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

Part 2: Information object specification

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National foreword

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

Part 2: Information object specification

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

Partie 2: Spécification des objets informationnels

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Foreword

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CONTENTS

		Page
Introduction		iv
1	Scope	1
2	Normative references	1
	2.1 Identical Recommendations | International Standards	1
3	Definitions	1
	3.1 Specification of basic notation	1
	3.2 Constraint specification	1
	3.3 Parameterization of ASN.1 specification	1
	3.4 Additional definitions	2
4	Abbreviations	3
5	Convention	3
6	Notation	3
	6.1 Assignments	3
	6.2 Types	3
	6.3 Values	4
	6.4 Elements	4
7	ASN.1 lexical items	4
	7.1 Information object class references	4
	7.2 Information object references	4
	7.3 Information object set references	4
	7.4 Type field references	4
	7.5 Value field references	4
	7.6 Value set field references	5
	7.7 Object field references	5
	7.8 Object set field references	5
	7.9 Word	5
	7.10 Additional keywords	5
8	Referencing definitions	5
9	Information object class definition and assignment	6
10	Syntax List	9
11	Information object definition and assignment	12
12	Information object set definition and assignment	14
13	Associated tables	15
14	Notation for the object class field type	16
15	Information from objects	18
Annex A – The TYPE-IDENTIFIER information object class		21
Annex B – Abstract syntax definitions		22
Annex C – The instance-of type		23
Annex D – Examples		25
	D.1 Example usage of simplified OPERATION class	25
	D.2 Example usage of "ObjectClassFieldType"	26
	D.3 Illustrate usage of objects and object sets	27
Annex E – Tutorial annex on the ASN.1 model of object set extension		28
Annex F – Summary of the notation		29

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Introduction

An application designer frequently needs to design a protocol which will work with any of a number of instances of some class of information objects, where instances of the class may be defined by a variety of other bodies, and may be added to over time. Examples of such information object classes are the "operations" of Remote Operations Service (ROS) and the "attributes" of the OSI Directory.

This Recommendation | International Standard provides notation which allows information object classes as well as individual information objects and information object sets thereof to be defined and given reference names.

An information object class is characterized by the kinds of fields possessed by its instances. A field may contain:

- an arbitrary type (a type field); or
- a single value of a specified type (a fixed-type value field); or
- a single value of a type specified in a (named) type field (a variable-type value field);
- a non-empty set of values of a specified type (a fixed-type value set field); or
- a non-empty set of values of a type specified in a (named) type field (a variable-type value set field); or
- a single information object from a specified information object class (an object field);
- an information object set from a specified information object class (an object set field).

A fixed-type value field of an information object class may be selected to provide unique identification of information objects in that class. This is called the identifier field for that class. Values of the identifier field, if supplied, are required to be unique within any information object set that is defined for that class. They may, but need not, serve to unambiguously identify information objects of that class within some broader scope, particularly by the use of object identifier as the type of the identifier field.

An information object class is defined by specifying:

- the names of the fields;
- for each field, the form of that field (type, fixed-type value, variable-type value, fixed-type value set, variable-type value set, object, or object set);
- optionality and default settings of fields;
- which field, if any, is the identifier field.

An individual information object in the class is defined by providing the necessary information for each field.

The notation defined herein permits an ASN.1 type to be specified by reference to a field of some information object class – the object class field type. In Rec. ITU-T X.682 | ISO/IEC 8824-3, notation is provided to enable this type to be restricted by reference to some specific information object set.

It can be useful to consider the definition of an information object class as defining the form of an underlying conceptual table (the associated table) with one column for each field, and with a completed row defining an information object. The form of the table (determined by the information object class specification) determines the sort of information to be collected and used to complete some protocol specification. The underlying conceptual table provides the link between those specifying information objects of that class and the protocol which needs that information to complete its specification. Typically, the actual information object set used to complete a particular protocol specification will be a parameter of that protocol (see Rec. ITU-T X.683 | ISO/IEC 8824-4).

The "InformationFromObjects" notation referencing a specific object or object set (probably a parameter) can be used to extract information from cells of conceptual tables.

This Recommendation | International Standard:

- Specifies a notation for defining an information object class, and for identifying it with a reference name (see clause 9).
- Specifies a notation by which the definer of an information object class can provide a defined syntax for the definition of information objects of that class; a default notation is provided for classes for which no defined syntax has been defined (see clause 10).
- Specifies a notation for defining an information object, and for assigning it to a reference name (see clause 11), and provides analogous notation for an object set (see clause 12).
- Defines the "associated table" for an object or object set of a class (see clause 13).

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– Specifies notation for the object class field type and its values (see clause 14).

NOTE – These constructs enable an ASN.1 type to be specified using a named field of a named information object class. Constraints on that type to restrict it to values related to a specific information object set appear in Rec. ITU-T X.682 | ISO/IEC 8824-3.

– Specifies notation for extracting information from objects (see clause 15).

