification attribute**: An XML attribute that can appear on any element to identify the type of that element (see clause 37).

3.2.2 *septdec* **Uniform Resource Identifier (URI)**: A globally unambiguous identifier, assigned according to any one of a number of URI schemes, used to provide identification of namespaces in EXTENDED-XER encodings.

> NOTE – The URI scheme used by default for ASN.1 enables an ASN.1 object identifier value to be used to identify namespaces (see 16.9 and 29.1.5).

Replace subclause 3.2.3 with the following:

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 BASIC-XER, CXER or EXTENDED-XER specification for the encoding of an ASN.1 type specified by an ASN.1 schema, possibly including XER encoding instructions.

Insert four new subclauses 3.2.3 bis through 3.2.3 quin as follows:

3.2.3 *bis* **XER encoding instructions**: Encoding instructions that are associated with an ASN.1 type (or with a component of an ASN.1 type) by assignment to that type (or component) in an XER type prefix (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 30.3) or an XER encoding control section (see ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 50).

3.2.3 *ter* **XML attribute**: Part of an EXTENDED-XER encoding consisting of an "XMLValue" enclosed in quotation marks or apostrophes, preceded by an (attribute) name and an equals sign.

3.2.3 *quat* **XML element**: Part of an XML document specified in W3C XML 1.0.

> NOTE – An XML element is either an empty-element tag or starts with a start-tag and ends with an end-tag. Both the start-tag and the empty-element tag can contain attribute encodings.

3.2.3 *quin* **XML element name**: The lexical item following a "<" or "</" lexical item in the associated tags.

Replace subclause 3.2.4 with the following:

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

Insert two new subclauses 3.2.5 and 3.2.6 as follows:

3.2.5 **XML processing instruction**: Part of an XML document which carries information concerning the processing of some or all of that document (see W3C XML 1.0).

> NOTE – The processing instruction identifies the type of processing for which it is applicable, and is ignored in other processing. It could be used to identify a style-sheet that is to be applied if the document is presented for human viewing.

3.2.6 **XML prolog**: The initial part of an XML document (which does not carry information about the value of the ASN.1 type that has been encoded).

Replace clause 4 with the following:

4 Abbreviations

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

ASN.1 Abstract Syntax Notation One

CXER Canonical XML Encoding Rules

PDU Protocol Data Unit

UCS Universal Multiple-Octet Coded Character Set

URI Uniform Resource Identifier

UTC Coordinated Universal Time

UTF-8 UCS Transformation Format, 8-bit form

XER XML Encoding Rules

XML Extensible Markup Language

Replace clause 5 with the following:

5 *This clause was removed by Amendment 1*

Replace subclauses 6.1, 6.2 and 6.3 with the following:

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

– Basic XML Encoding Rules (BASIC-XER);
– Canonical XML Encoding Rules (CXER);
– Extended XML Encoding Rules (EXTENDED-XER).

6.2 The basic set of encoding rules specified in this Recommendation | International Standard is BASIC-XER, which does not in general produce a canonical encoding, and which does not provide any user control over the style of XML which is produced.

6.3 A second set of encoding rules specified in this Recommendation | International Standard is CXER, 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 CXER for encoding is conformant to BASIC-XER for encoding. Any implementation conforming to BASIC-XER for decoding is conformant to CXER for decoding. Thus, encodings made according to CXER are encodings that are permitted by BASIC-XER.

> NOTE 2 – CXER produces encodings that have applications when authenticators need to be applied to abstract values.

Insert a new subclause 6.3 bis as follows:

6.3 *bis* The third set of encoding rules specified in this Recommendation | International Standard is EXTENDED-XER. This is defined as variations of the BASIC-XER encodings specified by XER encoding instructions (see 6 *bis*) associated with an ASN.1 type. In the absence of XER encoding instructions, an EXTENDED-XER encoding differs from a BASIC-XER encoding only because it provides more encoders options.

Replace subclause 6.4 with the following:

6.4 If a type encoded with CXER 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.

Insert a new clause 6 bis as follows:

6 *bis* Encoding instructions specified by this Recommendation | International Standard

6 *bis*.1 This Recommendation | International Standard specifies the syntax and semantics of XER encoding instructions (see clauses 11 to 39). XER encoding instructions only affect EXTENDED-XER encodings.

