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SERIES Z: LANGUAGES AND GENERAL SOFTWARE ASPECTS FOR TELECOMMUNICATION SYSTEMS

Formal description techniques (FDT) – Specification and Description Language (SDL)

Specification and Description Language – SDL-2010 combined with ASN.1 modules

Recommendation ITU-T Z.105

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Recommendation ITU-T Z.105

Specification and Description Language – SDL-2010 combined with ASN.1 modules

Summary

Recommendation ITU-T Z.105 defines how Abstract Syntax Notation One (ASN.1) modules are usable in combination with Specification and Description Language 2010 (SDL-2010). This text replaces Recommendation ITU-T Z.105 (2003) to align with Recommendations ITU-T Z.100, ITU-T Z.101, ITU-T Z.102, ITU-T Z.103, ITU-T Z.104, ITU-T Z.106 and ITU-T Z.107 for SDL-2010. Recommendation ITU-T Z.105 (2003) replaced the semantic mappings from ASN.1 to SDL-2000 defined in Recommendation ITU-T Z.105 (1999). The use of ASN.1 notation embedded in the Specification and Description Language previously defined in Recommendation ITU-T Z.107 (1999) is not defined by this Recommendation.

The main area of application of this Recommendation is the specification of telecommunication systems. The combined use of SDL-2010 and ASN.1 permits a coherent way to specify the structure and behaviour of telecommunication systems, together with data, messages and encoding of messages that these systems use.

This version of Recommendation ITU-T Z.105 includes necessary alignments with ASN.1:2002 Recommendations, mapping of XML values, improved mapping of bit string values and mapping of relevant ASN.1 constructs for extensions.

History

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Abstract Syntax Notation 1, ASN1, SDL-2010, Specification and Description Language.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Introduction

Objective

This Recommendation defines how Abstract Syntax Notation One (ASN.1) modules are usable in combination with Specification and Description Language 2010 (SDL-2010). The intention is that the structure and the behaviour of systems are described with SDL-2010, while parameters of exchanged messages are described with ASN.1. This Recommendation defines a mapping of ASN.1 constructs to already existing SDL-2010 constructs and contains only a small extension to Recommendations ITU-T Z.101, ITU-T Z.102, ITU-T Z.103 and ITU-T Z.104 to allow ASN.1 modules to be used.

Coverage

This Recommendation presents a semantic definition for the combination of SDL-2010 and ASN.1 modules. A mapping of the ASN.1 data defined in a module to the corresponding SDL-2010 constructs defined in Recommendations ITU-T Z.101, ITU-T Z.102, ITU-T Z.103 and ITU-T Z.104 is given, including the operators applicable to the ASN.1 data. The ASN.1 data items are then usable within SDL-2010 (using SDL-2010 notation).

Application

The main area of application of this Recommendation is the specification of telecommunication systems. The combined use of SDL-2010 and ASN.1 permits a coherent way to specify the structure and behaviour of telecommunication systems, together with data, messages and encoding of messages that these systems use.

NOTE – "Specification" in this Recommendation includes definition of requirements in a standard, Recommendation, or procurement document, and description of an implementation.

A specification conforms to this Recommendation if and only if it conforms to the syntactic and semantic grammar rules for the formal technical language defined by the Recommendation (which includes the referenced ASN.1 and SDL-2010 languages). Conformance implies that every possibly dynamic interpretation of the specification conforms to the language rules. A specification that uses extensions of the language does not conform.

A tool does not fully support the language if it rejects some constructs of the language or that has a static or dynamic interpretation of a specification in the language that does not conform to language semantics.

Status/Stability

This text replaces Recommendation ITU-T Z.105 (2003) to align with Recommendations ITU-T Z.100, ITU-T Z.101, ITU-T Z.102, ITU-T Z.103, ITU-T Z.104, ITU-T Z.106 and ITU-T Z.107 for SDL-2010. Recommendation ITU-T Z.105 (2003) defined the semantic mappings from ASN.1 to SDL-2000 (previously defined in Recommendation ITU-T Z.105 (1999)) and aligned with ASN.1:2002 Recommendations. The use of ASN.1 notation embedded in the Specification and Description Language previously defined in the withdrawn Recommendation ITU-T Z.107 (1999) is not defined by this Recommendation.