The set of information objects used in defining an object set may be partially or entirely unknown at the time of definition of an ASN.1 specification. Such cases occur, for example, in network management where the set of managed objects varies while the network manager is executing. This Recommendation | International Standard specifies the rules for inclusion of an *extension marker* in the definition of object sets to signal to implementers the intention of the designer that the contents of the object set is not fully defined in the ASN.1 specification. When an object set is defined with an extension marker, the implementer must provide means, possibly outside the scope of ASN.1, for dynamically adding objects to the object set and removing previously added objects from the object set.

Annex A, which is an integral part of this Recommendation | International Standard, specifies the information object class whose object class reference is **`TYPE-IDENTIFIER`**. This is the simplest useful class, with just two fields, an identifier field of type object identifier, and a single type field which defines the ASN.1 type for carrying all information concerning any particular object in the class. It is defined herein because of the widespread use of information objects of this form.

Annex B, which is an integral part of this Recommendation | International Standard, specifies the notation for defining an abstract syntax (composed of the set of values of a single ASN.1 type) by the definition of an appropriate information object.

Annex C, which is an integral part of this Recommendation | International Standard, specifies the notation for the instance-of type (the **`INSTANCE OF`** notation).

Annex D, which is not an integral part of this Recommendation | International Standard, provides examples on how to use the notation described in this Recommendation | International Standard.

Annex E, which is not an integral part of this Recommendation | International Standard, provides a summary of the ASN.1 model of object set extension.

Annex F, which is not an integral part of this Recommendation | International Standard, provides a summary of the notation defined herein.

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INTERNATIONAL STANDARD
ITU-T RECOMMENDATION

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

1 Scope

This Recommendation | International Standard is part of Abstract Syntax Notation One (ASN.1) and provides notation for specifying information object classes, information objects and information object sets.

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

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

– table constraint.

3.3 Parameterization of ASN.1 specification

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

a) parameterized type;

b) parameterized value.

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3.4 Additional definitions

3.4.1 associated table: (For some information object or information object set) an abstract table, derivable from the object or object set by flattening the hierarchical structure resulting from the presence of link fields (see 3.4.15).

NOTE – An associated table can be used to determine the precise nature of some constraint (see Rec. ITU-T X.682 | ISO/IEC 8824-3) which has been applied using an object set.

3.4.2 default syntax: The notation which shall be used for defining information objects of classes whose definers have not provided a defined syntax (see example 11.10).

3.4.3 defined syntax: A notation, provided by the definer of a class, which allows information objects of that class to be defined in a user-friendly manner.

NOTE – For example, the defined syntax for the class **OPERATION** might allow instances of the class to be defined by the word **ARGUMENT** followed by **&ArgumentType**, then the word **RESULT** followed by the **&ResultType**, then the word **CODE** followed by **&operationCode** (see example 11.11).

3.4.4 extensible object set: An object set with an extension marker or which has been defined using set arithmetic with object sets that are extensible.

3.4.5 field: A component of an information object class. Each field is a type field, a fixed-type value field, a variable-type value field, a fixed-type value set field, a variable-type value set field, an information object field or an information object set field.

3.4.6 field name: A name which identifies a field of some class; either the class which specifies the field directly, in which case the name is a primitive field name, or a class which has a chain of link fields to that in which the field is actually specified (see 9.13 and 9.14).

3.4.7 governing (class); governor: An information object class definition or reference which affects the interpretation of a part of the ASN.1 syntax, requiring it to reference or to specify information objects of the governing class.

3.4.8 identifier field: A fixed-type value field of a class, selected to provide unique identification of information objects in that class. Values of the identifier field, if supplied, are required to be unambiguous within any information object set that is defined for that class. They may, but need not, serve to unambiguously identify information objects of that class within some broader scope.

NOTE 1 – The identifier field has a fixed ASN.1 type, and values of that type can be carried in protocol to identify information objects within the class.

NOTE 2 – The scope within which the identifier is unambiguous is that of an information object set. It could, however, also be made unambiguous within any given abstract syntax, or within an entire application context, or could even be global across all classes and all application contexts by use of the object identifier type for the identifier field.

3.4.9 information object: An instance of some information object class, being composed of a set of fields which conform to the field specifications of the class.

NOTE – For example, one specific instance of the information object class **OPERATION** (mentioned in the example in 3.4.10) might be **invertMatrix**, which has an **&ArgumentType** field containing the type **Matrix**, a **&ResultType** field also containing the type **Matrix**, and an **&operationCode** field containing the value 7 (see example in 10.13).

3.4.10 information object class (class): A set of fields, forming a template for the definition of a potentially unbounded collection of information objects, the instances of the class.

NOTE – For example, an information object class **OPERATION** might be defined to correspond to the **operation** concept of Remote Operations Service (ROS). Each of the various named field specifications would then correspond to some aspect which can vary from one operation instance to another. Thus, there could be **&ArgumentType**, **&ResultType**, and **&operationCode** fields, the first two specifying type fields and the third specifying a value field.

3.4.11 information object field: A field which contains an information object of some specified class.

3.4.12 information object set: A non-empty set of information objects, all defined using the same information object class reference name.

