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

Part 6: Data presentation in 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

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member 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 shall not be held responsible for identifying any or all such patent rights.

ISO 14813-6 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

This first edition of ISO 14813-6 cancels and replaces ISO/TR 14813-6:2000.

ISO 14813 consists of the following parts, under the general title *Intelligent transport systems — Reference model architecture(s) for the ITS sector*:

— *Part 1: ITS service domains, service groups and services*

— *Part 2: Core TICS reference architecture* [Technical Report]

— *Part 3: Example elaboration* [Technical Report]

— *Part 4: Reference model tutorial* [Technical Report]

— *Part 5: Requirements for architecture description in ITS standards*

— *Part 6: Data presentation in ASN.1*

Introduction

This part of ISO 14813 is one of a series of documents to provide a form and structure to the reference architectures for intelligent transport systems (ITS). Specifically, this part of ISO 14813 is intended to enable conformance with a resolution of ISO/TC 204, a determination for the consistent use and elaboration of Abstract Syntax Notation One [ASN.1 (ISO/IEC 8824-1, ISO/IEC 8824-2, ISO/IEC 8824-3 and ISO/IEC 8824-4)] within ITS International Standards.

ISO/TR 14813-6:2000 was developed following the decision of the ISO Technical Committee ISO/TC 204 to adopt ASN.1 as its normal syntax notation for data definitions within ITS International Standards and to provide instructions and rules to facilitate interoperability and mobility of data. This part of ISO 14813 represents a revision of ISO/TR 14813-6:2000, clarifying and updating it by setting the use of ASN.1 in context with the use of other notations within ITS International Standards.

To be explicit, the ISO/TC 204 decision does not *require* that all ITS International Standards and systems shall use ASN.1 as their only means of encoding and transfer. In many cases other methods will be used because of industry practices or efficiency in certain situations. The ISO/TC 204 decision requires only that

— where data is defined within an ITS International Standard or data registry, it is elaborated in a consistent form within all ITS International Standards as an ASN.1 module to promote interoperability and reuse, and

— where ASN.1 is the chosen method for encoding, that it is consistently defined according to ISO/IEC 8825.

ASN.1 and its encoding rules provide a means of achieving interoperability of otherwise incompatible data concepts. In order to achieve this, levels of identification are required to precede certain data elements, to enable the comprehension of data messages.

Within the ASN.1 data definition there may be a requirement to use other notations or encoding rules in the transfer of information within a system specified within an ITS International Standard.

ISO 14817 defines the format of data dictionaries and data registries and is consistent to this document in requiring the definition of data according using ASN.1.

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

Part 6: Data presentation in ASN.1

1 Scope

This part of ISO 14813 provides an 'enabling' structure for use in the ITS sector. It provides a formal means to enact the ISO/TC 204 decision by resolution to use ASN.1 for data definitions within ITS International Standards. This provides a common message form to enable interoperability and reuse. It provides consistency of use so that where other aspects of ASN.1 (defined within ISO/IEC 8824 and ISO/IEC 8825), such as transfer rules, are selected to be used, they are used in a common and consistent way in order to maximize interoperability and reuse.

It is important to note that this part of ISO 14813 does not require the use of ASN.1 for anything other than providing a common and flexible form of data definition and this document makes specific provision for the support of use of other extant standardized syntax notations (EDIFACT, XML, etc.) whilst maintaining interoperability and reuse by defining these practices within an ASN.1 data definition.

Specific implementation requirements, other than those determined in the syntax notations identified above, are beyond the scope of this document.

This part of ISO 14813 also provides a means where particular ITS sector requirements, or existent International Standards, that require particular message forms and procedures that are expressed in other notations (EDIFACT, XML, etc.), may be referenced and reused by other ITS applications. Thus it presents an unambiguous system for identifying all the different data types and describing them in ITS International Standards in a common way.

