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**Intelligent transport systems —  
Reference model architecture(s) for  
the ITS sector —**

**Part 6:  
Use of ASN.1**

*Systèmes intelligents de transport (ITS) — Architecture(s) de modèle  
de référence pour le secteur ITS —*

*Partie 6: Présentation de données dans ASN.1*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 ISO documents 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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO 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](http://www.iso.org/patents)).

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

For an explanation on 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 the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This second edition cancels and replaces the first edition (ISO 14813-6:2009), which has been technically revised.

The main changes compared to the previous edition are as follows:

- The requirement to use the aligned variant of the PER ASN.1 encoding rules is relaxed; any set of ASN.1 encoding is now allowed;
- All new messages are now required to include a version number within its structure;
- Additional rules are defined to create unambiguous references to entries within the CIDCR;
- ASN.1 comments are now only allowed for informative text;
- OID assignments are now consistent with the rules defined in ISO 14817-3.

A list of all the parts in the ISO 14813 series, can be found on the ISO website.

## Introduction

This document is part of a series of international standards that provides a form and structure to the reference architectures for intelligent transport systems (ITS). Specifically, this document defines the consistent use of abstract syntax notation one (ASN.1) [ISO/IEC 8824 (all parts)] within ITS International Standards.

The previous versions of this document reflected the best practices at the time that they were written. This revised document clarifies and updates its predecessors by reflecting the current best practices.

ITS International Standards and systems are not required to use ASN.1 as their only means of encoding and transfer. In cases, other methods will be used because of industry practices or efficiency in certain situations. However, ITS International Standards and data concept specifications are required to a) elaborate their data in a consistent form using ASN.1 to promote interoperability and reuse; and b) where ASN.1 is the chosen encoding method, define specific encoding rules based on the ISO/IEC 8825 series of standards.

ASN.1 and its encoding rules provide a means of achieving interoperability of otherwise incompatible data. Within an ASN.1 data stream there may be a requirement to embed information that uses other notations or encoding rules. To achieve this, levels of identification are required to precede certain data elements, to enable the comprehension of data messages.

Users of this document should also be aware that data concepts defined in ITS International Standards should also be fully documented per the rules of the ISO 14817 series of standards.

### ASN.1 syntax

As stated in its defining document (ISO/IEC 8824-1), abstract syntax notation one (ASN.1) is a standard notation used for the formal definition of data types, values, and constraints on data types. An important feature of ASN.1 is its ability to enable separation of the specification of the message content, e.g. data structures, from the specification of the encoding of messages, e.g. BER, DER, PER, OER, XER, XML.

ASN.1 provides the following advantages by separating the structure definition from the encoding rules:

- Easy mapping to different syntaxes, including mapping to programming language data structures for easy implementation and mapping to compact binary forms for both security and bandwidth purposes.
- Provision of tools for validation of message syntax and processing of message content, including application-independent encode/decode libraries.
- Automatic generation of test suites.
- Checking for completion and validity.

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# Intelligent transport systems — Reference model architecture(s) for the ITS sector —

## Part 6: Use of ASN.1

### 1 Scope

This document provides a formal means to achieve consistency in the use of ASN.1 when specifying data types that are to be used in ITS International Standards. This is designed to ensure unambiguous and interoperable data exchange while providing consistent documentation of these exchanges. This document provides the necessary specifications to ensure consistent interpretation by providing formal references to several standards and in some cases specifying additional rules to promote greater consistency among standards.

This document does not require the use of ASN.1 for anything other than providing data type definitions in a common and flexible form. This document makes specific provision for the support of:

- Embedding other extant standardised encoding formats, e.g. jpg, while maintaining interoperability and reuse within ITS;
- Allowing alternative representations of data type definitions, e.g. XML schema;
- Allowing alternative encoding of defined data.

