



TECHNICAL REPORT

# TR-106

## Data Model Template for TR-069-Enabled Devices

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## **Executive Summary**

TR-106 specifies data model guidelines to be followed by all TR-069-enabled [2] devices. These guidelines include structural requirements for the data hierarchy, requirements for versioning of data models, and requirements for defining profiles.

In addition, TR-106 defines an XML Schema that as far as possible embodies these guidelines, and which is used for defining all TR-069 data models. This makes data model definitions rigorous, and helps to reduce the danger that different implementations will interpret data model definitions in different ways.

TR-106 also defines an XML Schema that allows a device to describe its supported TR-069 data models. This description is both specific and detailed, allowing an ACS to know exactly what is supported by the device, including any vendor-specific objects and parameters. Use of this Schema enhances interoperability and significantly eases the integration of new devices with an ACS.

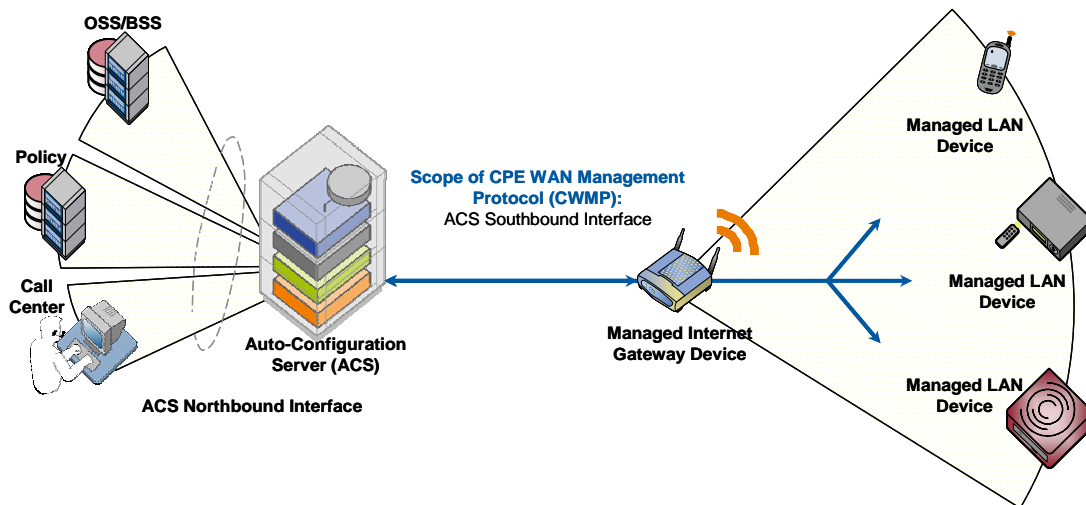
## 1 Introduction

TR-069 [2] defines the generic requirements of the CPE WAN Management Protocol (CWMP) methods which can be applied to any TR-069-enabled CPE. It is intended to support a variety of different functionalities to manage a collection of CPE, including the following primary capabilities:

- Auto-configuration and dynamic service provisioning
- Software/firmware image management
- Status and performance monitoring
- Diagnostics

The ability to manage the home network remotely has a number of benefits including reducing the costs associated with activation and support of broadband services, improving time-to-market for new products and services, and improving the user experience.

The following figure places TR-069 in the end-to-end management architecture:



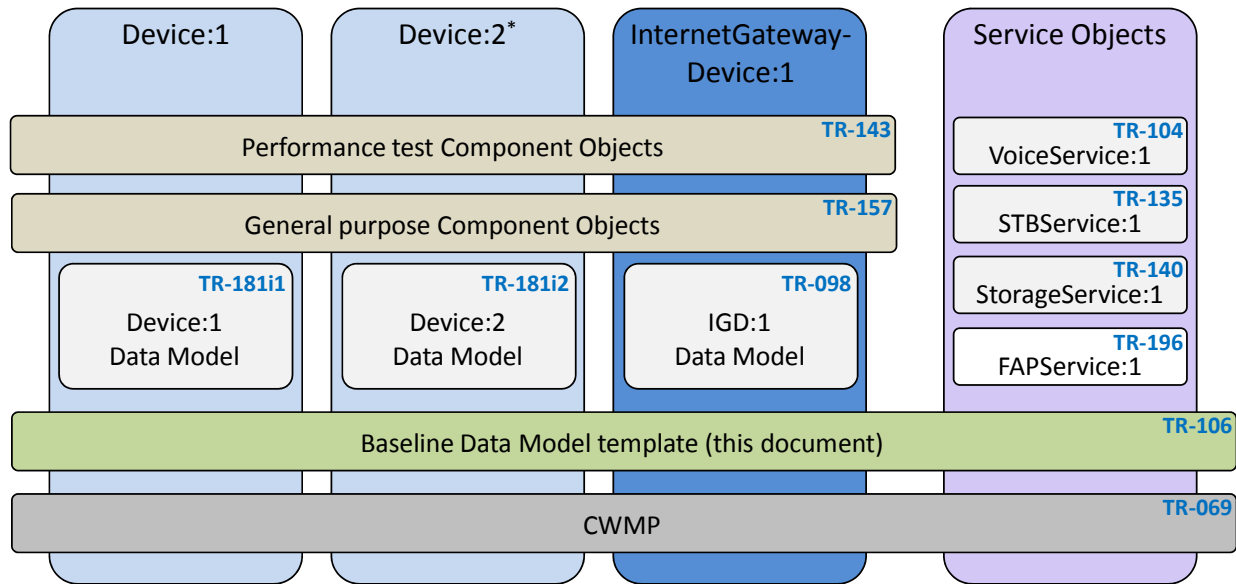
**Figure 1 – Positioning in the End-to-End Architecture**

The ACS is a server that resides in the network and manages devices in the subscriber premises. It uses the methods, or RPCs, defined in TR-069 to get and set the state of the device, initiate diagnostic tests, download and upload files, and manage events. Some portions of this state are common across managed devices and some are relevant only to certain device types or services.

### Specification Structure

Figure 2 shows the overall specification structure for the TR-069 [2] family of standards (as currently defined). Please note that this will gradually become out of date as new documents are published.





\* The Device:2 Data Model applies to all types of device, including Internet Gateway Devices (it includes everything that is in the IGD:1 data model)

**Figure 2 – Specification Structure**

TR-069 [2] defines the generic requirements of the CWMP methods which can be applied to any TR-069-enabled device. TR-106 (this document) specifies a baseline object structure to be supported by any TR-069-enabled device. It specifies how to structure and define data models, which are collections of objects and parameters on which the generic methods act to configure, diagnose, and monitor the state of specific devices and services. The actual data models are defined in their own specifications.

For a particular type of device, it is expected that the baseline defined in a document such as TR-181 [13] would be augmented with additional objects and parameters specific to the device type. The data model used in any TR-069-enabled device MUST follow the guidelines described in this document. These guidelines include the following aspects:

- Structural requirements for the data hierarchy
- Requirements for versioning of data models
- Requirements for defining profiles

In addition, this document defines two XML Schemas:

- An XML Schema that as far as possible embodies these guidelines, and which is used for defining all TR-069 data models. This makes data model definitions rigorous, and helps to reduce the danger that different implementations will interpret data model definitions in different ways.
- An XML Schema that allows a device to describe its supported TR-069 data models. This description is both specific and detailed, allowing an ACS to know exactly what is supported by the device, including any vendor-specific objects and parameters. Use of this Schema enhances interoperability and significantly eases the integration of new devices with an ACS.

## 1.1 Terminology

The following terminology is used throughout the series of documents defining the CPE WAN Management Protocol.

