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Information technology — Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications

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Technologies de l'information — Notation de syntaxe abstraite numéro 1 (ASN.1): Spécifications pour paramétrisation ASN.1

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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. 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.

International Standard ISO/IEC 8824-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 21, *Open systems interconnection, data management and open distributed processing,* in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.683.

This is a revision of ISO/IEC 8824:1990.

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ISO/IEC 8824-4:1995 consists of the following parts, under the general title *Information technology — Abstract Syntax Notation One (ASN.1)*:

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- *Part 1: Specification of basic notation*
- *Part 2: Information object specification*
- *Part 3: Constraint specification*
- *Part 4: Parameterization of ASN.1 specifications*

Annexes A and B of this part of ISO/IEC 8824:1995 are for information only.

Introduction

Application designers need to write specifications in which certain aspects are left undefined. Those aspects will later be defined by one or more other groups (each in its own way), to produce a fully defined specification for use in the definition of an abstract syntax (one for each group).

In some cases, aspects of the specification (for example, bounds) may be left undefined even at the time of abstract syntax definition, being completed by the specification of International Standardized Profiles or functional profiles from some other body.

NOTE 1 – It is a requirement imposed by this Recommendation | International Standard that any aspect that is not solely concerned with the application of constraints has to be completed prior to the definition of an abstract syntax.

In the extreme case, some aspects of the specification may be left for the implementor to complete, and would then be specified as part of the Protocol Implementation Conformance Statement.

While the provisions of ITU-T Rec. X.681 | ISO/IEC 8824-2 and ITU-T Rec. X.682 | ISO/IEC 8824-3 provide a framework for the later completion of parts of a specification, they do not of themselves solve the above requirements.

Additionally, a single designer is sometimes required to define many types, or many information object classes, or many information object sets, or many information objects, or many values, which have the same outer level structure, but differ in the types, or information object classes, or information object sets, or information objects, or values, that are used at an inner level. Instead of writing out the outer level structure for every such occurrence, it is useful to be able to write it once, with parts left to be defined later, then reference it and provide the additional information.

All these requirements are met by the provision for parameterized reference names and parameterized assignments by this Recommendation | International Standard.

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The syntactic form of a parameterized reference name is the same as that of the corresponding normal reference name, but the following additional considerations apply:

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- When it is assigned in a parameterized assignment statement, it is followed by a list of dummy reference names in braces, each possibly accompanied by a governor; these reference names have a scope which is the right-hand side of the assignment statement, and the parameter list itself.

  NOTE 2 – This is what causes it to be recognized as a parameterized reference name.

- When it is exported or imported, it is followed by a pair of empty braces to distinguish it as a parameterized reference name.

- When it is used in any construct, it is followed by a list of syntactic constructions, one for each dummy reference name, that provide an assignment to the dummy reference name for the purposes of that use only.

Dummy reference names have the same syntactic form as the corresponding normal reference name, and can be used anywhere on the right-hand side of the assignment statement that the corresponding normal reference name could be used. All such usages are required to be consistent.

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ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – ABSTRACT SYNTAX NOTATION ONE (ASN.1): PARAMETERIZATION OF ASN.1 SPECIFICATIONS

1 Scope

This Recommendation | International Standard is part of Abstract Syntax Notation One (ASN.1) and defines notation for parameterization of ASN.1 specifications.

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 editions of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunications 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 (1994) | ISO/IEC 8824-1:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*
- ITU-T Recommendation X.681 (1994) | ISO/IEC 8824-2:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification.*
- ITU-T Recommendation X.682 (1994) | ISO/IEC 8824-3:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification.*

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3 Definitions

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

3.1 Specification of basic notation

This Recommendation | International Standard uses the terms defined in ITU-T Rec. X.680 | ISO/IEC 8824-1.

3.2 Information object specification

This Recommendation | International Standard uses the terms defined in ITU-T Rec. X.681 | ISO/IEC 8824-2.

3.3 Constraint specification

This Recommendation | International Standard uses the terms defined in ITU-T Rec. X.682 | ISO/IEC 8824-3.

