INTERNATIONAL STANDARD

ISO/IEC 8825-7

Third edition
2021-06

Information technology — ASN.1 encoding rules —

Part 7: Specification of Octet Encoding Rules (OER)

Technologies de l'information — Règles de codage ASN.1 —
Partie 7: Spécification des règles de codage des octets (OER)

Reference number
ISO/IEC 8825-7:2021(E)

Documents
Document Sharing Hub

© ISO/IEC 2021

Full document details: ISO IEC 08825-7-2021

COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, 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
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO/IEC 2021 – All rights reserved

Documents
Document Sharing Hub

Full document details: ISO IEC 08825-7-2021

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs)

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document 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.696 (02/2021).

This third edition cancels and replaces the second edition (ISO/IEC 8825-7:2015), which has been technically revised. It also incorporates ISO/IEC 8825-7:2015/Cor 2:2017, ISO/IEC 8825-7:2015/Cor 3:2018, ISO/IEC 8825-7:2015/Cor 4:2018.

A list of all parts in the ISO/IEC 8825 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

© ISO/IEC 2021 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO IEC 08825-7-2021

Documents
Document Sharing Hub

Full document details: ISO IEC 08825-7-2021

CONTENTS

Page

1 Scope 1
2 Normative references 1
2.1 Identical Recommendations | International Standards 1
2.2 Additional references 1
3 Definitions 2
3.1 Specification of basic notation 2
3.2 Information object specification 2
3.3 Constraint specification 2
3.4 Parameterization of ASN.1 specification 2
3.5 Basic Encoding Rules (BER) 2
3.6 Packed Encoding Rules (PER) 2
3.7 Additional definitions 2
4 Abbreviations 4
5 Convention 4
6 Encodings specified by this Recommendation | International Standard 4
7 Conformance 5
8 General provisions 5
8.1 Use of the type notation 5
8.2 Constraints 5
8.3 Type and value model used for encoding 7
8.4 Types to be encoded 7
8.5 Production of a complete OER encoding 7
8.6 Length determinant 7
8.7 Encoding of tags 8
9 Encoding of Boolean values 8
10 Encoding of integer values 8
11 Encoding of enumerated values 9
12 Encoding of real values 10
13 Encoding of bitstring values 11
13.1 General 11
13.2 Encoding of bitstring types with a fixed size 11
13.3 Encoding of bitstring types with a variable size 11
14 Encoding of octetstring values 11
15 Encoding of the null value 12
16 Encoding of sequence values 12
17 Encoding of sequence-of values 13
18 Encoding of set values 13
19 Encoding of set-of values 13
20 Encoding of choice values 13
21 Encoding of object identifier values 14
22 Encoding of relative object identifier values 14
23 Encoding of values of the internationalized resource reference type 14
24 Encoding of values of the relative internationalized resource reference type 14
25 Encoding of values of the embedded-pdv type 14
26 Encoding of values of the external type 14
27 Encoding of values of the restricted character string types 15
28 Encoding of values of the unrestricted character string type 15

© ISO/IEC 2021 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO IEC 08825-7-2021

Page

29 Encoding of values of the time types 16
29.1 General 16
29.2 Optimized encoding of time subtypes with the Basic=Date property setting 17
29.3 Optimized encoding of time subtypes with the Basic=Time property setting 18
29.4 Optimized encoding of time subtypes with the Basic=Interval property setting 19
30 Encoding of open type values 20
31 Canonical Octet Encoding Rules 20
32 Object identifier values referencing the encoding rules 21
Annex A – Example of OER encodings 21
A.1 ASN.1 description of the record structure 22
A.2 ASN.1 description of a record value 22
A.3 BASIC-OER and CANONICAL-OER representation of this record value 22
A.3.1 Hexadecimal view 23
A.3.2 Descriptive view 23
Annex B – Interoperability with NTCIP 1102:2004 26
Bibliography 26

© ISO/IEC 2021 – All rights reserved
Documents
Document Sharing Hub
Full document details: ISO IEC 08825-7-2021

Introduction

The publications 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 which have been defined using the notation specified in the above-mentioned publications. 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 are 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 Octet Encoding Rules, so-called because the encoding of every type takes a whole number of octets. Encoding and decoding data with the Octet Encoding Rules is usually faster than encoding and decoding the same data with the Basic Encoding Rules (described in Rec. ITU-T X.690 | ISO/IEC 8825-1) or the Packed Encoding Rules (described in Rec. ITU-T X.691 | ISO/IEC 8825-2).