<b>ACS</b>	Auto-Configuration Server. This is a component in the broadband network responsible for auto-configuration of the <i>CPE</i> for advanced services.
<b>BBF</b>	Broadband Forum.
<b>Base Supported Data Model</b>	The <i>Data Model</i> that is supported by all <i>CPE</i> of a given make, model and firmware version. This refers to the <i>Objects</i> and/or <i>Parameters</i> that have code support in the current firmware.
<b>CPE</b>	Customer Premises Equipment; refers to any TR-069-enabled [2] device and therefore covers both Internet Gateway devices and LAN-side end devices.
<b>Current Supported Data Model</b>	The <i>Data Model</i> that is currently supported by an individual <i>CPE</i> , i.e. the <i>Base Supported Data Model</i> plus any additional <i>Objects</i> and/or <i>Parameters</i> supported by extra modules that have been installed on the <i>CPE</i> . This refers to the <i>Objects</i> and/or <i>Parameters</i> that have code support in the <i>CPE</i> .
<b>Common Object</b>	An <i>Object</i> defined in TR-181 [13] that can be contained either directly within the “Device” <i>Root Object</i> or (if the Common Object is a <i>Secondary Common Object</i> ) within a <i>Service Object</i> contained within the “Services” object.
<b>Component</b>	A named collection of <i>Objects</i> and/or <i>Parameters</i> and/or <i>Profiles</i> that can be included anywhere within a <i>Data Model</i> .
<b>CWMP</b>	<i>CPE</i> WAN Management Protocol. Defined in TR-069 [2], CWMP is a communication protocol between an <i>ACS</i> and <i>CPE</i> that defines a mechanism for secure auto-configuration of a <i>CPE</i> and other <i>CPE</i> management functions in a common framework.
<b>Data Model</b>	A hierarchical set of <i>Objects</i> and/or <i>Parameters</i> that define the managed objects accessible via TR-069 [2] for a particular <i>CPE</i> .
<b>Device</b>	Used here as a synonym for <i>CPE</i> .
<b>DM Instance</b>	Data Model Schema instance document. This is an XML document that conforms to the <i>DM Schema</i> and to any additional rules specified in or referenced by the <i>DM Schema</i> .
<b>DM Schema</b>	Data Model Schema. This is the XML Schema [11] that is used for defining data models for use with <i>CWMP</i> .
<b>DT Instance</b>	Device Type Schema instance document. This is an XML document that conforms to the <i>DT Schema</i> and to any additional rules specified in or referenced by the <i>DT Schema</i> .
<b>DT Schema</b>	Device Type Schema. This is the XML Schema [11] that is used for describing a <i>Device’s Supported Data Model</i> .
<b>Event</b>	An indication that something of interest has happened that requires the <i>CPE</i> to notify the <i>ACS</i> .
<b>Instantiated Data Model</b>	The <i>Data Model</i> that currently exists on an individual <i>CPE</i> . This refers to the <i>Object</i> instances and/or <i>Parameters</i> that currently exist within the data model. It can be thought of as the <i>Current Supported Data Model</i> with all the “{i}” placeholders expanded to be the actual instance numbers.  For example, “Device.Services.ABCService.{i}” in the <i>Current Supported Data Model</i> might correspond to “Device.Services.ABCService.1” and “Device.Services.ABCService.2” in the Instantiated Data Model.
<b>Internet Gateway Device</b>	A <i>CPE</i> device, typically a broadband router, that acts as a gateway between the WAN and the LAN.

<b>MediaWiki</b>	A software application that is used by Wikipedia and other projects. <a href="http://en.wikipedia.org/wiki/MediaWiki">http://en.wikipedia.org/wiki/MediaWiki</a> .
<b>Object</b>	A named collection of <i>Parameters</i> and/or other Objects.
<b>Parameter</b>	A name-value pair representing a manageable <i>CPE</i> parameter made accessible to an <i>ACS</i> for reading and/or writing.
<b>RPC</b>	Remote Procedure Call.
<b>Profile</b>	A named collection of requirements relating to a given <i>Root Object</i> , <i>Service Object</i> or <i>Component</i> .
<b>Root Object</b>	The top-level object of a <i>CPE</i> 's <i>Data Model</i> that contains all of the manageable objects. The name of the Root Object is either "Device" or "InternetGatewayDevice" – the latter is used only for the TR-098 [3] InternetGatewayDevice:1 <i>Data Model</i> .
<b>Secondary Common Object</b>	A <i>Common Object</i> other than "ManagementServer" or "GatewayInfo". Such objects can be contained either directly within the "Device" <i>Root Object</i> or within a <i>Service Object</i> contained within the "Services" object.
<b>Service Object</b>	The top-most object associated with a specific service within which all <i>Objects</i> and <i>Parameters</i> associated with the service are contained.
<b>Supported Data Model</b>	Refers to either <i>Base Supported Data Model</i> or <i>Current Supported Data Model</i> , depending on the context.
<b>URI</b>	Uniform Resource Identifier [7].
<b>URL</b>	Uniform Resource Locator [7].

## 1.2 Document Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [1].

## 2 Architecture

### 2.1 Data Hierarchy

The data model for a TR-069-enabled [2] device will follow a common set of structural requirements. The detailed structure depends on the nature of the device.

A device will always have a single Root Object, which will be called either "Device" or "InternetGatewayDevice". The latter is used only for the TR-098 [3] InternetGatewayDevice:1 data model.

In most cases, the Root Object contains three types of sub-elements: the Common Objects defined in TR-181 [13] (applicable only to the "Device" Root Object), Components defined in other specifications such as TR-143 [10] and TR-157 [12] (applicable to both the "Device" and "InternetGatewayDevice" Root Objects), and a single "Services" object that contains all Service Objects associated with specific services.

If the device implements the existing TR-098 [3] InternetGatewayDevice:1 data model, the Root Object will also contain the application-specific objects associated with an Internet Gateway Device.

A single device might include more than one Service Object. For example, a device that serves both as a VoIP endpoint and a game device, might include both VoIP-specific and game-specific Service Objects.

A single device might also include more than one instance of the same type of Service Object. An example of when this might be appropriate is a TR-069-enabled device that proxies the management functions for one or more other devices that are not TR-069-enabled. In this case, the ACS would communicate directly only with the TR-069-enabled device, which would incorporate the data models for all devices for which it is serving as a management proxy. For example, a video device serving as a management proxy for three VoIP phones would contain in its data model a video-specific Service Object plus three instances of a VoIP-specific Service Object. Note that whether a

device is serving as a management proxy for another device or whether it has that functionality embedded in it is generally opaque to the ACS.

### 2.1.1 Data Hierarchy Requirements

The data model for a TR-069-enabled [2] device (other than a device that implements the TR-098 [3] InternetGatewayDevice:1 data model) MUST adhere to the following structural requirements:

- 1) The data model MUST contain exactly one Root Object, called “Device”.
- 2) If (and only if) the Root Object major version (section 2.2) is 1, the Root Object MUST contain the (DEPRECATED) “DeviceSummary” parameter as specified in section 3.7.
- 3) The Root Object MAY contain any of the Common Objects defined in TR-181 [13], and Components defined in other specifications, e.g. TR-143 [10] or TR-157 [12], with the proviso that a Component that is defined as a child of a Common Object can only be included if the Common Object is also included.
- 4) The Root Object MUST contain exactly one “Services” object.
- 5) The “Services” object MUST contain all of the Service Objects supported by the device. Each Service Object contains all of the objects and parameters for a particular service.
- 6) The “Services” object MAY contain more than one Service Object, each corresponding to a distinct service type.
- 7) The “Services” object MAY contain more than one instance of a Service Object of the same type.
- 8) Each Service Object instance MUST be appended with an instance number (assigned by the CPE) to allow for the possibility of multiple instances of each. For example, if the device supports the Service Object ABCService, the first instance of this Service Object might be “ABCService.1”.
- 9) For each supported type of Service Object, a corresponding parameter in the “Services” object MUST indicate the number of instances of that Service Object type. If a particular Service Object type is supported by the device but there are currently no instances present, this parameter MUST still be present with a value of zero. The name of this parameter MUST be the name of the Service Object concatenated with “NumberOfEntries”. For example, for a device that contains instances of ABCService, there MUST be a corresponding parameter in the “Services” object called “ABCServiceNumberOfEntries”.
- 10) Each Service Object MAY contain additional copies of Secondary Common Objects, i.e. any of the Common Objects defined in TR-181 [13] other than ManagementServer and GatewayInfo (these two Common Objects are directly related to CWMP, and do not make sense in a Service Object).