The rules presented in this document enable data types to be recorded in a common ITS data registry, and in ITS International Standards, in a common and consistent form.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 8824 (all parts), *Information technology — Abstract Syntax Notation One (ASN.1)*

ISO/IEC 8825 (all parts), *Information technology — ASN.1 Encoding Rules*

ISO 14817-1, *Intelligent transport systems — ITS central data dictionaries — Part 1: Requirements for ITS data definitions*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### ASN.1 module

module that conforms to ISO/IEC 8824-1:2015

### 3.2

#### **ASN.1 data type**

name of a lexical ASN.1 item, typereference, as defined in ISO/IEC 8824-1:2015, 12.2

EXAMPLE     MyType

### 3.3

#### **ASN.1 data type definition**

TypeAssignment declaration, as defined in ISO/IEC 8824-1:2015, 16.1

EXAMPLE     MyType ::= INTEGER

### 3.4

#### **aggregate domain**

data concept representing a specific syntactic grouping of data elements and/or data frames

### 3.5

#### **custom extension**

customization of a standardised structure to support local, regional, and/or proprietary information

### 3.6

#### **data concept**

abstract entity that generalizes characteristics of interest about information systems and which can be specified using a structured format composed of a set of meta-attributes

Note 1 to entry: ISO 14817-1 defines a structured format for specifying several types of data concepts. The minimum required meta-attributes include a name, a definition, an object identifier, and a data concept type.

Note 2 to entry: Information systems frequently need to exchange messages. The atomic unit of a message is called a data element. A data element is a single property of an object class expressed using a specific (atomic) representation called a value domain. The concepts of "message", "data element", "object class", "property", and "value domain" (among others) are data concepts.

### 3.7

#### **data element**

data concept representing a single property about an object class and which is represented using a specific and atomic value domain, i.e. a representational form that uses a basic ASN.1 data type

### 3.8

#### **data frame**

data concept represented by a specific aggregate domain and that describes information of interest through a useful grouping of more atomic properties about one or more object classes

[SOURCE: ISO 14817-1:2015, 4.18]

### 3.9

#### **data type**

domain of values

Note 1 to entry: This is synonymous with the term "type", as defined in ISO/IEC 8824-1:2015.

### 3.10

#### **data unit**

data structure that is a logical unit of interchange between peer entities

### 3.11

#### **ITS data concept**

any data concept specified or referenced by an ITS International Standard or otherwise managed or stored in the CIDCR

Note 1 to entry: Data concepts are often specified for data exchange, but may also be specified for encoding and local storage, encoding followed by encrypting or hashing, or other purposes.

**3.12****ITS International Standard**

any standard developed by ISO/TC 204

**3.13****message**

data concept that is a grouping of data elements, data frames, or data elements and data frames that is used to convey a complete set of information

[SOURCE: ISO 14817-1:2015, 4.35, modified – the Note 1 to entry is deleted.]

**3.14****MIB**

Module that conforms to IETF RFC 2578

**3.15****module**

data concept that contains the formal syntactic definition, and optionally the semantic definition, of a defined set of other data concepts that are all version-controlled as a single unit; a module can be represented in multiple languages (e.g., ASN.1 or XML Schema) and compiled by computer systems

[SOURCE: ISO 14817-1:2015, 4.40]

**3.16****module identifier**

instance of an object identifier data type used to identify a module

Note 1 to entry: In ISO/IEC 8824-1 a module identifier is defined as:

ModuleIdentifier::=

Modulereference

DefinitiveIdentifier

If the "DefinitiveIdentifier" is not empty, the denoted object identifier value unambiguously and uniquely identifies the module being defined.