2 Normative references

The following referenced documents are indispensable for the application 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 8824-1:2002, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC 8824-2, *Information technology — Abstract Syntax Notation One (ASN.1): Information object specification*

ISO/IEC 8824-3, *Information technology — Abstract Syntax Notation One (ASN.1): Constraint specification*

ISO/IEC 8824-4, *Information technology — Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications*

ISO/IEC 8825-1, *Information technology — ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER)*

ISO/IEC 8825-2, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)*

ISO/IEC 8825-3, *Information technology — ASN.1 encoding rules: Specification of Encoding Control Notation (ECN)*

ISO/IEC 8825-4, *Information technology — ASN.1 encoding rules: XML Encoding Rules (XER)*

ISO/IEC 9834-1, *Information technology — Open Systems Interconnection — Procedures for the operation of OSI Registration Authorities: General procedures and top arcs of the ASN.1 Object Identifier tree*

ISO 14817, *Transport information and control systems — Requirements for an ITS/TICS central Data Registry and ITS/TICS Data Dictionaries*

3 Terms and definitions

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

3.1
ASN.1 type
ASN.1 type definition
definition of a type that conforms to ISO/IEC 8824

NOTE This is a data type, type definition (or type for short) that represents in a formalized way a class of information (for example, numerical, textual, still image or video information). The representation is conformant to definitions given in ISO/IEC 8824-1.

3.2
associated ASN.1 type
type which is used only for defining the value and subtype notation for a type

NOTE Associated types are defined when it is necessary to make it clear that there may be a significant difference between how the type is defined in ASN.1 and how it is encoded. Associated types do not appear in user specifications.

3.3
data element
some single unit of information of interest (such as a fact, proposition, observation, etc.) about some (entity) class of interest (e.g. a person, place, process, property, concept, association, state, event, etc.) considered to be indivisible in a particular context

[ISO 14817:2002, definition 4.7]

3.4
data frame
data concept; grouping of data elements primarily for the purpose of referring to the group with a single name and thereby efficiently reusing groups of data elements that commonly appear together (e.g. ASN.1 SEQUENCE, SEQUENCE OF, SET OF or CHOICE) in a message specification

[ISO 14817:2002, definition 4.9]

3.5
data primitive
data element that cannot be further subdivided meaningfully within the context of ASN.1

3.6
(data) type
named set of values

[ISO/IEC 8824-1:2002, definition 3.6.74]

3.7
EDI
electronic data interchange
passing of a message, or series of messages, between computers and/or between different software systems

NOTE Within this context an EDI message is normally compatible with the form specified in ISO/IEC 9897 [4].

3.8
EDIFACT
electronic data interchange for administration, commerce and transport
specific message format for the sector in question as specified in ISO 9735 [3]

3.9
information object
instance of some information object class, being composed of a set of fields which conform to field specification of the class

[ISO/IEC 8824-2:2002, definition 3.4.9]

3.10
information object class
set of fields, forming a template for the definition of a potentially unbounded collection of information objects, the instances of the class

[ISO/IEC 8824-2:2002, definition 3.4.10]

3.11
interface dialogue
bi-directional communication sequence between two parties in accordance with predetermined protocols and sequences

3.12
level of identification
position within ASN.1 OBJECT IDENTIFIER (ISO/IEC 9834-1)

3.13
message
information in a defined form sent from a source to a receiver; data concept, grouping of data elements and/or data frames, as well as associated message metadata, that is used to convey a complete unit of information

NOTE Adapted from ISO 14817.

3.14
module
one or more instances of the use of the ASN.1 notation for type, value, value set, information object class, information object, and information object set (as well as the parameterized variant of those), encapsulated using the ASN.1 module notation

[ISO/IEC 8824-1:2002, definition 3.6.43]

3.15
module identifier
instance of an object identifier type which relates to an associated module

NOTE In ISO/IEC 8824 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. No defined value may be used in defining the object identifier value.

