
**Information technology —
ASN.1 encoding rules: Registration and
application of PER encoding instructions**

*Technologies de l'information — Règles de codage ASN.1:
Enregistrement et application des instructions de codage PER*

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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 8825-6 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.695 (05/2007).

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*
- *Part 6: Registration and application of PER encoding instructions*

Introduction

ITU-T Rec. X.680 | ISO/IEC 8824-1 makes syntactic provision for the application of encoding instructions to modify the behaviour of a particular set of encoding rules, identified by an encoding reference (see ITU-T Rec. X.680 | ISO/IEC 8824-1).

ITU-T Rec. X.691 | ISO/IEC 8825-2 specifies the BASIC-PER and CANONICAL-PER encoding rules, each with two variants: the ALIGNED variant and the UNALIGNED variant. The PER encoding instructions allow minor variations to be made in parts of the UNALIGNED variant of a BASIC-PER and CANONICAL-PER encoding. They have no effect on the ALIGNED variant of these encodings.

NOTE – The purpose of PER encoding instructions is to ease the task of producing an ASN.1 specification, which when encoded by the UNALIGNED variant of a PER encoding produces bit-patterns that exactly match those of a legacy protocol. It is unusual for the ALIGNED variant to be used for this purpose, and so for simplicity all PER encoding instructions have no effect on the ALIGNED variant.

This Recommendation | International Standard specifies the use of type prefixes and encoding control sections (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 30.3 and clause 50) to associate one or more PER encoding instructions with an ASN.1 type. Where an encoding instruction is associated with an ASN.1 type, specific clauses in ITU-T Rec. X.691 | ISO/IEC 8825-2 are amended according to the specification of the encoding instruction. These mechanisms are similar to those for the application of XER encoding instructions specified in ITU-T Rec. X.693 | ISO/IEC 8825-4.

This Recommendation | International Standard also specifies the procedures for the operation of a Registration Authority to receive, record and publish the specification of PER encoding instructions that are agreed from time to time. The Registration Authority is the ITU Telecommunication Standardization Bureau, and the form of publication is an Implementors' Guide for ASN.1. This Guide will be available freely on the ITU-T web-site.

This Recommendation | International Standard also specifies the procedures to be used for the approval of new PER encoding instructions. Broadly, these procedures involve the prior publication in the Implementors' Guide of a proposed new encoding instruction, with a later publication announcing that the new encoding instruction has been approved by a simple resolution of the relevant Study Group of ITU-T and the relevant Sub-Committee of ISO/IEC JTC 1.

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Clauses 6 to 9 specify the operation of the Registration Authority for PER encoding instructions.

Clauses 10 to 13 specify the application of PER encoding instructions to an ASN.1 specification.

Annex A is informative and contains an example of the application of PER encoding instructions using encoding prefixes.

Annex B is informative and contains an example of the application of the same PER encoding instructions using an encoding control section.

Annex C is informative and summarizes the productions defined in this Recommendation | International Standard.

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**INTERNATIONAL STANDARD
ITU-T RECOMMENDATION**

**Information technology – ASN.1 encoding rules: Registration
and application of PER encoding instructions**

1 Scope

This Recommendation | International Standard:

- a) specifies the information needed and the format to be used for specifying PER encoding instructions;
- b) specifies the mechanisms for approving new PER encoding instructions from time to time and the operation of the Registration Authority for PER encoding instructions;
- c) specifies the means of associating a PER encoding instruction with an ASN.1 type using both type prefixes and an encoding control section.

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.

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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.1:2004, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation – 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)*.

3 Definitions

For the purposes of this Recommendation | International Standard, the definitions of ITU-T Rec. X.680 | ISO/IEC 8824-1 and of ITU-T Rec. X.680/Amd.1 | ISO/IEC 8824-1/Amd. 1 apply. The following additional definitions apply.

- 3.1 associated encoding instructions (for a type):** A set of PER encoding instructions associated with a type.
- 3.2 final encoding instructions (for a type):** The set of PER 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.
- 3.3 identifying keyword:** A word or hyphenated word that identifies a PER encoding instruction.
- 3.4 inherited encoding instructions:** PER encoding instructions that are associated with the type identified by a type reference.
- 3.5 Joint ITU-T | ISO/IEC JTC 1 Collaborative Team for ASN.1:** A group established in accordance with ITU-T Rec. A.23, Annex A and ISO/IEC JTC 1 Directives Edition 5 Version 2.0, subclause 2.6.4 and Annex K, clause 8 to progress work on Joint Text in relation to Abstract Syntax Notation One (ASN.1).