It is likely that changes to Recommendations ITU-T X.680, ITU-T X.681, ITU-T X.682 and ITU-T X.683, ITU-T Z.100, ITU-T Z.101, ITU-T Z.102, ITU-T Z.103, ITU-T Z.104, ITU-T Z.106 or ITU-T Z.107 will require modifications to this Recommendation.

This Recommendation is the complete reference manual describing the combination of SDL-2010 and ASN.1 modules.

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Recommendation ITU-T Z.105

Specification and Description Language – SDL-2010 combined with ASN.1 modules

1 Scope and objective

This Recommendation defines how ASN.1 modules are usable in combination with SDL-2010. ASN.1 modules are imported in SDL-2010 descriptions so that ASN.1 data definitions are mapped to internal SDL-2010 representation using equivalent SDL-2010 constructs and forming together with the rest of the SDL-2010 description a complete specification.

SDL-2010 is a language for the specification and description of telecommunication systems. SDL-2010 has concepts for:

- structuring systems;
- defining behaviour of systems;
- defining data used by systems.

ASN.1 is a language for the definition of data. Related to ASN.1 are encoding rules that define how ASN.1 values are transferred as bit streams during communication.

1.1 Objective

The combination of SDL-2010 and ASN.1 permits a coherent way of specifying the structure and behaviour of telecommunication systems, together with data, messages, and encoding of messages that these systems use. It is possible to describe structure and behaviour using SDL-2010, and data and messages using ASN.1. It is possible to describe the encoding of these messages by reference to the relevant encoding rules defined for ASN.1.

The full use of SDL-2010 (including data types) is supported by this Recommendation.

1.2 The characteristics of the combination of SDL-2010 and ASN.1 modules

Systems described in SDL-2010 combined with ASN.1 modules have the following characteristics:

- structure and behaviour are defined using SDL-2010 concepts;
- the SDL-2010 signal structure, i.e., the signal parameter types and their subtypes are defined in ASN.1 modules;
- it is allowed to define internal data by either ASN.1 types or SDL-2010 sorts;
- it is possible to define encoding of data values defined in ASN.1 by reference to the relevant encoding rules. Encoding is not in the scope of this Recommendation.

1.3 ASN.1 that is usable in combination with SDL-2010

The use of ASN.1 as defined in [ITU-T X.680], [ITU-T X.681], [ITU-T X.682] and [ITU-T X.683] is supported in combination with SDL-2010, with a recognition that it is not possible to successfully map some ASN.1 constructs to SDL-2010 (or at least the mapping has not been identified and specified in this Recommendation). Source ASN.1 constructs that cannot be mapped to SDL-2010 are treated during the transformation to SDL-2010 as if they were not present and should thus not cause any problems for the successful transformation of other constructs. Such constructs are the extension marker and exception marker defined in [ITU-T X.680], which are optionally present in ASN.1 but are ignored in the transformation to SDL-2010. Some constructs of ASN.1 are never transformed to SDL-2010 as such, but contain information that directs the transformation or is used

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in the transformation. The prominent examples of such constructs are relational constraints as defined in [ITU-T X.682], and information object classes and information object sets (see clause 8).

The use of SDL-2010 as defined in [ITU-T Z.100], [ITU-T Z.101], [ITU-T Z.102], [ITU-T Z.103], [ITU-T Z.104], [ITU-T Z.106] and [ITU-T Z.107] is supported.

ASN.1 modules that are used in the transformation to SDL-2010 are also usable for the generation of encoders and decoders, provided that encoding rules are defined. The SDL-2010 data specification implicitly derived from ASN.1 modules should not be used for generation of encoders and decoders, because it is possible to lose some information that is relevant for encoding in the transformation to SDL-2010.