3.16
non-ASN.1 type
type definition that does not conform to ISO/IEC 8824

3.17
object identifier
globally unique value associated with an object to unambiguously identify it

[ISO/IEC 8824-1:2002, definition 3.6.47]

3.18
object identifier type
simple type whose values are the set of all object identifiers allocated in accordance with the rules of the ISO/IEC 9834 series

[ISO/IEC 8824-1:2002, definition 3.6.48]

3.19
simple (data) type
type defined by directly specifying the set of its values

[ISO/IEC 8824-1:2002, definition 3.6.66]

3.20
value domain
data concept; expression of a specific and explicit representation of some information about something of the interest within the ICT/ITS domain

[ISO 14817:2002, definition 4.29]

4 Requirements

4.1 General requirements

ISO/TC 204 has resolved to use Abstract Syntax Notation.1 (ASN.1), as defined in ISO/IEC 8824-1, ISO/IEC 8824-2, ISO/IEC 8824-3 and ISO/IEC 8824-4, where there is a requirement to elaborate syntax notation of data definitions within ITS International Standards. This ITS International Standard provides a normative means to achieve this objective.

This requirement is particularly important for data reuse and interoperability now that ISO 14817 is approved and countries and regions are beginning to implement data registries and data dictionaries according to its requirements.

The requirement affects only

— data definitions in ITS International Standards, and

— the method of use of ASN.1 where ASN.1 has been selected for other syntax notation aspects (such as data transfer).

Where extant practice or desirability to achieve interoperability with other (non ITS) systems has caused an ITS International Standard to use other notations to transfer or format data, there is no limitation on this whatsoever and there is no requirement to use ASN.1 transfer encodings, etc. The sole requirement is that data definition within the ITS International Standard provides conversion to data module definitions in ASN.1. Annex B provides examples for ASN.1 type definitions.

4.2 ASN.1 syntax

As stated in its defining document (ISO/IEC 8824-1), 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 as it relates to the exchange of information regarding ITS is its ability to enable separation of the specification of message content (e.g. data elements, data frames) from the specification of the encoding or syntax of messages (e.g. EDI, EDIFACT, XML).

As presented in Reference [7], “the following advantages of formal and separate definitions can be cited.

— 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”.

4.3 Determining context

The general open system interconnection scheme provides for the communicating parties to negotiate the transfer context for the protocol at connection set-up time and before the actual data interchange occurs. When using devices such as microwave beacons (dedicated short range communications), there may be a very limited time budget to complete the negotiation, hence simplified schemes have to be elaborated (see Figure 2). Initialization of a sample system, working with simplified context negotiation, is illustrated in Annex A. It is possible to define ITS application environments where the context is predetermined and the exact sequence and content of the negotiation is known in advance. For these cases, the use of data encoding according to this International Standard and the rules given in ISO/IEC 8825-1 or ISO/IEC 8825-2 may not apply.

Where an ITS International Standard determines that a message is to be encoded or transferred using ASN.1, ISO/IEC 8824 and ISO/IEC 8825 shall be complied with, using the "Packed Encoding Rules (aligned or unaligned variants)".