3.6 PER encoding instructions (PER EIs): Notation used to change the unaligned PER encoding of a type (or of a component of a type).

NOTE – PER encoding instructions are included in either a PER type prefix (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 30.3) or a PER encoding control section (see ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 50).

3.7 PER EI proposal: A proposal for a new PER encoding instruction that is progressing to either the **REJECTED** or the **APPROVED** state.

3.8 PER EI change proposal: A proposal for deletion of or change to an **APPROVED** PER encoding instruction that is progressing to either the **REJECTED** or the **APPROVED** state.

NOTE – PER EI change proposals are expected to be rare occurrences, and due consideration will be needed to backwards compatibility considerations.

3.9 prefixed encoding instructions: PER encoding instructions that are assigned using a type prefix (see Annex A and ITU-T Rec. X.680 | ISO/IEC 8824-1, 30.3).

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

3.10 relevant Study Group: The ITU-T Study Group that is responsible for the Joint ITU-T | ISO/IEC JTC 1 Collaborative Team for ASN.1.

3.11 relevant Sub-Committee: The ISO/IEC JTC 1 Sub-Committee that is responsible for the Joint ITU-T | ISO/IEC JTC 1 Collaborative Team for ASN.1.

3.12 targeted encoding instructions: PER encoding instructions that are assigned using a target list in a PER encoding control section (see Annex B and ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 50).

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

4 Abbreviations

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

ASN.1	Abstract Syntax Notation One
ECN	Encoding Control Notation
EI	Encoding Instruction
PER	Packed Encoding Rules

5 Notation

5.1 This Recommendation | International Standard references and uses the notation defined by ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 5 for the specification of the syntax of PER encoding instructions via a set of productions.

5.2 All lexical items used in these productions are defined in ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 11.

5.3 In accordance with ITU-T Rec. X.680 | ISO/IEC 8824-1, 30.3.2, this Recommendation | International Standard specifies the "EncodingInstruction" production (see 11.2).

NOTE – The "[" and "]" " lexical items never appear in an "EncodingInstruction" production.

5.4 In accordance with ITU-T Rec. X.680 | ISO/IEC 8824-1, 50.4, this Recommendation | International Standard specifies the "EncodingInstructionAssignmentList" production (see 12.1.2).

NOTE – The **END** and **ENCODING-CONTROL** lexical items never appear in the "EncodingInstructionAssignmentList" production.

6 Information to be provided to specify a PER encoding instruction

6.1 The specification of a PER encoding instruction shall consist of the following information:

- a short informative title (such as "Use and size of a length field");
- the value for the identifying keyword, which shall be distinct from that used for any earlier PER EI;
- an illustration of the syntax of the EI, enclosed in square brackets ("[" and "]");
- a simple description of the EI and its purpose;
- a full specification of the types to which this EI applies and its effect in each case;
- a complete specification of an "EIDetail" production (see 11.4), with the semantics associated with each element;

- g) either:
- 1) an amendment to specific text in ITU-T Rec. X.691 | ISO/IEC 8825-2 that shall be applied to the encoding of any type to which the EI is applicable (see d) above) and that has this EI in its set of final encoding instructions; or
NOTE 1 – If the EI is not applicable to the type, then the amendment is not applied in the encoding of that type.
 - 2) an ECN specification of the effects of the encoding instruction; or
 - 3) any other clear and implementable statement of the effects of the EI;
 - 4) any combination of 1) to 3).
NOTE 2 – While option 3) is clearly desirable, it may be necessary to progress with options 1) or 4) and add the others later so as not to delay approval of the EI.
NOTE 3 – The choice of options 1) to 4) has to be determined by whether the specification is sufficiently clear and precise to enable interworking implementations of encoders and decoders to be produced.
- h) a statement that the clauses or subclauses of ITU-T Rec. X.691 | ISO/IEC 8825-2 that are being amended are disjoint from those amended by any previously approved encoding instruction that has an overlapping list of types to which they can be applied.

