INTERNATIONAL STANDARD

ISO/IEC 8824-3

Sixth edition
2021-06

Information technology — Abstract Syntax Notation One (ASN.1) —

Part 3: Constraint specification

Technologies de l'information — Notation de syntaxe abstraite numéro un (ASN.1) —

Partie 3: Spécification des contraintes

Reference number
ISO/IEC 8824-3:2021(E)

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Published in Switzerland

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems,* in collaboration with ITU-T. The identical text is published as ITU-T X.682 (02/2021).

This sixth edition cancels and replaces the fifth edition (ISO/IEC 8824-3:2015), which has been technically revised. It also incorporates ISO/IEC 8824-3:2015/Cor 1:2018 and ISO/IEC 8824-3:2015/Cor 2:2018.

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Introduction

Application designers require a notation to define a structured data type to convey their semantics. This is provided in Rec. ITU-T X.680 | ISO/IEC 8824-1 and Rec. ITU-T X.681 | ISO/IEC 8824-2. A notation is also required to further constrain the values that can appear. Examples of such constraints are restricting the range of some component(s), or using a specified information object set to constrain an "ObjectClassFieldType" component, or using the "AtNotation" to specify a relation between components.

This Recommendation | International Standard provides the notation for the general case of constraint specification.

NOTE 1 – For historical reasons the special case of a "subtype constraint" is specified in Rec. ITU-T X.680 | ISO/IEC 8824-1.

Constraint notation can appear (in round brackets) after any use of the syntactic construct "Type", and the purpose of this Recommendation | International Standard is to specify the general case of what goes in the round brackets.

NOTE 2 – Multiple constraints (each inside its own round brackets) can be applied to the same "Type", as the result of constraining a "Type" is itself formally a "Type" construct.

When a constraint is applied to the textually outermost use of a "Type" construct, it results in the creation of a new type which is a subtype of the original (parent) type.

A subtype of a parent type can itself be used in defining other subtypes of the same parent type in other uses of the constraint notation. Thus the subset of values constituting a subtype can be defined either by limiting the range of the parent type, or by specifying the subtype as a union of sets of values.

NOTE 3 – The "ValueSet" notation specified in Rec. ITU-T X.680 | ISO/IEC 8824-1, 16.7, provides a further means of specifying a subtype.

Constraints may also be used to produce a subtype of a parent type (as described above) when the notation is embedded within another type. However, some "component relation" constraints are textually included following a "Type" (within a set or sequence type definition), but are not used to restrict the set of possible values of the "Type" which they follow (the referencing component). Rather, they specify a relation between the value of the referencing component and the value of one or more other "Type"s in the same set or sequence type (called the referenced components).

Component relation constraints can be seen as subtyping the sequence type within which they are embedded, but not necessarily the referencing type.

A constraint on an "ObjectClassFieldType" component can be applied by restricting the type or values in the component by using an information object set. Such constraints are called table constraints, since they are specified in terms of the "associated table" of the object set. The component relation constraints defined in this Recommendation | International Standard are a special case of table constraints.

Finally, a "Type" may be subtyped by specifying the set of values in the subtype by human-readable text. Such a constraint is called a user-defined constraint. For example, a user-defined constraint can be specified to constrain a **`BIT STRING`** to the set of values produced by the encryption of a value of a specified ASN.1 type.

It is the purpose of this Recommendation | International Standard to provide the notation to be used for specifying table constraints (including component relation constraints), and user-defined constraints.

NOTE 4 – In general, full support for the specification of constraints in a flexible way (particularly component relation constraints, subtyping constraints, and user-defined constraints with a formally defined body) would require notation with a power comparable to that of programming languages. Such power can only be sensibly provided by the establishment of links from the ASN.1 notation into some other defined computer language. This version of this Recommendation | International Standard does not provide such links, and hence supports only a small number of constraining mechanisms.

While the embedding of notation defining constraints (subtypes and relationships) will frequently be the most convenient form of specification (particularly for the simple subtyping of primitive components of structures), separate (external) specification will sometimes be preferred, particularly where the constraints are being imposed by a separate group from that which defined the basic protocol.

NOTE 5 – The parameterization defined in Rec. ITU-T X.683 | ISO/IEC 8824-4 is specifically designed to enable a piece of ASN.1 specification (and in particular, a constraint) to be parameterized, allowing the actual constraint to be imposed by some other group that provides actual parameters for the parameterized construct.

The notations for constraint specification supported here are:

- user-defined constraints (see clause 9);
- table constraints, including component relation constraints between two components which are carrying values related to an information object, defined using the notation of Rec. ITU-T X.681 | ISO/IEC 8824-2 (see clause 10);
- contents constraints (see clause 11).

The application of table constraints to the "InstanceOfType" construct of Rec. ITU-T X.681 | ISO/IEC 8824-2, Annex C, is specified in Annex A.

INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification

1 Scope

This Recommendation | International Standard is part of Abstract Syntax Notation One (ASN.1) and provides notation for specifying user-defined constraints, table constraints, and contents constraints.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- Recommendation ITU-T X.680 (2021) | ISO/IEC 8824-1:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*
- Recommendation ITU-T X.681 (2021) | ISO/IEC 8824-2:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification.*
- Recommendation ITU-T X.683 (2021) | ISO/IEC 8824-4:2021, *Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications.*

NOTE – The references above shall be interpreted as references to the identified Recommendations | International Standards together with all their published amendments and technical corrigenda.

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 Rec. ITU-T X.680 | ISO/IEC 8824-1.