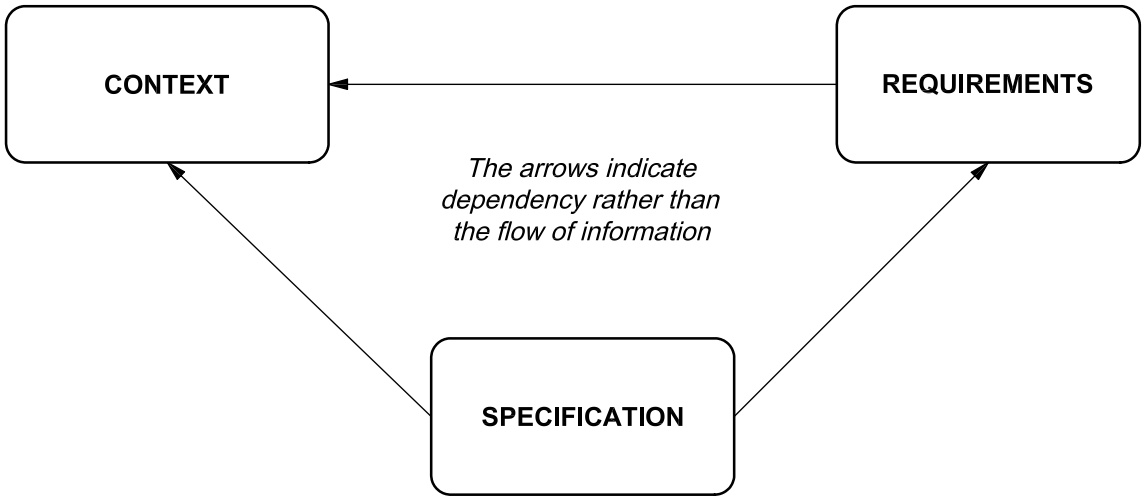

Figure 1 — Context negotiation

4.4 Using ASN.1 to define ITS data concepts

4.4.1 When ASN.1 is to be used for a data registry it shall be specified in accordance with ISO 14817.

NOTE The basis for the use of ASN.1 in ITS data registries and data dictionaries is defined in ISO 14817 which identifies the following meta attributes for ITS data concepts:

— ASN.1 Name;

— ASN.1 Object Identifier;

— Data type.

The ASN.1 Name shall be the name of a data concept expressed as a valid "typereference" as defined in ISO/IEC 8824-1:2002, 11.2. The ASN.1 Name should be unique within the ITS data registry. The ASN.1 Name applies to the following data concepts: "interface dialogue", "message", "data frame", "data element", and "value domain".

The "ASN.1 Object Identifier" shall be a unique ASN.1 object identifier in accordance with ISO/IEC 8824-1.

The "data type" shall be the logical representation of the "data concept", expressed as a valid data concept instance of an ASN.1 data type. The date type shall be a type with an ASN.1 type definition. The data type applies to the following data concepts: messages, data frames, data elements and value domains. As applied to these concepts, the meta attribute consists of a complete and syntactically correct ASN.1 module definition. See ISO 14817 for specific details.

Optionally, ITS data concepts may be documented as ASN.1 constructs in the form of an ASN.1 "information object specification" as defined by ISO/IEC 8824-2.

4.4.2 Within ASN.1 definitions, in order to achieve interoperability and to enable the comprehension of data messages, levels of identification shall precede certain data elements. The first level of identification required in a formal ASN.1 message definition shall identify the context of the message. For messages defined by other standardization committees and external organizations (even proprietary message formats), the use of "OBJECT IDENTIFIER" is mandatory in the formal ASN.1 message definition.

4.4.3 The syntactical description of data constructs shall conform to ISO/IEC 8824-1, ISO/IEC 8824-2, ISO/IEC 8824-3 and ISO/IEC 8824-4 in order to provide a common form of data definition to enable interoperability and reuse.

4.4.4 With the exception of transfers in a predetermined context (e.g. EDIFACT, CORBA, DATEX, etc. for which see 4.3) the requirements given in 4.4.4.1 to 4.4.4.4 apply.

4.4.4.1 All ASN.1 messages in ITS International Standards shall commence with an "ASN.1 OBJECT IDENTIFIER". This identifier shall be determined in accordance with the arc iso (1) standard (0) (ISO/IEC 9834-1) and is described in the form:

{iso(1) standard(0) standard-number(xxxxx) module-number(yyy) type-id(zzz)}

The component “iso(1)” defines the identifier as originating from ISO/IEC. The component “standard(0)” defines the identifier as an ISO standard assigned by the ISO Central Secretariat. The component “standard-number(xxxxx)” further defines the particular standard and is assigned by the ISO Central Secretariat to an organization that acts as the registration authority for all "ASN.1 OBJECT IDENTIFIER" values that start with {iso(1) standard(0) standard-number(xxxxx). The component “module-number(yyy)” identifies an ASN.1 module within the standard and is assigned by the registration authority. The component “type-id(zzz),” along with the other arcs in the object identifier value, identifies a particular message; it is assigned by the editor of the standard.

4.4.4.2 Data elements produced by other “identified organizations” shall start with an "ASN.1 OBJECT IDENTIFIER", which shall be determined in accordance with the arc iso(1) followed by the arc “identified organization(3)” followed by the “organization-identity(yyy)” followed by the reference to the “standard-number(xxxxx) and finally by “dataunit(zzz).”

{iso(1) identified-organization(3) organization-identity(yyy) standard-number(xxxxx) dataunit(zzz)}
Sample definitions according to this rule are:
Sample 1: All European Standards (EN) that are not also International Standards.