7 Status of a PER EI proposal during the approval process

7.1 A PER EI proposal can be in one of the following categories:

- **Considered but rejected (REJECTED):** There has been some (documented) discussion, but this PER EI proposal is unlikely to be progressed at this time.
- **Suggested as possibly useful (POSSIBLE):** The PER EI proposal is pending further discussion.
- **Under active development (NEEDED):** There is agreement that a PER EI performing this function is needed, but the precise specification has still to be developed. Work is in progress to refine the specification of this PER EI.
- **Conditionally approved (READY):** The full specification is available and ready for implementation. It has been approved by either the relevant Study Group or by the relevant Sub-Committee by a Resolution at a Plenary meeting.
- **Approved (APPROVED):** The full specification of the PER EI has been published in the READY state for at least six months, and has been approved by both the relevant Study Group and the relevant Sub-Committee by Resolutions at Plenary meetings.

NOTE – PER EI proposals in the **NEEDED**, **READY** and **APPROVED** categories are published by the Registration Authority (see clause 9). **REJECTED** and **POSSIBLE** PER EI proposals are recorded by the Joint ITU-T | ISO/IEC JTC 1 Collaborative Team for ASN.1 in standing documents.

7.2 A PER EI proposal will normally progress from an initial proposal into either the **REJECTED** or **POSSIBLE** or **NEEDED** category, and then to the **READY** and later to the **APPROVED** category. However, at any stage prior to moving to the **APPROVED** category, it can be moved to the **REJECTED** category.

NOTE – This will typically occur if problems are found with its implementation.

7.3 Once a PER EI proposal is in the **APPROVED** category (the PER EI is approved), it shall only be changed or removed by a PER EI change proposal that shall move through all the above stages with the same approval processes (specified in clause 8) before it results in the removal or modification of an **APPROVED** PER EI.

8 Approval process

8.1 Any member of the relevant Study Group and any member of the relevant Sub-Committee can generate a new PER EI proposal by submitting at least the information in 6.1 a) to d) in the format of Annex A. Additional free-form text with suggestions for e) to g) may also be included, and submitters of new EIs are encouraged to provide the full information required for 6.1.

8.2 Discussion of the proposal shall take place at the next available main or interim meeting of either the relevant Study Group or the relevant Sub-Committee. The proposal shall, after discussion, be placed in the category:

- a) **REJECTED:** minutes of the meeting shall record the reasons for the rejection; or
- b) **POSSIBLE:** details of the PER EI proposal shall be listed in a Standing Document of the Joint ITU-T | ISO/IEC JTC 1 Collaborative Team for ASN.1, recording proposed PER EIs, with the dates it was proposed, considered and details of the proposer and any relevant discussion; or

- c) **NEEDED**: details of the PER EI proposal shall be published (see clause 9).

8.3 A PER EI proposal shall progress to the **NEEDED** category from any interim or main meeting of the relevant Study Group or the relevant Sub-Committee if and only if those present at the meeting agree unanimously and there is text available for the public announcement, with the information required for 6.1 a) to f) approved by the meeting. Details of the PER EI shall be published.

NOTE – This information is sufficient for syntax tools to be produced, and for users to include the PER EI in their draft specifications.

8.4 A PER EI proposal shall progress to the **READY** category from any main meeting of the relevant Study Group or the relevant Sub-Committee if and only if there is a formal Resolution at that meeting, based on availability and review of complete text for all of 6.1 a) to h), that the PER EI proposal is approved by that relevant Sub-Committee or relevant Study Group. The revised details of the EI shall be published.

8.5 A PER EI proposal shall progress to the **APPROVED** status if and only if the following conditions are satisfied:

- a) the PER EI proposal has been in the **READY** category for at least six months;
- b) both the relevant Study Group and the relevant Sub-Committee have passed a formal Resolution at a Plenary meeting that they approve the PER EI.

9 Publication by the Registration Authority

9.1 All Registration and publication shall be via a Web page on a web-site of the relevant Study Group maintained by the ITU Telecommunication Standardization Bureau that acts as the formal Registration Authority. The new contents of this page shall be provided by the Joint ITU-T | ISO/IEC JTC 1 Collaborative Team for ASN.1 when the status of a PER EI proposal changes (see clause 8 for when such changes can occur).

NOTE 1 – The Web page at the time of publication can be located via the URL <http://www.itu.int/ITU-T/studygroups/com17>, under the heading "Registration Assignment", title "ASN.1 PER EIs".

NOTE 2 – Should these pages be moved, their new location can be obtained by an e-mail addressed to tsbmail@itu.int, asking to be put in contact with the ITU-T Rapporteur responsible for the maintenance of ITU-T Rec. X.695 | ISO/IEC 8825-6.