A device that implements the TR-098 [3] InternetGatewayDevice:1 data model MUST adhere to the above requirements with the following exceptions:

- 1) The data model MUST contain exactly one Root Object, called “InternetGatewayDevice”.
- 2) The (DEPRECATED) “DeviceSummary” parameter MAY be absent only in an Internet Gateway Device that supports the InternetGatewayDevice version 1.0 data model, as defined in section 2.4.2 of TR-098 [3], and no Service Objects.<sup>1</sup>
- 3) The Root Object MAY contain any of the objects specific to an Internet Gateway Device as defined in TR-098 [3], and any Components defined in other specifications, e.g. TR-143 [10] or TR-157 [12], with the proviso that a Component that is defined as a child of a Common Object can only be included if an Internet Gateway Device object with the same name as the Common Object is also included.
- 4) The “InternetGatewayDevice” Root Object MUST NOT directly contain any of the Common Objects defined in TR-181 [13]. While TR-098 [3] defines objects very similar to some of the Common Objects, they are not

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<sup>1</sup> The implication of this requirement is that a TR-098 [3] Internet Gateway Device that supports one or more Service Objects (for example, the VoiceService object defined in TR-104) is REQUIRED to support version 1.1 or greater of the InternetGatewayDevice Root Object.

identical and MUST NOT be considered the same as the Common Objects. (Service Objects within the “Services” object MAY, as in the non Internet Gateway Device case, contain Secondary Common Objects.)

5) The “Services” object MAY be absent if the device supports no Service Objects.

Formally, the top level of the data hierarchy is defined as follows:

```

Element = Root
| Root ".DeviceSummary"
| Root ".Services." ServiceObject "." Instance
| Root ".Services." ServiceObject "NumberOfEntries"
| Root ".Services." ServiceObject "." Instance "." SecondaryCommonObject
| Root "." ComponentObject
| DeviceRoot "." CommonObject
| DeviceRoot "." CommonObject "." ComponentObject
| TR-098GatewayRoot "." TR-098GatewaySpecificObject
| TR-098GatewayRoot "." TR-098GatewaySpecificObject "." ComponentObject

Root = DeviceRoot
| TR-098GatewayRoot

DeviceRoot = "Device"

TR-098GatewayRoot = "InternetGatewayDevice"

CommonObject = // As defined in TR-181 [13], e.g. "UserInterface" or "ManagementServer"

SecondaryCommonObject = // CommonObject other than "ManagementServer" or "GatewayInfo"

TR-098GatewaySpecificObject = // As defined in TR-098 [3]

ComponentObject = // As defined in other specs, e.g. TR-143 [10] or TR-157 [12]

Instance = NONZERODIGIT [DIGIT]*

```

### 2.1.2 Data Hierarchy Examples

Below are some examples of data hierarchies for various types of devices. (Objects are shown in bold text, parameters are shown in plain text.)

Simple device supporting the ABCService Service Object:

```

Device
  DeviceSummary2
  DeviceInfo
  ManagementServer
  Services
    ABCServiceNumberOfEntries = 1
    ABCService.1
      ABCServiceSpecificObjects

```

Device supporting both ABCService and XYZService Service Objects:

```

Device
  DeviceSummary2
  DeviceInfo
  ManagementServer
  Time
  UserInterface
  Services
    ABCServiceNumberOfEntries = 1
    ABCService.1
      ABCServiceSpecificObjects

```

<sup>2</sup> The (DEPRECATED) DeviceSummary parameter applies only to major version 1 of the “Device” Root Object.

XYZServiceNumberOfEntries = 1  
**XYZService.1**  
**XYZServiceSpecificObjects**

TR-098 [3] Internet Gateway Device that also supports the ABCService and XYZService Service Objects:

**InternetGatewayDevice**  
 DeviceSummary  
**DeviceInfo**  
**ManagementServer**  
**Time**  
**UserInterface**  
**Layer3Forwarding**  
 LANDeviceNumberOfEntries = 1  
**LANDevice.1**  
 WANDeviceNumberOfEntries = 1  
**WANDevice.1**  
**Services**  
 ABCServiceNumberOfEntries = 1  
**ABCService.1**  
**ABCServiceSpecificObjects**  
 XYZServiceNumberOfEntries = 1  
**XYZService.1**  
**XYZServiceSpecificObjects**

Device supporting the ABCService Service Object and proxying for two devices supporting the functionality of the XYZService Service Object:

**Device**  
 DeviceSummary<sup>2</sup>  
**DeviceInfo**  
**ManagementServer**  
**GatewayInfo**  
**Time**  
**UserInterface**  
**Services**  
 ABCServiceNumberOfEntries = 1  
**ABCService.1**  
**ABCServiceSpecificObjects**  
 XYZServiceNumberOfEntries = 2  
**XYZService.1**  
**DeviceInfo**  
**XYZServiceSpecificObjects**  
**XYZService.2**  
**DeviceInfo**  
**XYZServiceSpecificObjects**

TR-098 [3] Internet Gateway Device also serving as a management proxy for three devices supporting the functionality of the ABCService Service Object:

**InternetGatewayDevice**  
 DeviceSummary  
**DeviceInfo**  
**ManagementServer**  
**Time**  
**UserInterface**  
**Layer3Forwarding**  
 LANDeviceNumberOfEntries = 1  
**LANDevice.1**  
 WANDeviceNumberOfEntries = 1  
**WANDevice.1**

**Services**

ABCServiceNumberOfEntries = 3

**ABCService.1**

DeviceInfo

ABCServiceSpecificObjects

**ABCService.2**

DeviceInfo

ABCServiceSpecificObjects

**ABCService.3**

DeviceInfo

ABCServiceSpecificObjects

**2.1.3 The Supported Data Model and the Instantiated Data Model**

There is a distinction between a TR-069-enabled [2] device's Supported Data Model and its Instantiated Data Model.

- The Supported Data Model is those Objects and/or Parameters that have code support in the CPE.
- The Instantiated Data Model is those Object instances and/or Parameters that currently exist.

TR-157 [12] defines a SupportedDataModel Object (a sub-object of the DeviceInfo Common Object) that allows a TR-069-enabled device to indicate its Supported Data Model to the ACS, which assists the ACS in managing that device.

The SupportedDataModel object has the following properties:

- 1) It contains a list of URLs, each of which allows the ACS to determine details of part of the Supported Data Model.
- 2) When the Supported Data Model changes, e.g. because software is loaded or unloaded, entries are added to or removed from this list of URLs.
- 3) DeviceInfo is a Secondary Common Object (see section 2.1.1), and so can be contained within both Root Objects and Service Objects. However, the SupportedDataModel object is permitted only with a Root Object's DeviceInfo and MUST NOT be contained within a Service Object's DeviceInfo instance. It therefore describes the Supported Data Model for both the TR-069-enabled device and for any devices for which it is acting as a management proxy.

**2.2 Object Versioning**

To allow the definition of a Service Object or Root Object to change over time, the definition of a Service Object or Root Object MUST have an explicitly specified version.