The defined data elements shall all start with an "ASN.1 OBJECT IDENTIFIER" which shall be determined in accordance with the arc iso (1) followed by the arc identified-organization(3) followed by an identification of the “identified organization” (CEN number), followed by the “standard-number(xxxxx)”, and then by “dataunit(zzz).”

{iso(1) identified-organization(3) cen(yyy) standard-number(xxxxx) dataunit(zzz)}
Sample 2: EDIFACT messages

When these are used in an ITS environment they shall be preceded by an "ASN.1 OBJECT IDENTIFIER", which shall be determined in accordance with the arc iso (1) identified organization (3) and shall be described in the form

{iso(1) identified-organization(3) edifact-board(yyy) . . .}

where arc 1 determines the first node as being an ISO/IEC arc, arc 3 identifies an “identified organization”, and yyy is the allocated identification for the EDIFACT Board.

This is followed by the body of data encoded as an OCTET STRING type.

4.4.4.3 Where no International Standard, CEN or EDIFACT standard exists, ASN.1 data conforming to national standards may be determined as follows:

All ITS relevant messages conforming to national standards shall commence with an "ASN.1 OBJECT IDENTIFIER", which shall be determined in accordance with the arc iso (1) member-body (2) member-body-identification (bbb) and shall be described in the form

{iso(1) member-body(2) member-body-identification(bbb) . . .}

where arc iso(1) determines the first node as being an ISO/IEC arc, arc member-body(2) indicates a member body and bbb provides the identification for the standardization body (as an ISO/IEC 3166 [1] country code identifier).

This is followed by information determined by the Member body.

4.4.4.4 Identifying data elements: The words “AUTOMATIC TAGS” shall be put in all module headers so as to increase readability of the ASN.1 type definitions and to eliminate the possibility of certain types of errors.

4.5 Module definition using ASN.1

4.5.1 General description

The formal ASN.1 module definition in an ITS International Standard includes the ASN.1 type definition module "OBJECT IDENTIFIER" in the definition; however, the encoding rules defined in the module definition (e.g. XML, EDIFACT module, CORBA module) can determine whether or not the "ASN.1 OBJECT IDENTIFIER" is included in the transfer of data.

When the module definition is not explicit in this respect, identifiers for the specific message shall precede the message itself.

4.5.2 Module definition

4.5.2.1 A module definition is used to define one or more ITS messages. A module definition used for ITS messages shall conform to ISO/IEC 8824, and the DefinitiveIdentifier component of the module identifier shall always contain an object identifier value).

A module definition conforming to this International Standard shall commence with an "ASN.1 OBJECT IDENTIFIER" as specified in 4.5.2.3.

4.5.2.2 The type definition of an ITS message may be an ASN.1 type definition or a non-ASN.1 type definition.

An ITS message which is an ASN.1 type definition to be used in conformance to this International Standard may be one of two cases:

— The ITS message shall be imported from the ASN.1 module where the ASN.1 type is defined. The import mechanism is defined in ISO/IEC 8824-1.

— The ITS message shall be defined in the module where it is to be used.

4.5.2.3 The association of the ITS messages and their ASN.1 type definitions shall be defined in an ASN.1 module. This ASN.1 module shall be identified through an ASN.1 OBJECT IDENTIFIER and may use an information object specification as defined in ISO/IEC 8824-2.