9.2 All PER EI proposals in the **NEEDED**, **READY** or **APPROVED** stage shall be published.

9.3 All PER EI change proposals in the **NEEDED** or **READY** stage shall be published.

9.4 A PER EI change proposal that moves to the **APPROVED** stage shall result in an archive record of the previous PER EI and an appropriate change to the modified PER EI, with an explanation of any backwards compatibility considerations.

10 Restrictions on the use of PER Encoding Instructions

10.1 The application of PER EIs can prevent some abstract values of the type from being encoded by PER. Depending on the intended application, this may or may not matter. It may be considered desirable, however, to additionally provide an explicit constraint on the type to ensure that all allowed values can be encoded by all encoding rules.

10.2 Where a PER EI implicitly forbids the encoding of some abstract values, the specification of the EI shall state that use of this EI restricts the abstract values that can be encoded.

EXAMPLE 1: Application of a PER EI to terminate an ASCII string with a NULL terminating character cannot be encoded by PER if the string contains a NULL character. The designer may choose to apply a normal constraint to restrict the string to non-NULL characters.

NOTE – This makes the specification more verbose, and arguably less clear, but ensures that relaying between different encoding rules is possible.

EXAMPLE 2: Application of a PER EI to use a 16-bit field for the encoding of an INTEGER cannot be encoded by PER if the INTEGER is too large, and adding a constraint to a range that can be encoded in a 16-bit field should be considered.

10.3 A PER EI shall not be applied to a type that is extensible for PER encoding (see ITU-T Rec. X.691 | ISO/IEC 8825-2, 3.6.11)

NOTE – This applies to the type itself. Extensibility of a component does not restrict the application of PER EIs to other components or to the type itself.

11 Assigning a PER EI to an ASN.1 type using a type prefix

11.1 PER encoding instructions can be assigned to (or removed from) ASN.1 types (using either of the "EncodingInstruction" production alternatives) in a PER type prefix.

NOTE – The effect of multiple assignments of encoding instructions is specified in clause 13.

11.2 The PER "EncodingInstruction" production is:

```
EncodingInstruction ::=
    PositiveInstruction
    | NegatingInstruction
```

```
PositiveInstruction ::=
    IdentifyingKeyword
    EIDetail
```

```
NegatingInstruction ::=
    NOT PositiveInstruction
```

```
IdentifyingKeyword ::= encodingreference
```

11.3 The "IdentifyingKeyword" has the same syntax as an "encodingreference" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 11.20 *bis*), but has different semantics. Its value shall be determined for each PER EI, and shall be unambiguous within the set of all PER EIs. Its purpose is to identify a particular PER EI.

11.4 The "EIDetail" production shall be specified for each EI (see 6.1), and shall not contain the "[" and "]" lexical items.

11.5 An encoding instruction in a type prefix (or in an encoding control section – see 12.1.5) can be a positive instruction, used to add or to replace an encoding instruction (use of "PositiveInstruction"), or a negating instruction used to cancel one or more associated encoding instructions (use of "NegatingInstruction").

11.6 If the "Type" in a "TypeAssignment" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, 15.1) has final encoding instructions, all uses of the corresponding "type-reference" (in the module containing the "TypeAssignment" or in some other module) inherit its final encoding instructions.

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12 Assigning a PER encoding instruction using an encoding control section

12.1 The encoding instruction assignment list

12.1.1 PER encoding instructions can also be assigned to ASN.1 types in a PER encoding control section using the "EncodingInstructionAssignmentList" production.

12.1.2 The PER "EncodingInstructionAssignmentList" production is:

```
EncodingInstructionAssignmentList ::=
    TargettedEncodingInstruction
    EncodingInstructionAssignmentList ?
```

```
TargettedEncodingInstruction ::=
    "[" EncodingInstruction "]"
    TargetList
```

12.1.3 The "EncodingInstruction" production is defined in 11.2.

12.1.4 Each use of an "EncodingInstruction" in an encoding control section assigns that PER encoding instruction to the occurrences of "Type" that are identified in the "TargetList" of the "TargettedEncodingInstruction". The "TargetList" production and the targets it identifies are specified in 12.2.

12.1.5 Subclauses 11.5 and 11.6 also apply to encoding instructions in an encoding control section.

12.2 Identification of the targets for a PER encoding instruction using a target list

12.2.1 General rules

12.2.1.1 All targets are an occurrence of the "Type" production within the ASN.1 module.

NOTE – Multiple targets, in the same or in different ASN.1 type assignments, can be specified. A target that is the entire module, or all occurrences within the module of a built-in type or constructor can also be specified. Thus (using a PER encoding control