NOTE – For example, one information object set, **MatrixOperations**, of the class **OPERATION** (used in the example in 3.4.10) might contain **invertMatrix** (mentioned in 3.4.9) together with other related operations, such as **addMatrices**, **multiplyMatrices**, etc. Such an object set might be used in defining an abstract syntax that makes provision for the invocation and result reporting of all of these operations (see example in 12.11).

3.4.13 information object set field: A field which contains an information object set of some specified class.

3.4.14 instance-of type: A type, defined by referencing an information object class which associates object identifiers with types.

3.4.15 link field: An object or object set field.

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3.4.16 object class field type: A type specified by reference to some field of an information object class. In Rec. ITU-T X.682 | ISO/IEC 8824-3, notation is provided to enable this type to be restricted by reference to an information object set of the class.

3.4.17 primitive field name: The name specified directly in an information object class definition without use of a link field.

3.4.18 recursive definition (of a reference name): A reference name for which resolution of the reference name, or of the governor of the definition of the reference name, requires resolution of the original reference name.

NOTE – Recursive definition of an information object class is permitted. Recursive definition of an information object or an information object set is forbidden by 11.2 and 12.2 respectively.

3.4.19 recursive instantiation (of a parameterized reference name): An instantiation of a reference name, where resolution of the actual parameters requires resolution of the original reference name.

NOTE – Recursive instantiation of an information object class (including an encoding structure) is permitted. Recursive instantiation of an information object or an information object set is forbidden by 11.2 and 12.2 respectively.

3.4.20 type field: A field which contains an arbitrary type.

3.4.21 value field: A field which contains a value. Such a field is either of fixed-type or of variable-type. In the former case the type of the value is fixed by the field specification. In the latter case the type of the value is contained in some (specific) type field of the same information object.

3.4.22 value set field: A field which contains a non-empty set of values of some type. Such a field is either of fixed-type or of variable-type. In the former case the type of the values is fixed by the field specification. In the latter case the type of the values is contained in some (specific) type field of the same information object.

NOTE – The set of values in a value set field for an information object constitutes a subtype of the specified type.

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 Assignments

The following notations which can be used as alternatives for "Assignment" (see Rec. ITU-T X.680 | ISO/IEC 8824-1, clause 13) are defined in this Recommendation | International Standard:

– ObjectClassAssignment (see 9.1);

– ObjectAssignment (see 11.1);

– ObjectSetAssignment (see 12.1).

6.2 Types

6.2.1 The following notations which can be used as alternatives for "BuiltinType" (see Rec. ITU-T X.680 | ISO/IEC 8824-1, 17.2) are defined in this Recommendation | International Standard:

– ObjectClassFieldType (see 14.1);

– InstanceOfType (see Annex C).

6.2.2 The following notations which can be used as alternatives for "ReferencedType" (see Rec. ITU-T X.680 | ISO/IEC 8824-1, 17.3) are defined in this Recommendation | International Standard:

– TypeFromObject (see clause 15);

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– ValueSetFromObjects (see clause 15).

6.3 Values

6.3.1 The following notation which can be used as an alternative for "Value" (see Rec. ITU-T X.680 | ISO/IEC 8824-1, 17.7) is defined in this Recommendation | International Standard:

– ObjectClassFieldValue (see 14.6);

6.3.2 The following notation which can be used as an alternative for "BuiltinValue" (see Rec. ITU-T X.680 | ISO/IEC 8824-1, 17.9) is defined in this Recommendation | International Standard:

– InstanceOfValue (see Annex C).

6.3.3 The following notation which can be used as an alternative for "ReferencedValue" (see Rec. ITU-T X.680 | ISO/IEC 8824-1, 17.11) is defined in this Recommendation | International Standard:

– ValueFromObject (see clause 15).

6.4 Elements

6.4.1 The following notation which can be used as an alternative for "Elements" (see Rec. ITU-T X.680 | ISO/IEC 8824-1, 50.6) is defined in this Recommendation | International Standard:

– ObjectSetElements (see 12.10).

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, and in addition the character ampersand ("**&**").

NOTE – The Note in Rec. ITU-T X.680 | ISO/IEC 8824-1, 11.1, also applies to the lexical items specified in 7.1 to 7.9 below.

7.1 Information object class references

Name of lexical item – objectclassreference

An "objectclassreference" shall consist of a sequence of characters as specified for a "typereference" in Rec. ITU-T X.680 | ISO/IEC 8824-1, 12.2, except that no lower-case letters shall be included.

7.2 Information object references

Name of lexical item – objectreference

An "objectreference" shall consist of a sequence of characters as specified for a "valuereference" in Rec. ITU-T X.680 | ISO/IEC 8824-1, 12.4.

7.3 Information object set references

Name of lexical item – objectsetreference

An "objectsetreference" shall consist of a sequence of characters as specified for a "typereference" in Rec. ITU-T X.680 | ISO/IEC 8824-1, 12.2.

7.4 Type field references

Name of lexical item – typefieldreference

A "typefieldreference" shall consist of an ampersand ("**&**") immediately followed by a sequence of characters as specified for a "typereference" in Rec. ITU-T X.680 | ISO/IEC 8824-1, 12.2.

7.5 Value field references

Name of lexical item – valuefieldreference

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