6 *bis*.2 ASN.1 forms a basic XML schema notation. The ASN.1 schema is used to define the content and structure of data using ASN.1 and the BASIC-XER (and CXER) encoding rules. It can be used without XER encoding instructions.

6 *bis*.3 XER encoding instructions provide wider flexibility in the XML documents that can be specified.

6 *bis*.4 XER encoding instructions are assigned to ASN.1 type definitions or to type references using either or both of XER type prefixes (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 30.3) and an XER encoding control section (see ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 50). If encoding instructions are associated with a type definition, they are carried with the ASN.1 type (through its type reference) into other type definitions and other ASN.1 modules. When EXTENDED-XER encodes a type that has XER encoding instructions associated with some or all of its parts, those final encoding instructions are applied and modify the EXTENDED-XER encodings that are produced.

NOTE – The final encoding instructions are also used when performing validation and/or decoding of an EXTENDED-XER encoding.

Replace subclause 7.1 with the following:

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, and dynamic conformance for the extended XML Encoding Rules is specified by clause 10.

Replace subclause 7.3 with the following:

7.3 Alternative encodings are permitted by the basic XML Encoding Rules and by the extended XML Encoding Rules as an encoder's option. Decoders that claim conformance to BASIC-XER shall support all BASIC-XER encoding alternatives. Decoders that claim conformance to EXTENDED-XER shall support all EXTENDED-XER encoding alternatives.

NOTE – This clause applies whether or not there are any final encoding instructions.

Replace subclause 8.1 and its subclauses with the following:

8.1 Production of a complete BASIC-XER encoding

8.1.1 A conforming BASIC-XER encoding is a valid XML document which shall consist (in order) 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 8.6 completely defines the BASIC-XER encoding

NOTE – Other constructs of W3C XML 1.0, such as XML processing instructions, are not allowed by those subclauses, and are never produced by a conforming BASIC-XER encoder.

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 40.

8.1.4 Where this Recommendation | International Standard uses the term "white-space", this means one or more of the following characters of the Unicode Standard: HORIZONTAL TABULATION (9), LINE FEED (10), CARRIAGE RETURN (13), SPACE (32). The numbers in parentheses are the decimal value of the characters of the Unicode Standard. The number and choice of characters that constitutes "white-space" is an encoder's option.

Insert a new subclause 8.1.5 as follows:

8.1.5 Where this Recommendation | International Standard uses the term "white-space with escapes", this means one or more of the characters listed in 8.1.4, with an encoder's option to represent any of these characters with an escape sequence of the form "&#*n*;" or "&#x*n*;" (see ITU-T Rec. X.680 | ISO/IEC 8824_1, 11.15.8).

Replace subclause 8.3.1 with the following:

8.3.1 The XML document element shall be an "XMLTypedValue" as specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, 15.2, with the changes and restrictions specified in the following subclauses of this clause 8.3.

Insert a new subclause 8.3.3 bis as follows:

8.3.1 *bis* All occurrences of "ExternalTypeReference" within the "XMLTypedValue" shall be replaced by the "typereference" in that "ExternalTypeReference".

Replace subclause 8.3.1 with the following:

8.3.3 Where ITU-T Rec. X.680 | ISO/IEC 8824-1, 11.1.4, 11.11 and 11.13, permits the use of ASN.1 white-space between lexical items or in "xmlbstring" or in "xmlhstring", the characters used shall be restricted to the "white-space" specified in 8.1.4.

Insert a new subclause 8.3.3 bis as follows:

8.3.3 *bis* The "XMLBooleanValue" specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, 17.3, shall only be "EmptyElementBoolean" and the "XMLSequenceOfValue" and "XMLSetOfValue" with a component that is a boolean type shall be "ValueList".

Replace subclause 8.3.4 with the following:

8.3.4 The "XMLIntegerValue" specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, 18.9, shall only be "XMLSignedNumber".

Insert two new subclauses 8.3.4 bis and 8.3.4 ter as follows:

8.3.4 *bis* The "XMLEnumeratedValue" specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, 19.8, shall only be "EmptyElementEnumerated" and the "XMLSequenceOfValue" and "XMLSetOfValue" with a component that is an enumerated type shall be "ValueList".

8.3.4 *ter* The "XMLSpecialRealValue" specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, 20.6, shall only be "EmptyElementReal".