NOTE – The encoding rules specified in this Recommendation | International Standard derive from the Octet Encoding Rules (OER) published by American Association of State Highway and Transportation Officials (AASHTO), Institute of Transportation Engineers (ITE) and National Electrical Manufacturers Association (NEMA) as NTCIP 1102:2004. In most practical cases, an implementation of this Recommendation | International Standard can interoperate with an implementation of NTCIP 1102.

Clauses 8 to 30 specify the BASIC-OER encoding of ASN.1 types.

Clause 31 specifies the CANONICAL-OER encoding of ASN.1 types.

Annex A is informative and contains examples of BASIC-OER and CANONICAL-OER encodings.

Annex B is informative and addresses the Interoperability of the encoding rules with NTCIP 1102:2004.

© ISO/IEC 2021 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO IEC 08825-7-2021

Documents
Document Sharing Hub

Full document details: ISO IEC 08825-7-2021

INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

Information technology – ASN.1 encoding rules: Specification of Octet Encoding Rules (OER)

1 Scope

This Recommendation | International Standard specifies a set of Basic Octet Encoding Rules (BASIC-OER) that may be used to derive a transfer syntax for values of the types defined in 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. This Recommendation | International Standard also specifies a set of Canonical Octet Encoding Rules (CANONICAL-OER) which provides constraints on the Basic Octet Encoding Rules and produces a unique encoding for any given ASN.1 value. It is implicit in the specification of these encoding rules that they are also to be 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 encoding/decoding speed 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.

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 (2021) | ISO/IEC 8824-1:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.
- Recommendation ITU-T X.681 (2021) | ISO/IEC 8824-2:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification*.
- Recommendation ITU-T X.682 (2021) | ISO/IEC 8824-3:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification.*
- Recommendation ITU-T X.683 (2021) | ISO/IEC 8824-4:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications*.
- Recommendation ITU-T X.690 (2021) | ISO/IEC 8825-1:2021, *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 (2021) | ISO/IEC 8825-2:2021, *Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)*.

NOTE – The references above shall be interpreted as references to the identified Recommendations | International Standards together with all their published amendments and technical corrigenda.

2.2 Additional references

- ISO/IEC 2375:2003, *Information technology – Procedure for registration of escape sequences and coded character sets.*
- *ISO International Register of Coded Character Sets to be Used with Escape Sequences.*
- ISO/IEC 10646:2003, *Information technology – Universal Multiple-Octet Coded Character Set (UCS)*.

© ISO/IEC 2021 – All rights reserved

AVA Documents Document Sharing Hub
Full document details: ISO IEC 08825-7-2021

3 Definitions

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

3.1 Specification of basic notation

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

3.2 Information object specification

For the purposes of this Recommendation | International Standard, all the definitions in Rec. ITU-T X.681 | ISO/IEC 8824-2 apply.

3.3 Constraint specification

This Recommendation | International Standard makes use of the following terms defined in Rec. ITU-T X.682 | ISO/IEC 8824-3:

a) component relation constraint;

b) table constraint.

3.4 Parameterization of ASN.1 specification

This Recommendation | International Standard makes use of the following term defined in Rec. ITU-T X.683 | ISO/IEC 8824-4:

– variable constraint.

3.5 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.

3.6 Packed Encoding Rules (PER)

This Recommendation | International Standard makes use of the following terms defined in Rec. ITU-T X.691 | ISO/IEC 8825-2:

a) canonical encoding;

b) composite type;

c) composite value;

d) known-multiplier character string type;

e) outermost type;

f) relay-safe encoding;

g) simple type;

h) textually dependent.

3.7 Additional definitions

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

© ISO/IEC 2021 – All rights reserved
Documents
Document Sharing Hub
Full document details: ISO IEC 08825-7-2021

3.7.1 abstract syntax value: A value of an abstract syntax (defined as a set of values of a single ASN.1 type) which is to be encoded by BASIC-OER or CANONICAL-OER, or which is generated by BASIC-OER or CANONICAL-OER decoding.

3.7.2 effective value constraint (of an integer type): The smallest integer range that includes all the values of the integer type that are permitted by the OER-visible constraints (see 8.2.7).