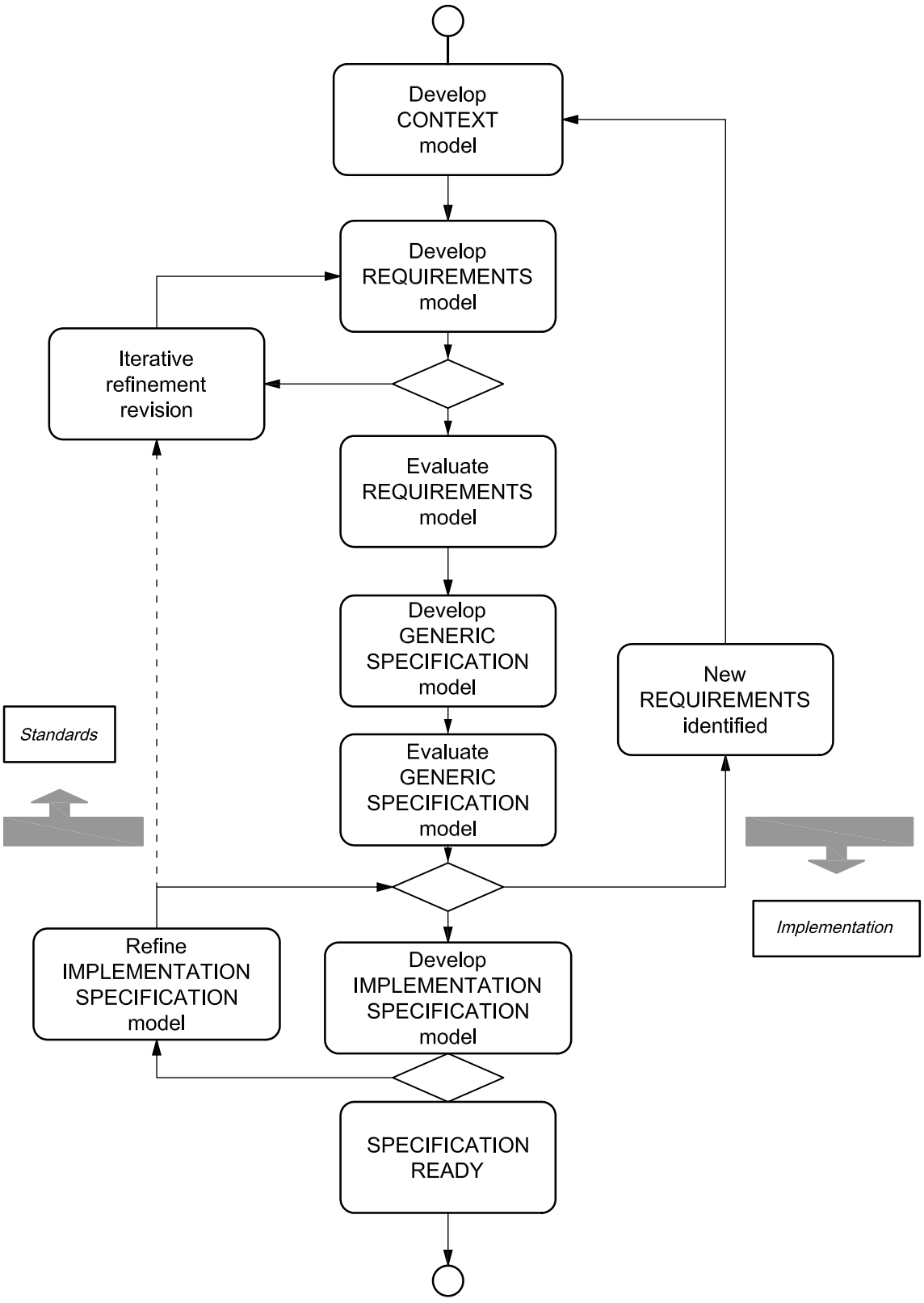

Figure 2 — Simplified context negotiation (informative)

Annex A
(informative)

Simplified context negotiation

As shown in Figure A.1, communication starts with the master (A_1) downloading a message to the slave (A_2) referring to a predetermined context defined by “protocol and application”. The slave confirms that it understands the protocol and application by starting the transmission.

NOTE In this context, “protocol” refers to the protocols that manage messages across the air interface and are specific to the medium used to transfer the data, and “application” refers to the interpretation and use of the transferred data as defined by the application).

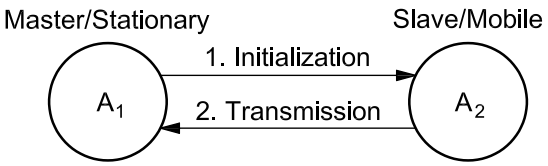

Figure A.1 — Simplified context negotiation (typical of a DSRC environment)

Annex B
(informative)

Examples

B.1 General

This annex comprises three examples of how to construct ASN.1 modules, taking into account the fact that the modules will have to use information available in both ASN.1 types and non-ASN.1 types.