Version numbering of Service Objects and Root Objects is defined to use a major/minor version numbering convention. The object version is defined as a pair of integers, where one integer represents the major version, and the second integer represents the minor version. The version MUST be written with the two integers separated by a dot (Major.Minor).

The first version of a given object SHOULD be defined as version "1.0".

For each subsequent version of the object, if the later version is compatible with the previous version, then the major version SHOULD remain unchanged, and the minor version SHOULD be incremented by one. For example, the next compatible version after "2.17" would be "2.18". The requirements for a version to be considered compatible with an earlier version are described in section 2.2.1.

For each subsequent version of the object, if the later version is not compatible with the previous version, then the major version MUST increment by one, and the minor version MAY reset back to zero. For example, the next incompatible version after "2.17" might be "3.0".

### 2.2.1 Requirements for Compatible Versions

For one version of an object to be considered compatible with another version, the later version **MUST** be a strict superset of the earlier version. Using major/minor versioning, this requirement applies only between minor versions that share the same major version.

More specifically, this requires the following of the later version with respect to all earlier versions to which it is to be compatible:

- The later version **MAY** add objects and parameters not previously in any earlier version, but **MUST NOT** remove objects or parameters already defined in earlier versions.
- The later version **MUST NOT** modify the definition of any parameter or object already defined in an earlier version (unless the original definition was clearly in error and has to be modified as an erratum or clarified through a corrigendum process).
- The later version **MUST NOT** require any of the objects or parameters that have been added since the earliest compatible version to be explicitly operated upon by the ACS to ensure proper operation of the device (except those functions specifically associated with functionality added in later versions). That is, the later version will accommodate an ACS that knows nothing of elements added in later versions.

The goal of the above definition of compatibility is intended to ensure bi-directional compatibility between an ACS and CPE. Specifically that:

- If an ACS supports only an earlier version of an object as compared to the version supported by the CPE, the ACS can successfully manage that object in the CPE as if it were the earlier version.
- If a CPE supports only an earlier version of an object as compared to the version supported by an ACS, the ACS can successfully manage that object in the CPE as if it were the later version (without support for new components defined only in later versions).

### 2.2.2 Version Notation

For objects, the following notation is defined to identify specific versions:

Notation	Description	Example
ObjectName:Major.Minor	Refers to a specific version of the object.	Device:1.0
ObjectName:Major	Refers to any minor version of the object with the specified major version.	Device:1
ObjectName	Refers to any version of the object.	Device

Note that the version notation defined here is *only* to be used for purposes of documentation and in the content of the DeviceSummary parameter defined in section 3.7. The actual names of objects and parameters in the data model **MUST NOT** include version numbers.

## 2.3 Profiles

Note: Originally, profiles were seen as a means of limiting the variability that an ACS needs to accommodate among various devices that it might manage. This feature is now provided by the TR-157 [12] SupportedDataModel object (see section 2.1.3) and associated Device Type XML documents (DT Instances).

A profile is a named collection of requirements associated with a given object. A device can adhere to zero or more profiles. Adherence to a profile means that the device supports all of the requirements defined by that profile. The use of profiles gives Service Providers a shorthand means of specifying CPE data model support requirements.

The following sections define the conventions to be used when defining profiles associated with TR-069 [2] data models.



### 2.3.1 Scope of Profiles

A given profile is defined only in the context of a specific Service Object or Root Object with a specific major version. For each profile definition, the specific object name and major version to which the profile is to apply **MUST** be explicitly identified.

A profile's name **MUST** be unique among profiles defined for the same object and major version, but a name **MAY** be reused to define a different profile for a distinct combination of object name and major version. For example, if we define profile "A" associated with object "X:2" (major version 2 of object X), the same name "A" might be used to define a different profile for object "Y:1" or for object "X:3".

A given profile is defined in association with a minimum minor version of a given object. The minimum **REQUIRED** version of an object is the minimum version that includes all of the **REQUIRED** elements defined by the profile. For each profile definition, the specific minimum version **MUST** be explicitly identified.

### 2.3.2 Multiple Profile Support

For a given type of Service Object or Root Object, multiple profiles **MAY** be defined. Profiles **MAY** be defined that have either independent or overlapping requirements.

To maximize interoperability, a device that fully implements the (DEPRECATED) DeviceSummary parameter (section 3.7) **MUST** indicate all profiles that it supports. That is, it has to indicate all profiles whose definition is a subset of the support provided by that device. Doing so maximizes the likelihood that an ACS will be aware of the definition of the indicated profiles. For example, if profile "A" is a subset of profile "B", and a device supports both, by indicating support for both "A" and "B" an ACS that is unaware of profile "B" will at least recognize the device's support for profile "A".

### 2.3.3 Profile Versions

To allow the definition of a profile to change over time, the definition of every profile **MUST** have an associated version number.

Version numbering of profiles is defined to use a minor-only version numbering convention. That is, for a given profile name, each successive version **MUST** be compatible with all earlier versions. Any incompatible change to a profile **MUST** use a different profile name.

For one version of a profile to be considered compatible with another version, the later version **MUST** be a strict superset of the earlier version. This requires the following of the later version with respect to all earlier versions to which it is to be compatible:

- The later version **MAY** add requirements that were not in earlier versions of the profile, but **MUST NOT** remove requirements.
- The later version **MAY** remove one or more conditions that had previously been placed on a requirement. For example, if a previous profile **REQUIRED** X only if condition A was True, then the later profile might require X unconditionally.

For profiles, the following notation is defined to identify specific versions:

Notation	Description	Example
ProfileName:Version	Refers to a specific version of the profile.	Baseline:1
ProfileName	Refers to any version of the profile.	Baseline

ProfileName **MUST** start with a letter or underscore, and subsequent characters **MUST** be letters, digits, underscores or hyphens. The terms "letter" and "digit" are as defined in Appendix B of the XML specification [8].

### 2.3.4 Baseline Profiles

For every Service Object (and Root Object) there **SHOULD** be at least one profile defined. In many cases it is desirable to define a Baseline profile that indicates the minimum requirements **REQUIRED** for any device that supports that object. Where a Baseline profile is defined, and if the (DEPRECATED) DeviceSummary parameter

(section 3.7) is fully implemented, it would normally be expected that all implementations of the corresponding object would indicate support for the Baseline profile in addition to any other profiles supported.

### 2.3.5 Types of Requirements in a Profile

Because a profile is defined within the context of a single object (and major version), all of the requirements associated with the profile **MUST** be specific to the data model associated with that object.

Profile requirements can include any of the following types of requirements associated with an object's data model:

- A requirement for read support of a Parameter.
- A requirement for write support of a Parameter.
- A requirement for support of a sub-object contained within the overall object.
- A requirement for the ability to add or remove instances of a sub-object.
- A requirement to support active notification for a Parameter.
- A requirement to support access control for a given Parameter.

For each of the requirement categories listed above, a profile can define the requirement unconditionally, or can place one or more conditions on the requirement. For example, a profile might require that a Parameter be supported for reading only if the device supports some other parameter or object (one that is not itself **REQUIRED** by the profile). Such conditions will be directly related to the data model of the overall object associated with the profile.

Because a device has to be able to support multiple profiles, all profiles **MUST** be defined such that they are non-contradictory. As a result, profiles **MUST** only define minimum requirements to be met, and **MUST NOT** specify negative requirements. That is, profiles will not include requirements that specify something that is not to be supported by the device, or requirements that exclude a range of values.