**3.17****non-ASN.1 data type**

data type definition that does not conform to ISO/IEC 8824 (all parts)

**3.18****object class**

data concept representing a set of objects that share the same properties, relationships, and semantics

**3.19****object identifier**

ordered list of primary integer values from the root of the international object identifier tree to a node, which unambiguously identifies that node

[SOURCE: ISO/IEC 9834-1:2012, 3.5.11]

**3.20****value domain**

data concept representing a defined data type

## 4 Abbreviated terms

ASN.1	Abstract Syntax Notation.1
CIDCR	Central ITS Data Concept Registry
ITS	Intelligent Transport Systems
MIB	Management Information Base
SNMP	Simple Network Management Protocol
TC	Technical Committee
XML	eXtensible Markup Language

## 5 Requirements

### 5.1 General requirements

#### 5.1.1 Use of ASN.1 is mandatory

Data may be organised and presented in many forms in ITS standards but in order to achieve consistency and interoperability, wherever data is defined in an ITS standard, its syntax shall be provided in Abstract Syntax Notation.1 (ASN.1) data type as detailed in this document. Other formats, e.g. XML, may additionally be presented where industry practice commonly use such forms.

ITS application standards may specify the use of data transfer in forms other than ASN.1, but an ASN.1 definition of the data shall always be provided in order that it may be registered unambiguously in a Central ITS Data Concept Registry (CIDCR).

This document specifies how this ASN.1 definition is provided.

#### 5.1.2 Consistency with the CIDCR

Every data type specified within an ITS International Standard should have a corresponding data concept definition according to ISO 14817-1. Each data concept definition should be provided to the CIDCR. Every data concept provided to the CIDCR shall conform to ISO 14817-1. The name used in the ASN.1 of the ITS International Standard should match the ASN.1 name in the CIDCR. The data type used in the ITS International Standard shall be consistent with the data type of the corresponding entry in the CIDCR.

NOTE 1 See [Annex B](#) for examples of how to document data concepts in a standard. The tabular format allows for the easy translation to/from the \*.csv file format that can be easily imported to/exported from the CIDCR.

NOTE 2 ISO/TC 204 has recognized the importance of a central repository of all ITS-related data concepts through several resolutions dating back to 1997. This registry is intended to promote harmonisation among ITS standardisation efforts within and beyond ISO/TC 204. The CIDCR is the realization of this effort and every ITS data concept in an ITS standards publication, specified according to the ISO 14817 series of standards, is intended to be included in the CIDCR.

NOTE 3 The ISO 14817 series of standards identifies the following ASN.1-related meta-attributes for ITS data concepts:

- ASN.1 Name
- ASN.1 Object Identifier
- Data type

### 5.1.3 Limited use of OCTET STRING

Within ASN.1, OCTET STRINGS may be used to embed binary encoded information into a larger structure. In order to simplify implementations and improve interoperability, the OCTET STRING data type shall be avoided whenever practical. Nonetheless, an OCTET STRING may be used to:

- Decouple the encoding/decoding of layered information in electronic communications;
- Embed information that is typically exchanged in non-ASN.1 formats, such as jpeg;
- Embed encrypted information, but where possible the information before encryption should be defined in ASN.1;
- Embed fields that are best represented as binary strings as they may contain any sequence of binary values (e.g. security data, such as a hash of a password);
- Embed an ASN.1 structure that uses a different set of encoding rules than the parent structure, (e.g. this might be desirable to minimise the size of a message);
- Embed information in other formats in order to obtain interoperability with extant ITS or other (non-ITS) systems, standards, or practices.

### 5.1.4 ASN.1 historical name

A module may replace the ASN.1 name of a data concept with one of the recorded ASN.1 historic names of the data concept when appropriate to maintain consistency with other standards. However, all ITS International Standards should eventually migrate to the formal ASN.1 name for all data concepts.

## 5.2 Encoding rules

ITS International Standards shall define the encoding of messages by specifying one of the encoding rules defined within ISO/IEC 8825 (all parts). Components of a message shall follow the same encoding rules as its immediate parent structure, unless otherwise specified and embedded as an OCTET STRING.

NOTE The same data concept may be represented using different ISO/IEC 8825 encoding rules in different contexts. The abstract design of ASN.1 data types allows for the translation among different encoding rules.