3.4 Additional definitions

3.4.1 normal reference name: A reference name defined, without parameters, by means of an "Assignment" other than a "ParameterizedAssignment". Such a name references a complete definition and is not supplied with actual parameters when used.

3.4.2 parameterized reference name: A reference name defined using a parameterized assignment, which references an incomplete definition and which, therefore, must be supplied with actual parameters when used.

3.4.3 parameterized type: A type defined using a parameterized type assignment and thus whose components are incomplete definitions which must be supplied with actual parameters when the type is used.

3.4.4 parameterized value: A value defined using a parameterized value assignment and thus whose value is incompletely specified and must be supplied with actual parameters when used.

3.4.5 parameterized value set: A value set defined using a parameterized value set assignment and thus whose values are incompletely specified and must be supplied with actual parameters when used.

3.4.6 parameterized object class: An information object class defined using a parameterized object class assignment and thus whose field specifications are incompletely specified and must be supplied with actual parameters when used.

3.4.7 parameterized object: An information object defined using a parameterized object assignment and thus whose components are incompletely specified and must be supplied with actual parameters when used.

3.4.8 parameterized object set: An information object set defined using a parameterized object set assignment and thus whose objects are incompletely specified and must be supplied with actual parameters when used.

3.4.9 variable constraint: A constraint employed in specifying a parameterized abstract syntax, and which depends on some parameter of the abstract syntax.

4 Abbreviations

ASN.1 Abstract Syntax Notation One

5 Convention

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This Recommendation | International Standard employs the notational convention defined in ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 5.

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6 Notation

This clause summarizes the notation defined in this Recommendation | International Standard.

6.1 Assignments

The following notation which can be used as an alternative for "Assignment" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 10) is defined in this Recommendation | International Standard:

– ParameterizedAssignment (see 8.1).

6.2 Parameterized definitions

6.2.1 The following notation which can be used as an alternative for "DefinedType" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, subclause 11.1) is defined in this Recommendation | International Standard:

– ParameterizedType (see 9.2).

6.2.2 The following notation which can be used as an alternative for "DefinedValue" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, subclause 11.1) is defined in this Recommendation | International Standard:

– ParameterizedValue (see 9.2).

6.2.3 The following notation which can be used as an alternative for "DefinedType" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, subclause 11.1) is defined in this Recommendation | International Standard:

– ParameterizedValueSetType (see 9.2).

6.2.4 The following notation which can be used as an alternative for "ObjectClass" (see ITU-T Rec. X.681 | ISO/IEC 8824-2, subclause 9.2) is defined in this Recommendation | International Standard:

– ParameterizedObjectClass (see 9.2).

6.2.5 The following notation which can be used as an alternative for "Object" (see ITU-T Rec. X.681 | ISO/IEC 8824-2, subclause 11.2) is defined in this Recommendation | International Standard:

– ParameterizedObject (see 9.2).

6.2.6 The following notation which can be used as an alternative for "ObjectSet" (see ITU-T Rec. X.681 | ISO/IEC 8824-2, subclause 12.2) is defined in this Recommendation | International Standard:

– ParameterizedObjectSet (see 9.2).

6.3 Symbols

The following notation which can be used as an alternative for "Symbol" (see ITU-T Rec. X.680 | ISO/IEC 8824-1, subclause 10.1) is defined in this Recommendation | International Standard:

– ParameterizedReference (see 9.1).

7 ASN.1 items

This Recommendation | International Standard makes use of the ASN.1 items specified in ITU-T Rec. X.680 | ISO/IEC 8824-1, clause 9.