## 2.4 DEPRECATED and OBSOLETE Items

The key word “**DEPRECATED**” in the data model definition for any TR-069-enabled [2] device is to be interpreted as follows: This term refers to an object, parameter or parameter value that is defined in the current version of the standard but is meaningless, inappropriate, or otherwise unnecessary. It is intended that such objects, parameters or parameter values will be removed from the next major version of the data model. Requirements on how to interpret or implement deprecated objects, parameters or parameter values are given below. For more information on how to interpret or implement specific deprecated objects, parameters or parameter values, refer to the definition of the object or parameter.

The key word “**OBSOLETE**” in the data model definition for any TR-069-enabled [2] device is to be interpreted as follows: This term refers to an object, parameter or parameter value that meets the requirements for being deprecated, and in addition is obsolete. Such objects, parameters or parameter values can be removed from a later minor version of a data model, or from a later version of a profile, without this being regarded as breaking backwards compatibility rules. Requirements on how to interpret or implement obsolete objects, parameters or parameter values are given below. For more information on how to interpret or implement specific obsolete objects, parameters or parameter values, refer to the definition of the object or parameter.

### 2.4.1 Requirements for DEPRECATED Items

This section defines requirements that apply to all **DEPRECATED** objects, parameters and parameter values unless specifically overridden by the object or parameter definition.

Data model requirements:

- 1) The definition of a **DEPRECATED** parameter, object or parameter value **MUST** include an explanation of why the item is deprecated.
- 2) The definition of a **DEPRECATED** parameter, object or parameter value **MAY** specify further requirements relating to the item; such requirements **MAY** override CPE or ACS requirements specified in this section.

CPE requirements:

- 1) A DEPRECATED parameter MUST have a value which is valid for its data type and fulfils any range (for numeric parameters), length (for string, base64 or hexBinary parameters) and enumerated value (for string parameters) requirements.
- 2) Detailed behavioral requirements for a DEPRECATED parameter, e.g. that its value is a unique key, MAY be ignored by the CPE.
- 3) The CPE MUST, if such operations are permitted by the data model definition, permit creation of DEPRECATED objects, modification of DEPRECATED parameters, and setting of DEPRECATED parameter values. However, it MAY choose not to apply such changes to its operational state.
- 4) Regardless of whether DEPRECATED changes are applied to the CPE operational state, a read of a DEPRECATED writable parameter SHOULD return the value that was last written, i.e. the CPE is expected to store the value even if it chooses not to apply it to its operational state.
- 5) The CPE MAY reject an attempt by the ACS to set any parameter to a DEPRECATED value.

ACS requirements:

- 1) The ACS SHOULD NOT create DEPRECATED objects, modify DEPRECATED parameters, or set DEPRECATED parameter values.
- 2) The ACS SHOULD ignore DEPRECATED objects, parameters and parameter values.
- 3) The ACS SHOULD NOT set a DEPRECATED parameter to a value that is invalid for its data type or fails to fulfill any range (for numeric parameters), length (for string, base64 or hexBinary parameters) or enumerated value (for string parameters) requirements.
- 4) The ACS SHOULD NOT set any parameter to a DEPRECATED value.

## 2.4.2 Requirements for OBSOLETE Items

This section defines requirements that apply to all OBSOLETE objects, parameters or parameter values unless specifically overridden by the object or parameter definition.

An OBSOLETE object, parameter or parameter value MUST meet all the requirements of the previous section. In addition, the following data model requirements apply.

- 1) An OBSOLETE object, parameter or parameter value MAY be removed from a later minor version of a data model without this being regarded as breaking backwards compatibility rules.
- 2) An OBSOLETE object, parameter or parameter value MUST NOT be removed from the current version of a profile, but MAY be removed from a later version of a profile without this being regarded as breaking backwards compatibility rules.
- 3) A data model definition MUST include a list of those OBSOLETE objects, parameters or parameter values that have been removed from the data model or from its profiles. This is to prevent future namespace conflicts.

# 3 Object Definitions

## 3.1 General Notation

Parameter names use a hierarchical form similar to a directory tree. The name of a particular Parameter is represented by the concatenation of each successive node in the hierarchy separated with a "." (dot), starting at the trunk of the hierarchy and leading to the leaves. When specifying a partial path, indicating an intermediate node in the hierarchy, the trailing "." (dot) is always used as the last character.

Parameter names MUST be treated as case sensitive. The name of each node in the hierarchy MUST start with a letter or underscore, and subsequent characters MUST be letters, digits, underscores or hyphens. The terms "letter" and "digit" are as defined in Appendix B of the XML specification [8].

In some cases, where multiple instances of an object can occur, the placeholder node name “{i}” is shown. In actual use, this placeholder is to be replaced by an instance number, which **MUST** be a positive integer ( $\geq 1$ ). Because in some cases object instances can be deleted, instance numbers will in general not be contiguous.

## 3.2 Data Types and Representation

Parameters make use of a limited subset of the default SOAP data types [5]. The supported data types are defined by the DM Schema and are also listed in A.2.3.

The named data types that specify the representations of IP addresses, MAC addresses etc, are defined in a DM Instance document (see Annex A). Table 1 gives links to this XML file and to the corresponding HTML. Note that this DM Instance defines named data types that are expected to be used in several data model definitions; it is possible to define local named data types in any DM Instance document.

**Table 1 – Named Data Type Definitions**

DM Instance	XML and HTML
tr-106-1-0-types.xml	<a href="http://broadband-forum.org/cwmp/tr-106-1-0-types.xml">http://broadband-forum.org/cwmp/tr-106-1-0-types.xml</a>
	<a href="http://broadband-forum.org/cwmp/tr-106-1-0-types.html">http://broadband-forum.org/cwmp/tr-106-1-0-types.html</a>

The following sub-sections specify additional rules governing parameter value representation within XML documents.

### 3.2.1 Escaping non-ASCII Characters

When transporting a string value within an XML document, any characters which are special to XML **MUST** be escaped as specified by the XML specification [8]. Additionally, any characters other than printable ASCII characters, i.e. any characters whose decimal ASCII representations are outside the (inclusive) ranges 9-10 and 32-126, **SHOULD** be escaped as specified by the XML specification.

### 3.2.2 Date and Time Rules

All times **MUST** be expressed in UTC (Universal Coordinated Time) unless explicitly stated otherwise in the definition of a parameter of this type.

If absolute time is not available to the CPE, it **SHOULD** instead indicate the relative time since boot, where the boot time is assumed to be the beginning of the first day of January of year 1, or 0001 01 01T00:00:00. For example, 2 days, 3 hours, 4 minutes and 5 seconds since boot would be expressed as 0001 01 03T03:04:05. Relative time since boot **MUST** be expressed using an untimezoned representation. Any untimezoned value with a year value less than 1000 **MUST** be interpreted as a relative time since boot.

If the time is unknown or not applicable, the following value representing “Unknown Time” **MUST** be used: 0001-01-01T00:00:00Z. For an infinite timeline, the following value representing “Infinite Time” **MUST** be used: 9999-12-31T23:59:59Z.

Any dateTime value other than one expressing relative time since boot (as described above) **MUST** use timezoned representation (that is, it **MUST** include a timezone suffix).

### 3.2.3 Comma-separated Lists

For strings that are defined to contain comma-separated lists, the format is defined as follows. Between every pair of successive items in a comma-separated list there **MUST** be a separator. The separator **MUST** include exactly one comma character, and **MAY** also include one or more whitespace characters before or after the comma. The entire separator, including any whitespace characters, **MUST NOT** be considered part of the list items it separates. The last item in a comma-separated list **MUST NOT** be followed with a separator. Individual items in a comma-separated list **MUST NOT** include a whitespace or comma character within them. Any whitespace or comma characters within an item value **MUST** be escaped using percent encoding as specified in [7] Section 2.1.