## 5.3 Module definitions

### 5.3.1 General requirements

#### 5.3.1.1 Use of modules

Each ITS International Standard shall define the syntax for its data concepts in one or more modules. The modules shall be presented as either an ASN.1 module or an MIB. Other module formats (e.g. XML) may also be presented.

NOTE 1 The MIB format is used by the SNMP community and was based on an early version of ASN.1. MIB definitions are based on the ASN.1 MACRO which is deprecated and cannot be mixed in the same module with the latest versions of ASN.1.

NOTE 2 The preferred location for this information is in Annex A of the standard.

#### 5.3.1.2 Standards to reference an electronic form of module

Every module presented in an ITS International Standard shall be complemented with or substituted by an unequivocal reference to the normative electronic form of the module and a cryptographic hash digest of the module that can be used to verify its integrity.

### 5.3.1.3 Electronic form is normative

The official electronic form of the module that corresponds to the hash contained in the standard itself shall be the normative definition of the module.

NOTE Modules are defined for computer processing. While there are benefits in including a copy of each module in the published standard, implementations typically rely upon the electronic version; therefore the electronic version is considered the normative copy.

### 5.3.2 Conformance

Every ASN.1 module shall conform to ISO/IEC 8824 (all parts).

### 5.3.3 Name

The `moduleName` component of the ASN.1 module shall be the ASN.1 name of the module data concept and shall follow the naming rules defined in ISO 14817-1.

NOTE Among other things, this means the module name will include the major version number of the module and will ensure that any non-backwards compatible change will force a new version of the module while maintaining identical version numbers for revisions that do not entail changes that affect backwards compatibility.

### 5.3.4 Identification

#### 5.3.4.1 Definitive OID

The `DefinitiveIdentification` component of the ASN.1 module shall include a `DefinitiveOID` that corresponds to the ASN.1 Object Identifier assigned to the module.

#### 5.3.4.2 Prohibition on NameForm

The `DefinitiveOID` shall not contain any `DefinitiveObjIdComponents` using the `NameForm` format.

NOTE In other words, all modules will be assigned an `OBJECT IDENTIFIER` where all nodes include the number of the node rather than just a node name.

#### 5.3.4.3 Location on OID tree

The `OBJECT IDENTIFIER` assigned to the ASN.1 module shall commence with the ISO standard number in the form:

{ iso(1) standard(0) xxxxx yyy }

where:

“xxxxx” is the number of the ISO standard defining the ASN.1 module;

“yyy” is a series of one or more sub-arcs that provide a unique identifier for the module. At a minimum, this should include a version number. If the standard has multiple parts, it should also indicate the part number. If the standard has multiple modules within the part, it should identify each uniquely.

### 5.3.5 Tag default

The `TagDefault` component of the ASN.1 module shall be “AUTOMATIC TAGS”.

NOTE This increases readability of the ASN.1 data type definitions and eliminates the possibility of certain types of errors.

### 5.3.6 Version and revision

Prior to the `ModuleDefinition` or as the first item within the `ModuleBody`, a comment shall be provided that identifies the precise version and revision of the ASN.1 module. If the module is recorded in the CIDCR, the version number and revision shall be consistent with what is recorded in the CIDCR.

EXAMPLE     -- Version 1.2

NOTE        This may be omitted in early drafts of an International Standard.

## 5.4 Data type assignments

### 5.4.1 General

Each message, data frame, aggregate domain, data element, and value domain introduced in an ITS International Standard shall be defined in an ASN.1 `TypeAssignment` that equates the ASN.1 name of the data concept to its corresponding data type.

EXAMPLE     VehicleInformation ::= SEQUENCE { vin INTEGER, registration INTEGER }

### 5.4.2 Message versioning

#### 5.4.2.1 Versioning of new messages

All new messages shall include a version component near the start of every instance of its ASN.1 structure.