3.7.3 effective size constraint (of a string type): The smallest integer range that includes the lengths of all the values of the string type that are permitted by the OER-visible constraints (see 8.2.8).

3.7.4 fixed-size signed number: A word (see 3.7.13) representing a negative, zero or positive whole number encoded as a signed integer encoding (see 3.7.9).

NOTE 1 – The least significant bit of the whole number is stored in bit 1 of the last octet of the word.

NOTE 2 – The range of integers that can be encoded as fixed-size signed numbers is −128 to 127 for a one-octet word, −32768 to 32767 for a two-octet word, −2147483648 to 2147483647 for a four-octet word, and −9223372036854775808 to 9223372036854775807 for an eight-octet word.

3.7.5 fixed-size unsigned number: A word (see 3.7.13) representing a zero or positive whole number encoded as an unsigned integer encoding (see 3.7.10).

NOTE 1 – The least significant bit of the whole number is stored in bit 1 of the last octet of the word.

NOTE 2 – The smallest integer that can be encoded as fixed-size unsigned numbers of any size is 0. The largest integer that can be encoded as a fixed-size unsigned number is 255 for a one-octet word, 65535 for a two-octet word, 4294967295 for a four-octet word, and 18446744073709551615 for an eight-octet word.

3.7.6 length determinant: A group of one or more consecutive octets encoding the length of a series of octets (see 8.6).

3.7.7 octet: A group of eight consecutive bits, numbered from bit 8 (the most significant bit) to bit 1 (the least significant bit).

NOTE – Within an OER encoding, each octet starts at a location that is a whole multiple of eight bits from the first bit of the encoding.

3.7.8 OER-visible constraint: An instance of use of the ASN.1 constraint notation that affects the OER encoding of a value.

3.7.9 signed integer encoding: The encoding of a whole number into a group of consecutive octets of a specified length as a 2's-complement binary integer, which provides representations for whole numbers that are equal to, greater than or less than zero.

NOTE – The value of a signed integer encoding is derived by numbering the bits in the octets of the group, starting with bit 1 of the last octet and ending the numbering with bit 8 of the first octet. Each bit is assigned a numerical value of 2^N, where N is its position (starting from 0) in the above numbering sequence. The value of the signed integer encoding is obtained by summing the numerical values assigned to each bit for those bits which are set to one, excluding bit 8 of the first octet, and then reducing this value by the numerical value assigned to bit 8 of the first octet if that bit is set to one.

3.7.10 unsigned integer encoding: The encoding of a whole number into a group of consecutive octets of a specified length as an unsigned binary integer, which provides representations for whole numbers that are equal to or greater than zero.

NOTE – The value of an unsigned integer encoding is derived by numbering the bits in the octets of the group, starting with bit 1 of the last octet and ending the numbering with bit 8 of the first octet. Each bit is assigned a numerical value of 2^N, where N is its position (starting from 0) in the above numbering sequence. The value of the unsigned integer encoding is obtained by summing the numerical values assigned to each bit for those bits which are set to one.

3.7.11 variable-size signed number: A group of one or more consecutive octets containing a negative, zero, or positive whole number encoded as a signed integer encoding, with the least significant bit of the binary number stored in bit 1 of the last octet of the variable-size signed number.

NOTE – There are no restrictions to the length of such a group of octets. In particular, the Basic Octet Encoding Rules (but not the Canonical Octet Encoding Rules) allow the presence of redundant octets set to 0 (for zero or positive values) or 255 (for negative values) at the beginning of the group.

3.7.12 variable-size unsigned number: A group of one or more consecutive octets containing a zero or positive whole number encoded as an unsigned integer encoding, with the least significant bit of the binary number stored in bit 1 of the last octet of the variable-size unsigned number.

NOTE – There are no restrictions to the length of such a group of octets. In particular, the Basic Octet Encoding Rules (but not the Canonical Octet Encoding Rules) allow the presence of redundant octets set to 0 at the beginning of the group.

3.7.13 word: A group of one, two, four or eight consecutive octets containing the encoding of a whole number, where the first octet contains the most significant part of the number and the last octet contains the least significant part of the number.

© ISO/IEC 2021 – All rights reserved

Documents
Document Sharing Hub
Full document details: ISO IEC 08825-7-2021