### 3.2.4 Parameters that Reference Objects

For string parameters that are defined to contain the hierarchical path name of an object (or for each item in parameters that are defined to contain comma-separated lists of object path names), the representation of the object name **MUST NOT** include a trailing “dot.” An example of a parameter of this kind in the TR-098 [3] InternetGatewayDevice:1 data model is InternetGatewayDevice.Layer3Forwarding.DefaultConnectionService. For this parameter, the following is an example of a properly formed value:

```
InternetGatewayDevice.WANDevice.1.WANConnectionDevice.2.WANPPPPConnection.1
```

Path names in parameter values **MUST** always be full path names, with the single exception that a path that begins with a dot is relative to the Root or Service Object. For example, in the Device Root Object, a parameter value of “.DeviceInfo” always means “Device.DeviceInfo”.

In order to be able to use reference parameters as unique keys (A.2.8.1), their path names **MUST** conceptually be converted to full path names before being compared. For example, in the Device Root Object, “.DeviceInfo.” and “Device.DeviceInfo.” would compare as equal. If a reference parameter is list-valued, i.e. it is a list of path names or instance numbers, the parameter value **MUST** conceptually be regarded as a set when being compared, i.e. the comparison has to ignore the item order and any repeated items. For example, “1,2,1” and “2,1” would compare as equal because both reference instances 1 and 2.

### 3.2.5 Units Conventions

For numeric parameters whose values are defined in terms of units, bit and byte-related units will always refer to powers of 2. For example, a kilobyte will always be 1024 bytes, a megabyte always 1024 \* 1024 bytes, etc.

### 3.2.6 Default Maximum String Length

For string-valued parameters, a maximum length is either explicitly indicated or implied by the size of the elements composing the string. For strings in which the content is an enumeration, the longest enumerated value determines the maximum length. Similarly, for strings in which the content is a pattern, the longest possible matching value determines the maximum length. For strings in which the content is a list, the maximum number of items and the individual item lengths can help to determine the maximum string length. If a string does not have an explicit or implied maximum length, the default maximum is 16 characters unless otherwise indicated in an associated parameter description.

## 3.3 Vendor-Specific Parameters

A vendor **MAY** extend the standardized parameter list with vendor-specific parameters and objects. Vendor-specific parameters and objects **MAY** be defined either in a separate naming hierarchy or within the standardized naming hierarchy.

The name of a vendor-specific parameter or object not contained within another vendor-specific object **MUST** have the form:

```
X_<VENDOR>_VendorSpecificName
```

In this definition <VENDOR> is a unique vendor identifier, which **MAY** be either an OUI or a domain name. The OUI or domain name used for a given vendor-specific parameter **MUST** be one that is assigned to the organization that defined this parameter (which is not necessarily the same as the vendor of the CPE or ACS). An OUI is an organizationally unique identifier as defined in [4], which **MUST** be formatted as a six-hexadecimal-digit string using all upper-case letters and including any leading zeros. A domain name **MUST** be upper case with each dot (“.”) replaced with a hyphen or underscore.

The VendorSpecificName **MUST NOT** contain a “.” (period) or a space character.

*Note – the use of the string “X\_” to indicate a vendor-specific parameter implies that no standardized parameter can begin with “X\_”.*

The name of a vendor-specific parameter or object that is contained within another vendor-specific object which itself begins with the prefix described above need not itself include the prefix.

The full path name of a vendor-specific parameter or object **MUST NOT** exceed 256 characters in length.

Below are some example vendor-specific parameter and object names:

```
Device.UserInterface.X_012345_AdBanner
Device.X_EXAMPLE-COM_MyConfig.Status
```

When appropriate, a vendor MAY also extend the set of values of an enumeration. If this is done, the vendor-specified values MUST be in the form "X\_<VENDOR>\_VendorSpecificValue". The total length of such a string MUST NOT exceed 31 characters.

### 3.4 Common Object Definitions (Removed)

Common Object Definitions moved to TR-181 [13].

### 3.5 Inform Requirements (Removed)

Inform Requirements moved to TR-181 [13].

### 3.6 Notification Requirements (Removed)

Notification Requirements moved to TR-181 [13].

### 3.7 DeviceSummary Definition

*Note – the DeviceSummary parameter is DEPRECATED. This is because the TR-157 [12] SupportedDataModel object (see section 2.1.3) and associated Device Type XML documents (DT Instances) provide a more granular and scalable way of describing the device's data model than does DeviceSummary. Therefore the value of DeviceSummary MAY be an empty string if (and only if) the SupportedDataModel object is supported.*

The DeviceSummary parameter is defined to provide an explicit summary of the top-level data model of the device, including version and profile information. This parameter MAY be used by an ACS to discover the nature of the device and the ACS's compatibility with specific objects supported by the device.

The DeviceSummary is defined as a list that includes the Root Object followed by all Service Object instances (or support for a Service Object type if no instances are currently present). For each of these objects, the DeviceSummary specifies the version of the object, the associated instance number used to identify the specific object instance, and a list of the supported profiles for that object.

The syntax of the DeviceSummary parameter is defined formally as follows:

```
DeviceSummary = RootObject [ ", " ServiceObject ]*
RootObject = ObjectName ":" ObjectVersion "(" ProfileList ")"
ServiceObject = ObjectName ":" ObjectVersion "[" [Instance] "]" ProfileList ")"
ObjectVersion = MajorVersion "." MinorVersion
ProfileList = [ Profile [ ", " Profile ]* ]
Profile = ProfileName ":" ProfileVersion
MajorVersion = Integer
MinorVersion = Integer
ProfileVersion = Integer
Integer = DIGIT*
Instance = [ "+" ] NONZERODIGIT [DIGIT]*
```

For each object instance, the ObjectVersion element MUST indicate the major and minor versions of the object supported by the device.

The ObjectVersion for all objects for which explicit major and minor version numbers have not been defined is 1.0. Future updates to these objects will specify distinct version numbers.

Instance is the instance number of the particular object instance. If the device supports an object type, but no instances are currently present, a single entry for this object MUST be listed in the DeviceSummary, and the instance number MUST be empty (" "). In this case, the device need not list support for specific profiles since the profile list might be dependent on the specific instance when it is instantiated.

If the instance number for an object might change (for example, if the instances represent physically separate devices, being managed by proxy, that can be connected or disconnected), the instance number MUST be prefixed with a "+" character. Lack of a "+" character indicates that the instance number is expected to remain unchanged.

For each object (Root Object and Service Objects), a device MUST list all profiles that it supports in the ProfileList element. That is, it MUST list all profiles for which the device's actual level of support is a superset. Each entry in the ProfileList MUST include the ProfileName and the ProfileVersion. The ProfileVersion is a single integer representing the minor version of the profile.

Vendor-specific objects and profiles MAY be included in this list, and if so MUST begin with X\_<VENDOR>\_, where <VENDOR> MUST be as defined in section 3.3.

### 3.7.1 DeviceSummary Examples

Below are some examples of the DeviceSummary parameter. (The first examples correspond directly to the examples given in section 2.1.2.)