3.2 Information object specification

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

3.3 Parameterization of ASN.1 specification

This Recommendation | International Standard uses the following term defined in Rec. ITU-T X.683 | ISO/IEC 8824-4:

- parameterized type.

3.4 Additional definitions

3.4.1 component relation constraint: A constraint on the values of a set type or sequence type which is textually associated with one of the component types (the referencing component) of the set type or sequence type, and which specifies the relationship between the value of that component and the values of one or more other components (the referenced components).

3.4.2 constrained type: The innermost "Type" which contains the referencing component and all of the referenced components of some component relation constraint.

3.4.3 constraining set: The information object set referenced in some component relation constraint.

3.4.4 constraining table: The associated table (see Rec. ITU-T X.681 | ISO/IEC 8824-2, clause 13) corresponding to a constraining set.

3.4.5 referenced component: A component of a set type or sequence type identified in a component relation constraint.

3.4.6 referencing component: A component of a set type or sequence type which has an associated component relation constraint.

3.4.7 selected rows: Those rows of a constraining table which contain, in the appropriate columns, the values of all of the referenced components.

3.4.8 table constraint: A constraint applied to an object class field type which demands that its values conform to the contents of the appropriate column of some table.

3.4.9 user-defined constraint: A constraint which requires a more complicated statement than can be accommodated by the other forms of constraint, and which must therefore involve specification by some means outside of ASN.1.

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviation applies:

ASN.1 Abstract Syntax Notation One

5 Convention

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

6 Notation

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

6.1 Constraint

The following notation which can be used as an alternative for "ConstraintSpec" (see Rec. ITU-T X.680 | ISO/IEC 8824-1, 49.6) is defined in this Recommendation | International Standard:

– GeneralConstraint (see 8.1).

7 ASN.1 lexical items

In addition to the lexical items specified in Rec. ITU-T X.680 | ISO/IEC 8824-1, clause 12, this Recommendation | International Standard makes use of the lexical items specified in the following subclauses. The general rules applicable to these lexical items are as defined in Rec. ITU-T X.680 | ISO/IEC 8824-1, 12.1. These new lexical items make use of the ASN.1 character set, as specified in Rec. ITU-T X.680 | ISO/IEC 8824-1, clause 11.

7.1 Additional keywords

The names **CONSTRAINED**, **CONTAINING**, **ENCODED** and **BY** are listed in Rec. ITU-T X.680 | ISO/IEC 8824-1, 12.38, as reserved words.

8 General constraint specification

8.1 The notation for a "GeneralConstraint" is as follows:

```
GeneralConstraint ::=
UserDefinedConstraint
|    TableConstraint
|    ContentsConstraint
```

8.2 The various possibilities for specification of the constraint are defined as follows:

a) "UserDefinedConstraint", in clause 9;

b) "TableConstraint", in clause 10;

c) "ContentsConstraint", in clause 11.

9 User-defined constraints

NOTE 1 – This form of constraint specification can be regarded as a special form of ASN.1 comment, since it is not fully machine-processable. However, it would be possible for an automatic tool to use the presence of a particular user-defined constraint to invoke user-supplied constraint checking.

NOTE 2 – Protocol designers should be aware that since the definition of a constraint in this way is not fully machine-processable, a specification which employs this capability may be less easy to handle with automatic tools.

9.1 A user-defined constraint is specified by the syntax:

```
UserDefinedConstraint ::=
CONSTRAINED BY "{" UserDefinedConstraintParameter "," * "}"
```

9.2 It is recommended that the actual constraint be referenced by a comment anywhere inside the braces ("**{**" and "**}**"). This comment should clearly state what constraint is imposed by the "UserDefinedConstraint".

NOTE – If there are any "UserDefinedConstraintParameter"s within the braces (see 9.3), the comments may precede, follow, or be interspersed among them, at the definer's convenience.

9.3 The actual constraint to be applied may depend on some parameters. For each such parameter, a "UserDefinedConstraintParameter" shall be included in the "UserDefinedConstraint". Each "UserDefinedConstraintParameter" shall be any "Value", "Object", "DefinedObjectSet", "Type" or "DefinedObjectClass" which is specified by a reference name or, in the case of "Value", "Object" or "Type", can also be defined inline.

NOTE – The reference name may be a dummy parameter if the "UserDefinedConstraint" is used within a "ParameterizedAssignment".


```
UserDefinedConstraintParameter ::=
Governor ":" Value
|   Governor ":" Object
|   DefinedObjectSet
|   Type
|   DefinedObjectClass
```


The notation "Governor" is defined in Rec. ITU-T X.683 | ISO/IEC 8824-4, 8.3. When the first alternative is used, the "Governor" shall be a "Type". When the second alternative is used, the "Governor" shall be a "DefinedObjectClass".

9.4 Example

If an application designer wishes to specify that certain components are to be bit strings carrying an encryption of the value of some ASN.1 type (different for each component), then (using the parameterization of Rec. ITU-T X.683 | ISO/IEC 8824-4) the parameterized **ENCRYPTED** type can be defined as follows:

```
ENCRYPTED {ToBeEnciphered} ::= BIT STRING
(CONSTRAINED BY
        {-- must be the result of the encipherment of some BER-encoded
         -- value of -- ToBeEnciphered}
! Error : securityViolation)

Error ::= ENUMERATED {securityViolation}
```

and a use of the **ENCRYPTED** parameterized subtype of **BIT STRING** (which is what the **ENCRYPTED** type is) becomes simply:

```
ENCRYPTED{SecurityParameters}
```

or, equivalently, at the whim of the designer:

```
BIT STRING (ENCRYPTED{SecurityParameters})
```

The occurrence of a **securityViolation** is handled according to local security policy.