Insert a new subclause 8.5 as follows:

8.5   Encoding of the open type

Both alternatives of "XMLOpenTypeFieldVal" (see ITU-T Rec. X.681 | ISO/IEC 8824-2, 14.6) can be used.

NOTE – The use of the "xmlhstring" alternative of "XMLOpenTypeFieldVal" is not recommended in general, as there are no mechanisms to identify the encoding rules being used to produce the "xmlhstring" in an instance of an encoding. Cases where this alternative may be convenient are when the message being encoded in XER (e.g. for display purposes) is the result of a previous binary encoding and has not been completely decoded, or when there are bilateral agreements.

Insert a new subclause 8.6 as follows:

8.6   Decoding of types with extension markers

8.6.1   A BASIC-XER decoder shall accept as a valid XML document BASIC-XER encodings of types with extension markers in which unknown extensions are present.

8.6.2   Unknown extensions in a sequence or set type result in unexpected XML elements with names distinct from any of the names of the next expected XML element.

NOTE – There may be multiple names for a known following XML element when optionality is present, but the extension additions will always have names that differ from all of these.

8.6.3   Unknown extensions in a choice type result in a single unexpected XML element in place of an element corresponding to one of the known choices. It will always have a different XML element name from that of any XML element that encodes a known alternative of the choice type.

8.6.4   Unknown extensions in an enumerated type result in an XML element with an unexpected content, but with no unexpected XML elements.

8.6.5   Unknown extensions arising from relaxation of a subtype constraint result in an encoding that can be a valid encoding of any value of the unconstrained type. Such encodings can produce unexpected content, but no unexpected XML elements.

Replace subclause 9.1 with the following:

9.1   General rules for canonical <u>XER</u>

Replace subclause 9.1.2 with the following (retaining the NOTE):

9.1.2   All lexical items forming the "XMLTypedValue" shall have no "white-space" between them (see <u>8.3.3</u>).

Replace subclause 9.3.1 with the following:

9.3.1   If the "XMLTypedValue" alternative of "XMLBitStringValue" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 21.9) can be used (as specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, 21.10), then it shall be used. Otherwise, the "xmlbstring" alternative shall be used with all <u>"white-space"</u> removed <u>(see 8.3.3)</u>.

Replace subclause 9.4 with the following:

9.4   Octetstring value

If the "XMLTypedValue" alternative of "XMLOctetStringValue" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 22.3) can be used (as specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, 22.4), then it shall be used. Otherwise, the "xmlhstring" alternative shall be used with all <u>"white-space"</u> removed <u>(see 8.3.3)</u>, and all letters in upper-case.

Replace subclause 9.6.1 with the following:

9.6.1   The set type shall have the elements in its "RootComponentTypeList" sorted into the canonical order specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, 8.6, and additionally for the purposes of determining the order in which components are encoded when one or more component is <u>a</u> choice type <u>with no ASN.1 tag</u>, each <u>such</u> choice type is ordered as though it has a tag equal to that of the smallest tag in the "RootAlternativeTypeList" of that choice type or any <u>such</u> choice types nested within <u>it</u>.

Replace subclause 9.7.1 with the following:

9.7.1   The order of the elements of an "XMLSetOfValue" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 27.3) shall be determined by sorting the character strings which represent the <u>C</u>XER encoding for each element as specified in 9.7.2 and 9.7.3.

Insert a new subclause 9.12 as follows:

9.12   Open type value

The "xmlhstring" alternative of "XMLOpenTypeFieldVal" shall not be used (see 8.5).

Insert the following 30 new clauses 10 through 39 before the existing clause 10 (note that the existing clause 10 is renumbered as clause 40 by this amendment):

10   Extended XML encoding rules

10.1   General

10.1.1   The extended XML encoding rules (EXTENDED-XER) augment and modify BASIC-XER. They enable ASN.1 to define the form and content of a much wider range of XML documents.

10.1.2   EXTENDED-XER extends BASIC-XER in three main ways.

   a)   It provides additional encoder's options (for example, for the insertion of XML Processing Instructions or XML Comment, and for the use of identifiers for named bits in a bitstring value);

   b)   It specifies a set of encoding instructions that can be used to specify modification of the BASIC-XER encoding of an ASN.1 type, including an encoding instruction to use simple text rather than empty-element tags for boolean, integer (with named numbers), enumerated, special values of real, and bitstring (with named bits) types;