1.4 The structure of this Recommendation

This Recommendation is not self-contained: the mapping defined in this Recommendation is based on [ITU-T X.680], [ITU-T X.681], [ITU-T X.682], [ITU-T X.683], [ITU-T Z.100], [ITU-T Z.101], [ITU-T Z.102], [ITU-T Z.103], [ITU-T Z.104] and [ITU-T Z.106]. The language as defined in [ITU-T Z.100], [ITU-T Z.101], [ITU-T Z.102], [ITU-T Z.103], [ITU-T Z.104], [ITU-T Z.106] and [ITU-T Z.107] applies, except that the rule <sdl specification> is extended to allow direct use of ASN.1 modules. This Recommendation is structured in the following manner:

Clause 6 defines the changes to SDL-2010 in order to incorporate ASN.1 modules.

Clause 7 defines the mapping of [ITU-T X.680] ASN.1 types and values to SDL-2010 data in order to incorporate ASN.1 data types and values.

Clause 8 defines the mapping of ASN.1 types defined using information objects, classes and information object sets. The use of [ITU-T X.682] constructs is also treated in this clause.

Clause 9 defines the mapping of parameterized ASN.1 types to SDL-2010 data in order to incorporate parameterized ASN.1 data types.

Clause 10 lists items in the **package** Predefined needed to support the use of ASN.1.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T X.680] Recommendation ITU-T X.680 (2021) | ISO/IEC 8824-1:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.

[ITU-T X.681] Recommendation ITU-T X.681 (2021) | ISO/IEC 8824-2:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification*.

[ITU-T X.682] Recommendation ITU-T X.682 (2021) | ISO/IEC 8824-3:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification*.

[ITU-T X.683] Recommendation ITU-T X.683 (2021) | ISO/IEC 8824-4:2021, Information technology – *Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications*.

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[ITU-T Z.100] Recommendation ITU-T Z.100 (2021), *Specification and Description Language – Overview of SDL-2010*.

[ITU-T Z.101] Recommendation ITU-T Z.101 (2021), *Specification and Description Language – Basic SDL-2010*.

[ITU-T Z.102] Recommendation ITU-T Z.102 (2021), *Specification and Description Language – Comprehensive SDL-2010*.

[ITU-T Z.103] Recommendation ITU-T Z.103 (2021), *Specification and Description Language – Shorthand notation and annotation in SDL-2010*.

[ITU-T Z.104] Recommendation ITU-T Z.104 (2021), *Specification and Description Language – Data and action language in SDL-2010*.

[ITU-T Z.106] Recommendation ITU-T Z.106 (2021), *Specification and Description Language – Common interchange format for SDL-2010*.

[ITU-T Z.107] Recommendation ITU-T Z.107 (2021), *Specification and Description Language – Object-oriented data in SDL-2010*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere: the definitions of [ITU-T Z.100] apply for SDL-2010 items and the definitions of [ITU-T X.680] apply for ASN.1 items.

3.2 Term defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

The abbreviations defined in [ITU-T Z.100] and [ITU-T X.680] apply, in particular SDL-2010 from [ITU-T Z.100] and ASN.1 from [ITU-T X.680].

5 Conventions

In subsequent clauses, the *ASN.1 grammar* identifies the ASN.1 production rules and items that are mapped to SDL-2010, and the *Model* describes the mapping to SDL-2010.

6 Package

ASN.1 grammar

ModuleDefinition, **ModuleIdentifier**, **DefinitiveIdentification**, **Imports** and **Exports** are defined in clause 13.1 of [ITU-T X.680].

Model

The rules <sdl specification> and <module definition> are defined in [ITU-T Z.106] as follows:

```
<sdl specification> ::=
                    {       { <package diagram> | <package definition> |
                                <system specification> | <textual system specification> |
                                <module definition> }
                            <referenced definition>* }set
```


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NOTE 1 – After mapping according to this Recommendation the ASN.1 module definition is replaced by an SDL-2010 <package diagram> (or equivalent <package definition>).

<module definition> ::=
ModuleDefinition

where the non-terminal **ModuleDefinition** is defined in clause 13.1 of [ITU-T X.680].

A <module definition> has the same meaning as a <package diagram> with a <package text area> where:

- **ModuleIdentifier** (without any **DefinitiveIdentification**) corresponds to the <package name>;
- **Imports** corresponds to the <package use clause>s;
- **Exports** corresponds to the <package public> in the <package text area> of the <package diagram>;
- the remaining parts of the **ModuleDefinition** are transformed into items in the <package text area> of the <package diagram>.