EXAMPLE

```
MyMessage ::= SEQUENCE {
  version      MyMessage-version, -- e.g., an INTEGER
  ...
}
```

NOTE 1     If the message is a CHOICE structure, this requirement can be met by either embedding the CHOICE into a wrapping SEQUENCE structure or ensuring that each alternative within the CHOICE is a SEQUENCE that includes a version component.

NOTE 2     A specific version field within each message enables for better backwards compatibility and minimizes the potential for older systems to experience unintended problems due to receiving unexpected data, i.e. the older system can immediately recognize the message as unsupported and discard the remainder of the content.

#### 5.4.2.2 Incrementing message versions

If a message with a previously defined version component and extension marker is updated by only adding an extension, the version number shall not be changed.

Any other change to a message with a previously defined version component that does not impact the encoding of the ASN.1 structure prior to the version field shall only require an increase in the number assigned to the version field of the message; the message should retain the same name and identifier.

#### 5.4.2.3 Replacing messages

Any normative change to an ASN.1 message that is not covered by [5.4.2.2](#) shall require the development of a new message with a new name and identifier that prevents conflict with the older version of the message. The new message shall conform to [5.4.2.1](#).

**5.4.3 Contents of message or aggregate domain**

Every component, i.e. `NamedType`, within a message or aggregate domain shall reference a defined data frame or a data element rather than a basic ASN.1 type.

**5.4.4 Reference style in NamedTypes**

The reference to the data frame or data element in a `NamedType` shall be the ASN.1 name of the referenced data frame or data element. An ASN.1 comment may be provided after the reference to provide the resolved data type.

EXAMPLE 1 An example CHOICE statement:

```
MyVehicleIdentifier ::= CHOICE {
  universal      Vehicle-vin,                -- VisibleString (SIZE (17))
  myIdentifier   VehicleMyCustomization-id, -- VisibleString (SIZE (5.20))
  ...
}
```

EXAMPLE 2 An example SEQUENCE statement:

```
MyVehicleMotion ::= SEQUENCE {
  vehicle      VehicleMyCustomization-identifier, -- MyVehicleIdentifier
  location     Vehicle-position2D,                -- GeoLocation2D
  speed       Vehicle-speed OPTIONAL,            -- INTEGER (0..8191)
  ...
}
```

Every referenced data frame and data element shall be defined in its own `TypeAssignment`, either within the module or through an import statement.

**5.4.5 Comments**

All comments contained in a module shall be interpreted as informative text.

NOTE ASN.1 comments may be used to remind the reader of information contained elsewhere in a normative form.

EXAMPLE:

```
speed Vehicle-speed, -- INTEGER (0..8191) in units of 0.02 m/s.
```

**5.4.6 Version Control of data types**

**5.4.6.1 Extension markers**

**5.4.6.1.1 Include extension markers**

Extension markers ("...") should be used in all locations where they are permitted, if it is reasonable to believe that a future version of the standard may need to extend the data type and the inclusion of the extension does not cause unacceptable inefficiencies.

NOTE 1 Many SEQUENCE and CHOICE data types are prone to change over time and use of the extension marker allows for these modifications while maintaining maximum backwards compatibility. However, in some cases, data structures may be well known and stable enough that extension markers are not needed.

NOTE 2 The presence of an extension marker potentially increases the size of an encoded message depending on the encoding rules used.

EXAMPLE

```
StandardMessage ::= SEQUENCE {
  std-field-1      Vehicle-vin,
  std-field-2      UTF8String,
  ...              -- this is an extension marker
                  -- it allows the addition of fields in a future version while maintaining
```

```

    -- backwards compatibility
}

```

#### 5.4.6.1.2 Extension markers only for standardized extensions

Extension markers shall only be used to allow for future, standardized extensions.

NOTE 1 ASN.1 allows for standardized extensions (after the initial version) by adding extensions after the extension marker. This allows for interoperable and backwards compatible operation of systems.