B.2 Module definition using ASN.1 types

The example below comprises an ASN.1 module, which is based on using ASN.1 type definitions as defined in ISO 14816. These are imported as required in 4.5.2.2.

```
 ITSMessage ::= CHOICE {

   UsefullType      UsefullTyep;
   editFactMsg0     OCTET STRING;
            -- with EDIFACT Msg 0
   editFactMsg1     BIT STRING;
            -- with EDIFACT Msg 1
   interIndustryDO OCTET STRING
            -- with interIndustry mgs DO
   }

END
```

B.3 Module definition using non-ASN.1 types (example EDIFACT)

The example below comprises an ASN.1 module, which shows how to handle non-ASN.1 types. The ASN.1 module itself must create an association between an ASN.1 type definition and a message.

```
ITSMessage ::= CHOICE {

   UsefullType      UsefullType;
   editFactMsg0     EditFactMsg0;
   editFactMsg1     EditFactMsg1;
   interIndustryDO InterIndustryDO
   }

EditFactMsg0 ::= OCTET STRING
      -- with EDIFACT Msg 0

EditFactMsg1 ::= BIT STRING
      -- with EDIFACT Msg 1

InterIndustryDOn ::= OCTET STRING
      -- with interIndustry mgs DO

END
```

In this example, the types can be defined in another ASN.1 module and imported.

B.4 Module definition using non-ASN.1 types (example XML)

When using XML Schema to define a message, the method given in B.2 enables handling of a non-ASN.1 type XML Schema. ISO/IEC 8825-5 [2] gives another way to handle an XML Schema, which defines the way to transform an XML Schema to the equivalent ASN.1 module. This ASN.1 module encodes data efficiently using any ASN.1 encoding rules. The example XML Schema uses a fictitious road weather condition.

XML Schema example

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" id="iso_standard_24531_schema_1"
  targetNamespace="http://www.example.com" version="1.0.a" xmlns:rc = "http://www.example.com">
  <!-- ********************************************************************************** -->
  <!-- Schema Header is elided in this example -->
  <!-- ********************************************************************************** -->
  <xs:element name="location" id="iso_standard_24531_schema_1_element_1"
    type="rc:LocationStructure"/>
    <xs:complexType name="LocationStructure">
        <xs:sequence maxOccurs="1" minOccurs="1">
            <xs:element name="latitude" type="xs:string"/>
            <xs:element name="longitude" type="xs:string"/>
            <xs:element name="height" type="xs:float"/>
        </xs:sequence>
        <xs:attribute name="locationID" type="xs:integer" use="required"/>
        <xs:attribute name="heightUnit" type="xs:string" fixed="m"
use="required"/>

</xs:complexType>
  <xs:element name="weatherCondition" id="iso_standard_24531_schema_1_element_2"
    type="rc:WeatherConditionStructure"/>
  <xs:complexType name="WeatherConditionStructure">
    <xs:sequence maxOccurs="unbounded" minOccurs="1">
      <xs:element name="weather" type="xs:string"/>
      <xs:element name="windDirection" type="xs:string"/>
      <xs:element name="windVelocity" type="xs:float"/>
    </xs:sequence>
    <xs:attribute name="Time" type="xs:dateTime" use="required"/>
    <xs:attribute name="WindVelocityUnit" type="xs:string" fixed="m/sec"/>
  </xs:complexType>
  <xs:element name="roadSurfaceCondition" id="iso_standard_24531_schema_1_element_3"
    type="rc:RoadSurfaceConditionStructure"/>

    <xs:complexType name="RoadSurfaceConditionStructure">
        <xs:sequence maxOccurs="unbounded" minOccurs="1">
            <xs:elementname="coefficientOfFriction"
                                                type="rc:CoefficientOfFriction"/>
        </xs:sequence>
        <xs:attribute name="time" type="xs:dateTime" use="required"/>
    </xs:complexType>
    <xs:simpleType name="CoefficientOfFriction">
        <xs:restriction base="xs:float">
            <xs:maxExclusive value="1"/>
            <xs:minExclusive value="0"/>
        </xs:restriction>
    </xs:simpleType>
</xs:schema>
```

Using ISO/IEC 8825-5 generates this ASN.1 module.