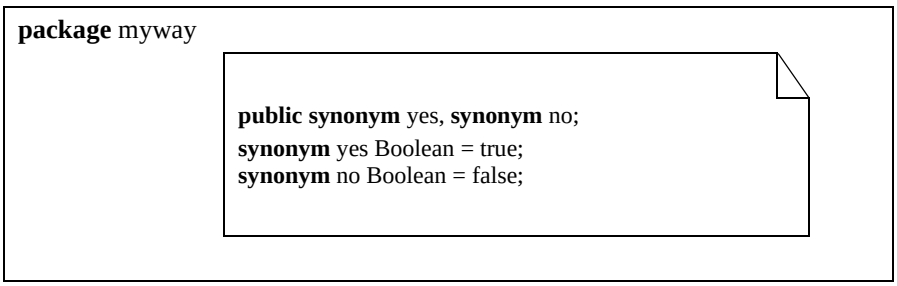
An ASN.1 **ModuleDefinition** is transformed into the equivalent SDL-2010 before it is considered as a package, and before any SDL-2010 transformations. In this transformation, names are transformed into fully qualified identifiers where SDL-2010 requires or allows an identifier rather than a name. However, for conciseness, this is often omitted from the examples in this Recommendation.

Example

The ASN.1 module definition:

```
myway DEFINITIONS ::=
     BEGIN
     EXPORTS yes, no;
     yes  BOOLEAN ::= TRUE
     no   BOOLEAN ::= FALSE
END
```

is the same as:



Similarly, when the package is used in the **imports** of another package:

```
IMPORTS yes FROM myway;
```

This is the same as the <package reference clause>:

use myway/yes;

NOTE 2 – Because SDL-2010 does not support object identifier values for package identification, ASN.1 modules with the same **modulereference** (see clause 12.5 of [ITU-T X.680]) but different **DefinitiveIdentification** will potentially cause name resolution problems.

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7 Definition and use of data

The different definitions of the use of data are described in the following way:

ASN.1 grammar	Defining the grammar production rules representing the construction to be represented in SDL-2010.
Model	Describing the transformations of the different parts of the ASN.1 grammar into SDL-2010 productions. This part is referencing both the SDL-2010 grammar, represented as <sdl grammar rule>, and the ASN.1 grammar, represented as ASN1GrammarRule.

7.1 Name mapping

ASN.1 grammar

ASN.1 names are ASN.1 lexical items defined in clause 11 of [ITU-T X.680] such that only letters, digits, and hyphens are allowed in ASN.1 names. If the hyphen character is used in SDL-2010, this would be interpreted as the minus operator.

Model

ASN.1 names containing hyphen characters are mapped to lexically similar SDL-2010 names except that hyphen characters are converted to underline characters.

Example

The ASN.1 name **`my-example-name`** is mapped to my_example_name in SDL-2010.

7.2 Variable and data definitions

7.2.1 Type assignment

ASN.1 grammar

TypeAssignment, **Type**, **ConstrainedType** and **Constraint** are defined in clause 16.1 of [ITU-T X.680], clause 17.1 of [ITU-T X.680], clause 49.1 of [ITU-T X.680] and clause 49.6 of [ITU-T X.680], respectively.

Model

If the **Type** is a **typereference**, then the **TypeAssignment** is the same as a <syntype definition> (see [ITU-T Z.101] and clause 12.1.8.1 of [ITU-T Z.104]) containing only the SDL-2010 equivalent of the **Type**.

If the **Type** is a **ConstrainedType**, then the **TypeAssignment** is the same as a <syntype definition> (see [ITU-T Z.101] and clause 12.1.8.1 of [ITU-T Z.104]) containing only the SDL-2010 equivalent of the **Constraint**.

If the **Type** is a neither a **typereference** nor a **ConstrainedType,** the **TypeAssignment** is represented by a <data type definition> with an empty or omitted <data type definition body> and where <formal context parameters> is omitted (see [ITU-T Z.101] and clause 12.1.1 of [ITU-T Z.104]).

Example

The ASN.1 type assignment:

```
Mytype ::= AnotherType -- typereference
```

is the same as:

syntype Mytype = AnotherType **endsyntype** Mytype; /* full qualification omitted here. */

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