Simple device supporting the ABCService Service Object:

**"Device:1.0[(Baseline:1), ABCService:1.0[1](Baseline:1)]"**

Device supporting both ABCService and XYZService Service Objects:

**"Device:1.0[(Baseline:1), ABCService:1.0[1](Baseline:1), XYZService:1.0[1](Baseline:1)]"**

TR-098 [3] Internet Gateway Device that also supports the ABCService and XYZService Service Objects:

**"InternetGatewayDevice:1.0[(Baseline:1), ABCService:1.0[1](Baseline:1), XYZService:1.0[1](Baseline:1)]"**

Device supporting the ABCService Service Object and proxying for two devices supporting the functionality of the XYZService Service Object:

**"Device:1.0[(Baseline:1), ABCService:2.17[1](Baseline:1), XYZService:1.2[1](Baseline:2), XYZService:1.2[2](Baseline:2, AnotherProfile:3)]"**

TR-098 [3] Internet Gateway Device also serving as a management proxy for three devices supporting the functionality of the ABCService Service Object:

**"InternetGatewayDevice:1.0[(Baseline:1), ABCService:1.0[1](Baseline:1), ABCService:1.0[2](Baseline:1), ABCService:1.0[3](Baseline:1, AnotherProfile:1)]"**

TR-098 [3] Internet Gateway Device with no additional service objects supported:

**"InternetGatewayDevice:1.0[(Baseline:1)]"**

Device supporting the ability to proxy for devices supporting the functionality of the ABCService Service Object, but with no current instances of that object:

**"Device:1.0[(Baseline:1), ABCService:2.17[ ]]"**

Device supporting the ABCService Service Object with the baseline and a vendor-specific profile:

**"Device:1.0[(Baseline:1), ABCService:2.17[1](Baseline:1, X\_EXAMPLE-COM\_MyProfile:2)]"**

Device supporting the ABCService Service Object, but with no profiles:

“Device:1.0[(Baseline:1), ABCService:2.17[1]0)”

## **4 Profile Definitions (Removed)**

**Profile Definitions moved to TR-181 [13].**



## Normative References

A list of the currently valid Broadband Forum Technical Reports is published at <http://www.broadband-forum.org>. The following documents are referenced by this specification.

- [1] [RFC 2119](#), *Key words for use in RFCs to Indicate Requirement Levels*, IETF, 1997
- [2] [TR-069 Amendment 3](#), *CPE WAN Management Protocol*, Broadband Forum, 2010
- [3] [TR-098 Amendment 2](#), *Internet Gateway Device Data Model for TR-069*, Broadband Forum, 2008
- [4] [Organizationally Unique Identifiers \(OUIs\)](#), IEEE
- [5] [Simple Object Access Protocol \(SOAP\) 1.1](#), W3C, 2000
- [6] [RFC 3513](#), *Internet Protocol Version 6 (IPv6) Addressing Architecture*, IETF, 2003
- [7] [RFC 3986](#), *Uniform Resource Identifier (URI): Generic Syntax*, IETF, 2005
- [8] [Extensible Markup Language \(XML\) 1.0 \(Fourth Edition\)](#), W3C, 2008
- [9] [RFC 2648](#), *A URN Namespace for IETF Documents*, IETF, 1999
- [10] [TR-143 Corrigendum 1](#), *Enabling Network Throughput Performance Tests and Statistical Monitoring*, Broadband Forum, 2008
- [11] [XML Schema Part 0: Primer Second Edition](#), W3C, 2004
- [12] [TR-157 Amendment 3](#), *Component Objects for CWMP*, Broadband Forum, 2010
- [13] [TR-181 Issue 1](#), [TR-181 Issue 2 Amendment 1](#), *Device Data Model for TR-069*, Broadband Forum
- [14] [XML Schema Part 2: Datatypes Second Edition](#), W3C, 2004

# Annex A. CWMP Data Model Definition XML Schema

## A.1 Introduction

The CWMP Data Model Definition XML Schema [11], or DM Schema, is used for defining TR-069 [2] data models, and is specified in A.3.

DM Schema instance documents can contain any or all of the following:

- Data type definitions
- Root Object definitions (including profiles)
- Service Object definitions (including profiles)
- Component definitions
- Vendor extension definitions

## A.2 Normative Information

It is possible to create instance documents that conform to the DM Schema but nevertheless are not valid data model definitions. This is because it is not possible to specify all the normative data model definition requirements using the XML Schema language. Therefore, the schema contains additional requirements written using the usual normative language. Instance documents that conform to the DM Schema and meet these additional requirements are referred to as DM Instances.

For example, the definition of the parameter element includes the following additional requirements on the name and base attributes:

```
<xs:complexType name="ModelParameter">
  <xs:annotation>
    <xs:documentation>Parameter definition and reference.</xs:documentation>
  </xs:annotation>
  ...
  <xs:attribute name="name" type="tns:ParameterName">
    <xs:annotation>
      <xs:documentation>MUST be unique within the parent object (this is checked by schema
        validation).
        MUST be present if and only if defining a new parameter.</xs:documentation>
    </xs:annotation>
  </xs:attribute>
  <xs:attribute name="base" type="tns:ParameterName">
    <xs:annotation>
      <xs:documentation>MUST be present if and only if modifying an existing
        parameter.</xs:documentation>
    </xs:annotation>
  </xs:attribute>
  ...
</xs:complexType>
```

In some cases, a requirement that is in fact implied by the DM Schema is emphasized within the schema via the xs:documentation element (the uniqueness requirement on the name is an example of this).

In other cases, a schema-implied requirement is not highlighted. For example, the name and base attributes are of type `tns:ParameterName`:

```

<!DOCTYPE cwmp-datamodel [
...
  <!ENTITY name "([\i-[:]][\c-[:\]]*)">
...
]>
...
<xs:simpleType name="ParameterName">
  <xs:annotation>
    <xs:documentation>Parameter name (maximum length 256); the same as xs:NCName except that periods
                        are not permitted. This name MUST in addition follow the vendor-specific
                        parameter name requirements of section 3.3.</xs:documentation>
  </xs:annotation>
  <xs:restriction base="xs:token">
    <xs:maxLength value="256"/>
    <xs:pattern value="&name;"/>
  </xs:restriction>
</xs:simpleType>

```

This states that the parameter name is a string that follows the following rules:

- It is derived from `xs:token`, which has a whitespace facet of “collapse”, meaning that any leading whitespace in the name will be ignored.
- It has a maximum length of 256 characters.
- Its first character matches the pattern “[\i-[:]]”, which means “any character permitted as the first character of an XML name, except for a colon”, and any subsequent characters match the pattern “[\c-[:\]]”, which means “any character permitted in an XML name, except for a colon and a dot”.
- It follows the vendor-specific parameter name requirements of section 3.3.

The question of the location of the definitive normative information therefore arises. The answer is as follows:

- All the normative information in the main part of the document remains normative.
- The DM Schema, and the additional requirements therein, are normative. Some of these additional requirements are duplicated (for emphasis) in this Annex.
- The DM Schema references additional material in this Annex. Such material is normative.
- If the DM Schema conflicts with a normative requirement in the main part of the document, this is an error in the DM Schema, and the requirement in the main part of the document takes precedence.

## A.2.1 Importing DM Instances

DM Instances are imported using the top-level import element. The DM Schema specifies that the DM Instance is located via the file attribute.

The rules governing the file attribute’s value and its use for locating the DM Instance are as follows:

- It MUST be a URL adhering to RFC 3986 [7].
- If the URL includes a scheme, it MUST be `http`, `https` or `ftp`.
- If the URL includes an authority, it MUST NOT include credentials.
- For standard BBF DM Instances, the rules that apply to the filename part (final path segment) of the A.2.1.1 BBFURL MUST be applied to the filename part of this URL. This means that the corrigendum number can be omitted in order to refer to the latest corrigendum.
- If the URL is a relative reference, processing tools MUST apply their own logic, e.g. apply a search path.

### A.2.1.1 URI Conventions

The top-level spec attribute contains the URI of the associated specification document, e.g. the BBF Technical Report.

This URI SHOULD uniquely identify the specification. More than one DM Schema instance document MAY reference the same specification.