8 Parameterized assignments

8.1 There are parameterized assignment statements corresponding to each of the assignment statements specified in ITU-T Rec. X.680 | ISO/IEC 8824-1 and ITU-T Rec. X.681 | ISO/IEC 8824-2. The "ParameterizedAssignment" construct is:

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```
ParameterizedAssignment ::=
        ParameterizedTypeAssignment                 |
        ParameterizedValueAssignment                |
        ParameterizedValueSetTypeAssignment         |
        ParameterizedObjectClassAssignment          |
        ParameterizedObjectAssignment               |
        ParameterizedObjectSetAssignment
```

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8.2 Each "Parameterized<X>Assignment" has the same syntax as "<X>Assignment" except that following the initial item there is a "ParameterList". The initial item thereby becomes a parameterized reference name (see 3.4.2):

NOTE – ITU-T Rec. X.680 | ISO/IEC 8824-1 imposes the requirement that all reference names assigned within a module, whether parameterized or not, must be distinct.

```
ParameterizedTypeAssignment ::=
        typereference
        ParameterList
        "::="
        Type

ParameterizedValueAssignment ::=
        valuereference
        ParameterList
        Type
        "::="
        Value

ParameterizedValueSetTypeAssignment ::=
        typereference
        ParameterList
        Type
        "::="
        ValueSet

ParameterizedObjectClassAssignment ::=
        objectclassreference
        ParameterList
        "::="
        ObjectClass
```

ParameterizedObjectAssignment ::=
objectreference
ParameterList
DefinedObjectClass
"::="
Object

ParameterizedObjectSetAssignment ::=
objectsetreference
ParameterList
DefinedObjectClass
"::="
ObjectSet

8.3 A "ParameterList" is a list of "Parameter"s between braces.

ParameterList ::= "{" Parameter "," + "}"

Each "Parameter" consists of a "DummyReference" and possibly a "ParamGovernor".

Parameter ::= ParamGovernor ":" DummyReference | DummyReference

ParamGovernor ::= Governor | DummyGovernor

Governor ::= Type | DefinedObjectClass

DummyGovernor ::= DummyReference

DummyReference ::= Reference

A "DummyReference" in "Parameter" may stand for:

a) a "Type" or "DefinedObjectClass", in which case there shall be no "ParamGovernor";

b) a "Value" or "ValueSet", in which case the "ParamGovernor" shall be present, and in case "ParamGovernor" is a "Governor" it shall be a "Type", and in case "ParamGovernor" is a "DummyGovernor" the actual parameter for the "ParamGovernor" shall be a "Type";

c) an "Object" or "ObjectSet", in which case the "ParamGovernor" shall be present, and in case "ParamGovernor" is a "Governor" it shall be a "DefinedObjectClass", and in case "ParamGovernor" is a "DummyGovernor" the actual parameter for the "ParamGovernor" shall be a "DefinedObjectClass".

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A "DummyGovernor" shall be a "DummyReference" that has no "Governor".

8.4 The scope of a "DummyReference" appearing in a "ParameterList" is the "ParameterList" itself, together with that part of the "ParameterizedAssignment" which follows the "::=". The "DummyReference" hides any other "Reference" with the same name in that scope.

8.5 The usage of a "DummyReference" within its scope shall be consistent with its syntactic form, and, where applicable, governor, and all usages of the same "DummyReference" shall be consistent with one another.

NOTE – Where the syntactic form of a dummy reference name is ambiguous (for example, between whether it is an "objectclassreference" or "typereference"), the ambiguity can normally be resolved on the first use of the dummy reference name on the right-hand side of the assignment statement. Thereafter, the nature of the dummy reference name is known. The nature of the dummy reference is, however, not determined solely by the right hand side of the assignment statement when it is in turn used only as an actual parameter in a parameterized reference; in this case, the nature of the dummy reference must be determined by examining the definition of this parameterized reference. Users of the notation are warned that such a practice can make ASN.1 specifications less clear, and it is suggested that adequate comments are provided to explain this for human readers.

Example

Consider the following parameterized object class assignment:

```
PARAMETERIZED-OBJECT-CLASS { TypeParam, INTEGER:valueParam, INTEGER:ValueSetParam } ::=
    CLASS {
        &valueField1        TypeParam,
        &valueField2        INTEGER DEFAULT valueParam,
        &valueField3        INTEGER (ValueSetParam),
        &ValueSetField      INTEGER DEFAULT { ValueSetParam }
    }
```

For the purpose of determining proper usage of the "DummyReference"s in the scope of the "ParameterizedAssignment", and for that purpose only, the "DummyReference"s can be regarded to be defined as follows:

TypeParam ::= UnspecifiedType

valueParam INTEGER ::= unspecifiedIntegerValue

ValueSetParam INTEGER ::= { UnspecifiedIntegerValueSet }

where:

a) TypeParam is a "DummyReference" which stands for a "Type". Therefore TypeParam can be used wherever a "typereference" can be used, e.g. as a "Type" for the fixed-type value field valueField1.

b) valueParam is a "DummyReference" which stands for a value of an integer type. Therefore valueParam can be used wherever a "valuereference" of an integer value can be used, e.g. as a default value for the fixed-type value field valueField2.

c) ValueSetParam is a "DummyReference" which stands for a value set of an integer type. Therefore ValueSetParam can be used wherever a "typereference" of an integer value can be used, e.g. as a "Type" in the "ContainedSubtype" notation for valueField3 and ValueSetField.

8.6 Each "DummyReference" shall be employed at least once within its scope.

NOTE – If the "DummyReference" did not so appear, then the corresponding "ActualParameter" would have no effect on the definition, and would simply be "discarded", while to the user it might seem that some specification was taking place.

"ParameterizedValueAssignment"s, "ParameterizedValueSetTypeAssignment"s, "ParameterizedObjectAssignment"s and "ParameterizedObjectSetAssignment"s that contain either a direct or indirect reference to themselves are illegal.

8.7 In the definition of a "ParameterizedType", "ParameterizedValueSet", or "ParameterizedObjectClass, a "DummyReference" shall not be passed as a tagged type (as an actual parameter) to a recursive reference to that "ParameterizedType", "ParameterizedValueSet", or "ParameterizedObjectClass" (see A.3).

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8.8 In the definition of a "ParameterizedType", "ParameterizedValueSet", or "ParameterizedObjectClass, a circular reference to the item being defined shall not be made unless such reference is directly or indirectly marked OPTIONAL or, in the case of "ParameterizedType" and "ParameterizedValueSet", made through a reference to a choice type, at least one of whose alternatives is non-circular in definition.

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8.9 The governor of a "DummyReference" shall not include a reference to another "DummyReference" if that other "DummyReference" also has a governor.

8.10 In a parameterized assignment the right side of the "::=" shall not consist solely of a "DummyReference".

8.11 The governor of a "DummyReference" shall not require knowledge of either the "DummyReference" nor of the parameterized reference name being defined.

9 Referencing parameterized definitions

9.1 Within a "SymbolList" (in "Exports" or "Imports") a parameterized definition shall be referenced by a "ParameterizedReference":

ParameterizedReference ::= Reference | Reference "{" "}"

where "Reference" is the first item in the "ParameterizedAssignment", as specified in 8.2 above.

NOTE – The first alternative of "ParameterizedReference" is provided solely as an aid to human understanding. Both alternatives have the same meaning.

9.2 Other than in "Exports" or "Imports", a parameterized definition shall be referenced by a "Parameterized<X>" construct, which can be used as an alternative for the corresponding "<X>".

ParameterizedType ::=
SimpleDefinedType
ActualParameterList

SimpleDefinedType ::=
Externaltypereference |
typereference

ParameterizedValue ::=
SimpleDefinedValue
ActualParameterList

SimpleDefinedValue ::=
Externalvaluereference |
valuereference

ParameterizedValueSetType ::=
SimpleDefinedType
ActualParameterList

ParameterizedObjectClass ::=
DefinedObjectClass
ActualParameterList

ParameterizedObjectSet ::=
DefinedObjectSet
ActualParameterList

ParameterizedObject ::=
DefinedObject
ActualParameterList

9.3 The reference name in the "Defined<X>" shall be a reference name to which an assignment is made in a "ParameterizedAssignment".

9.4 The restrictions on the "Defined<X>" alternative to be used, which are specified in ITU-T Rec. X.680 | ISO/IEC 8824-1 and ITU-T Rec. X.681 | ISO/IEC 8824-2 as normal reference names, apply equally to the corresponding parameterized reference names.

NOTE – In essence, the restrictions are as follows. Each "Defined<X>" has two alternatives, "<x>reference" and "External<x>Reference". The former is used within the module of definition or if the definition has been imported and there is no name conflict; the latter is used where there is no imports listed (deprecated), or if there is a conflict between the imported name and a local definition (also deprecated) or between imports.

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9.5 The "ActualParameterList" is:

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ActualParameterList ::=
"{" ActualParameter "," + "}"

ActualParameter ::=
Type |
Value |
ValueSet |
DefinedObjectClass |
Object |
ObjectSet

9.6 There shall be exactly one "ActualParameter" for each "Parameter" in the corresponding "ParameterizedAssignment" and they shall appear in the same order. The particular choice of "ActualParameter", and the governor (if any) shall be determined by examination of the syntactic form of the "Parameter" and the environment in which it occurs in the "ParameterizedAssignment". The form of the "ActualParameter" shall be the form required to replace the "DummyReference" everywhere in its scope (see 8.4).

Example

The parameterized object class definition of the previous example (see 8.5) can be referenced, for instance, as follows:

MY-OBJECT-CLASS ::= PARAMETERIZED-OBJECT-CLASS { BIT STRING, 123, {4 | 5 | 6} }

9.7 The actual parameter takes the place of the dummy reference name in determining the actual type, value, value set, object class, object, or object set that is being referenced by this instance of use of the parameterized reference name.

9.8 The meaning of any references which appear in the "ActualParameter", and the tag default applicable to any tags which so appear, are determined according to the tagging environment of the "ActualParameter" rather than that of the corresponding "DummyReference".

NOTE – Thus, parameterization, like referencing, selection types, and "COMPONENTS OF", among others, is not exactly textual substitution.

Example

Consider the following modules:

```
M1 DEFINITIONS AUTOMATIC TAGS ::= BEGIN
    EXPORTS T1;

    T1 ::= SET {
        f1      INTEGER,
        f2      BOOLEAN
    }
END

M2 DEFINITIONS EXPLICIT TAGS ::= BEGIN
    IMPORTS T1 FROM  M1;

    T3 ::= T2{T1}

    T2{X} ::= SEQUENCE {
        a       INTEGER,
        b       X
    }
END
```

Application of 9.8 implies that the tag for the component f1 of T3 (i.e. @T3.b.f1) will be implicitly tagged because the tagging environment of the dummy parameter X, namely explicit tagging, does not affect the tagging of the components of the actual parameter T1.

Consider the module M3.

```
M3 DEFINITIONS AUTOMATIC TAGS ::= BEGIN
    IMPORTS T1 FROM M1;

    T5 ::= T4{T1}

    T4{Y} ::= SEQUENCE {
        a       INTEGER,
        b       Y
    }
END
```

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Application of ITU-T Rec. X.680 | ISO/IEC 8824-1, subclause 28.6, implies that the tag for the component b of T5 (i.e. @T5.b) will be explicitly tagged because the dummy parameter (Y) is always explicitly tagged, hence @T5 is equivalent to

```
T5 ::= SEQUENCE {
    a   [0] IMPLICIT INTEGER,
    b   [1] EXPLICIT SET {
        f1    [0] INTEGER,
        f2    [1] BOOLEAN
    }
}
```

while @T3 is equivalent to

```
T3 ::= SEQUENCE {
    a   INTEGER,
    b   SET {
        f1    [0] IMPLICIT INTEGER,
        f2    [1] IMPLICIT BOOLEAN
    }
}
```

10 Abstract syntax parameters

10.1 Annex of ITU-T Rec. X.681 | ISO/IEC 8824-2 provides the ABSTRACT-SYNTAX information object class and recommends its use to define abstract syntaxes, using as an example an abstract syntax defined as the set of values of a single ASN.1 type which was not parameterized at the outer level.