NOTE 2 Use of the extension marker for local use breaks interoperability since extensions defined by different local sources are likely to conflict. For example, it is possible that data encoded using one local extension definition would be parsed without error by a system expecting a different local extension. As a result, the data received means something different than the data transmitted. In extreme cases, this miscommunication could even result in safety critical issues.

#### 5.4.6.2 Customizations

##### 5.4.6.2.1 Custom extensions must be explicitly allowed

Custom extensions shall only be allowed when a standardised structure allows for such an extension through the use of a globally unique self-identifying structure as an integral part of the standardized structure.

NOTE Standardised structures should generally only include space for custom extensions where extension markers are used because, if there may be a need for a custom extension, there is likely to be a desire to standardize those extensions at some point in the future.

##### EXAMPLE

```

StandardMessage ::= SEQUENCE {
    std-field-1      Vehicle-vin,
    std-field-2      UTF8String,
    custom-data      EmbeddedData      OPTIONAL,
    ...
}

```

##### 5.4.6.2.2 The EmbeddedData aggregate domain

Custom extensions may use the EmbeddedData aggregate domain, as defined in [Annex A](#).

##### 5.4.6.2.3 Registration of object identifiers

Where an EmbeddedData aggregate domain is used, the OBJECT IDENTIFIER fields in the EmbeddedData aggregate domain shall be registered on the international object identifier tree.

NOTE An organization may acquire an object identifier for its own use via the CIDCR. The OBJECT IDENTIFIERS for standard ASN.1 encoding rules already exist under the {joint-iso-itu-t(2) asn1(1)} node.

##### 5.4.6.2.4 Optionality of customizations

A field for custom extensions should typically be marked "OPTIONAL".

## Annex A (normative)

### ASN.1 module

The following text provides the formal ASN.1 module definition for this document.

```
ISO-14813-6-Domains-1 {iso(1) standard(0) 14813 part6(6) domains(1) version1(1)}  
DEFINITIONS AUTOMATIC TAGS ::= BEGIN  
-- Version 1.0  
  
EmbeddedData ::= SEQUENCE {  
    oid          OBJECT IDENTIFIER,                -- EmbeddedData.id:id  
    encoding     OBJECT IDENTIFIER OPTIONAL, -- EmbeddedData.encoding:id  
    data         OCTET STRING                      -- EmbeddedData.data:bin  
}  
END
```

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## Annex B (normative)

### Data concept definitions

The following text provides the formal data concept definitions for each data concept introduced in this document.1 module definition for this document.

#### B.1 Nodes

[Table B.1](#) defines the meta-attributes for the object identifier nodes introduced in this document.

**Table B.1 — Nodes**

Contextual name	OID <sup>a</sup>	Definition
embeddedData	{its 135}	An entity that self-identifies its content and encoding rules
embeddedData-misc	{embeddedData 0}	A node containing miscellaneous information about embeddedData
embeddedData-aggregate-domains	{embeddedData-misc 1}	A node containing aggregate domains related to embedded data

<sup>a</sup> For the definition of the parent arcs of the OID, see ISO 14817-3.

#### B.2 Object classes

[Table B.2](#) defines the meta-attributes for the object classes introduced in this document.

**Table B.2 — Object Classes**

Contextual name	OID <sup>a</sup>	Definition	Abstract
EmbeddedData	{its 135}	entity that self-identifies its content and encoding rules	False

<sup>a</sup> For the definition of the parent arcs of the OID, see ISO 14817-3.

#### B.3 Modules

[Table B.3](#) defines the meta-attributes for the modules included within this document.

**Table B.3 — Modules**

Contextual Name	OID	Definition
ISO-14813-6-Do-mains-1	{iso(1) std(0) 14813 part6(6) version1(1) 1}	A module that defines the first version of the aggregate domain for EmbeddedData

#### B.4 Aggregate domains

[Table B.4](#) defines the meta-attributes for the aggregate domains defined within this document.