```
/* xml version="1.0" encoding="UTF-8" */
Www-example-com
DEFINITIONS XER INSTRUCTIONS AUTOMATIC TAGS ::=
BEGIN
IMPORTS
    String, Float, DateTime
    FROM XSD;

/* ********************************************************************** */

/* Schema Header is elided in this example  */

/*
********************************************************************************** */

Location ::= [NAME AS UNCAPITALIZED] [ELEMENT] LocationStructure

LocationStructure ::= SEQUENCE {
    heightUnit [ATTRIBUTE] XSD.String ("m"),
    locationID [ATTRIBUTE] INTEGER,
    latitude   XSD.String,
    longitude  XSD.String,
    height     XSD.Float
}

WeatherCondition ::= [NAME AS UNCAPITALIZED] [ELEMENT]
    WeatherConditionStructure

WeatherConditionStructure ::= SEQUENCE {
    time             [NAME AS CAPITALIZED] [ATTRIBUTE] XSD.DateTime,
    windVelocityUnit [NAME AS CAPITALIZED] [ATTRIBUTE] XSD.String ("m/sec")
            DEFAULT "m/sec",
    sequence-list    [UNTAGGED] SEQUENCE (SIZE(1..MAX)) OF [UNTAGGED]
    SEQUENCE {
   weather       XSD.String,
   windDirection XSD.String,
   windVelocity  XSD.Float
    }
}

RoadSurfaceCondition ::= [NAME AS UNCAPITALIZED] [ELEMENT]
    RoadSurfaceConditionStructure

RoadSurfaceConditionStructure ::= SEQUENCE {
    time          [ATTRIBUTE] XSD.DateTime,
    sequence-list [UNTAGGED] SEQUENCE (SIZE(1..MAX)) OF [UNTAGGED] SEQUENCE {
   coefficientOfFriction CoefficientOfFriction
    }
}

CoefficientOfFriction ::= XSD.Float (0 <..< 1.0E0)

CoefficientOfFriction ::= XSD.Float (0 <..< 1.0E0)

ENCODING-CONTROL XER
    GLOBAL-DEFAULTS MODIFIED-ENCODINGS
    GLOBAL-DEFAULTS CONTROL-NAMESPACE
   "http://www.w3.org/2001/XMLSchema-instance" PREFIX "xsi"
    NAMESPACE ALL AS "http://www.example.com" PREFIX "rc"
END
```

B.5 Module definition using both ASN.1 types and non-ASN.1 types

The example below comprises an ASN.1 module which illustrates that both ASN.1 type definitions and non-ASN.1 types may be combined in the same module. This example also shows how the encoding may be for specific values of the different ASN.1 type definitions and non-ASN.1 types.

```
ITS-Sample {iso(1) standard(0) iso14813(14813) ITS(1) sample(1)} DEFINITIONS AUTOMATIC TAGS ::=
BEGIN
--EXPORTS Everything;
IMPORTS CS1, CS2, CS3, CS4, CS5
                FROM ISO14816{iso(1) standard(0) iso14816(14816)}
        edifactid0, edifactid1, ediFactMsg0, ediFactMsg1
                FROM ITS {iso(1) standard(0) iso14813(14813) ITS(1)};
CS ::= CHOICE {
    cs1 CS1,
    cs2 CS2,
    cs3 CS3,
    cs4 CS4,
    cs5 CS5,
    ...
    }

UsefulType ::= CHOICE {
                smallint INTEGER(0 .. 255),
                cs       CS
    }
interIndustryDataObjectId   OBJECT   IDENTIFIER   ::=   {   iso(1)   standard(0)
iso7816(7816) part6(6) }

interIndustryDO    TYPE-IDENTIFIER    ::=    {OCTET    STRING    IDENTIFIED    BY
interIndustryDataObjectId}

Objset TYPE-IDENTIFIER ::= { ediFactMsg0 | ediFactMsg1 | interIndustryDO }

ITSMessage ::= CHOICE {
    usefulType   UsefulType,
    anObject  INSTANCE OF TYPE-IDENTIFIER({Objset})
    }

END
```

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