The following rules apply to the value of the top-level spec attribute:

- For a BBF Technical Report, it MUST be of the form “urn:broadband-forum-org:tr-*nnn*-*i*-*a*-*c*”, where *nnn* is the specification number (including leading zeros), *i* is the issue number, *a* is the amendment number, and *c* is the corrigendum number. The issue, amendment and corrigendum numbers do not include leading zeros. For example, “urn:broadband-forum-org:tr-106-1-0” refers to TR-106 (Issue 1 Amendment 0), and “urn:broadband-forum-org:tr-106-1-2” refers to TR-106 (Issue 1) Amendment 2. If the corrigendum number (including the preceding hyphen) is omitted, the most recent corrigendum is assumed.
- For specifications issued by other standards organizations, or by vendors, it SHOULD be of a standard form if one is defined. For example, RFC 2648 [9] specifies a syntax for referencing RFCs.
- Note that processing tools are likely to assume that all files that share a spec value are related to each other. Therefore, use of meaningful spec values is RECOMMENDED.

Formally, the value of the spec attribute is defined as follows:

```

SpecURI = BBFURI
        | OtherURI

BBFURI = "urn:broadband-forum-org:" BBFDoc

BBFDoc = "tr-" BBFNumber BBFIssue BBFAmendment BBFCorrigendum

BBFNumber = [DIGIT]{3,} // including leading zeros, e.g. 069

BBFIssue = "-" NoLeadingZeroPositiveNumber

BBFAmendment = "-" NoLeadingZeroNumber

BBFCorrigendum = "-" NoLeadingZeroPositiveNumber
                | "" // if omitted, most recent corrigendum is assumed

NoLeadingZeroNumber = [DIGIT]
                    | [NONZERODIGIT] [DIGIT]*

NoLeadingZeroPositiveNumber = [NONZERODIGIT] [DIGIT]*

OtherURI = <of a standard form if one is defined>

```

Standard BBF DM Instances can be accessed at the following URL:

```

BBFURL = "http://www.broadband-forum.org/cwmp/" BBFDoc BBFSubDoc ".xml"

BBFDoc = <as before>

BBFSubDoc = "-" LABEL // distinguishing label (not beginning with a digit)
           | "" // not needed if only one DM Instance is associated with spec

```

For example, the DM Instance associated with TR-106 Amendment 2 can be accessed at <http://www.broadband-forum.org/cwmp/tr-106-1-2.xml>. If two DM Instances had been associated with TR-106 Amendment 2, they might have been accessible at <http://www.broadband-forum.org/cwmp/tr-106-1-2-types.xml> and <http://www.broadband-forum.org/cwmp/tr-106-1-2-objects.xml>.

## A.2.2 Descriptions

Many elements have descriptions, and the same rules apply to all description elements in the DM Schema. A description is free text which can contain a limited amount of MediaWiki-like markup as specified in A.2.2.3.

### A.2.2.1 Character Set

For BBF standards, the character set **MUST** be restricted to printable characters in the Basic Latin Unicode block, i.e. to characters whose decimal ASCII representations are in the (inclusive) ranges 9-10 and 32-126.

### A.2.2.2 Pre-processing

All DM Instance processing tools **MUST** conceptually perform the following pre-processing before interpreting the markup:

- 1) Remove any leading whitespace up to and including the first line break<sup>3</sup>.
- 2) Remove the longest common whitespace prefix (i.e. that occurs at the start of every line) from each line. See the example below, where three lines start with four spaces and one line starts with five spaces, so the longest whitespace prefix that occurs at start of each line is four spaces. In this calculation, a tab character counts as a single character. To avoid confusion, the description **SHOULD NOT** contain tab characters.
- 3) Remove all trailing whitespace, including line breaks.

This pre-processing is designed to permit a reasonable variety of layout styles while still retaining predictable behavior. For example, both the following:

```
<description>This is the first line.
This is the second line.
  This is the indented third line.
This is the fourth line.</description>
```

```
<description>
  This is the first line.
  This is the second line.
    This is the indented third line.
  This is the fourth line.
</description>
```

...result in the following:

```
This is the first line.
This is the second line.
  This is the indented third line.
This is the fourth line.
```

### A.2.2.3 Markup

The pre-processed description can contain the following markup, which is inspired by, but is not identical to, MediaWiki markup. All DM Instance processing tools **SHOULD** support this markup to the best of their ability.

**Table 2 – XML Description Markup**

Name	Markup Example	Description
Italics	''italic text''	Two apostrophes on each side of some text will result in the contained text being emphasized in italics.
Bold	'''bold text'''	Three apostrophes on each side of some text will result in the contained text being emphasized in bold.
Bold italics	''''''b+i text''''''	Five apostrophes on each side of some text will result in the contained text being emphasized in bold italics.
Paragraph	This paragraph just ended.	A line break is interpreted as a paragraph break.

<sup>3</sup> It can be assumed that all line breaks are represented by a single line feed, i.e. ASCII 10. See [8] section 2.11.

Name	Markup Example	Description
Bulleted lists	<pre>* level one ** level two * level one again ** level two again *** level three *: level one continued outside of list</pre>	<p>A line starting with one or more asterisks (*) denotes a bulleted list entry, whose indent depth is proportional to the number of asterisks specified.</p> <p>If the asterisks are followed by a colon (:), the previous item at that level is continued, as shown.</p> <p>An empty line, or a line that starts with a character other than an asterisk, indicates the end of the list.</p>
Numbered lists	<pre># level one ## level two # level one again ## level two again ### level three #: level one continued outside of list</pre>	<p>A line starting with one or more number signs (#) denotes a numbered list entry.</p> <p>All other conventions defined for bulleted lists apply here (using # rather than *), except that numbered list entries are prefixed with an integer decoration rather than a bullet.</p>
Indented lists	<pre>: level one :: level two : level one again :: level two again ::: level three outside of list</pre>	<p>A line starting with one or more colons (:) denotes an indented list entry.</p> <p>All other conventions defined for bulleted lists apply here (using : rather than *), except that indented list entries have no prefix decoration, and item continuation is not needed.</p>
Verbatim	<pre>code example: if (something) {     /* do something */ } else {     /* do other */ }</pre>	<p>A block of lines each of which starts with a space is to be formatted exactly as typed, preferably in a fixed width font.</p> <p>This allows code fragments, simple tables etc. to be included in descriptions.</p> <p>Note that the pre-processing rules of A.2.2.2 imply that it is not possible to process an entire description as verbatim text (because all the leading whitespace would be removed). This is not expected to be a problem in practice.</p>
Hyperlinks	<pre>http://www.broadband- forum.org</pre>	<p>URL links are specified as plain old text (no special markup).</p>
Templates	<pre>{{bibref 1 section 2}} {{section table}} {{param Enable}} {{enum Error}}</pre>	<p>Text enclosed in double curly braces ({} ) is a template reference, which is replaced by template-dependent text.</p> <p>A.2.2.4 specifies the standard templates.</p>

#### A.2.2.4 Templates

A template invocation is encoded as two curly braces on either side of the template name and arguments. Arguments can follow the template name, separated by vertical pipe (|) characters. All whitespace is significant. For example:

```
{{someTemplate|arg1|arg2|...|argN}}
```

In some cases, one template can impact the behavior of another template, e.g. the definitions of both the `{{enum}}` and the `{{hidden}}` templates state that the template expansion can be automatically placed after the rest of the description, which raises the question of which template expansion would come first. This ambiguity is resolved by stating that processing tools SHOULD generate such automatic text in the same order that the templates are defined below. In the above example, `{{enum}}` is defined before `{{hidden}}`, so an automatically-generated list of enumeration values would be placed before an automatically-generated explanation that the parameter value is hidden.

The following standard templates are defined. Any vendor-specific template names MUST obey the rules of section 3.3.

**Table 3 – XML Description Templates**

Name	Markup Definition	Description
Bibliographic reference	<pre> {{bibref id}} {{bibref id section}} </pre>	<p>A bibliographic reference.</p> <p>The id argument <b>MUST</b> match the id attribute of one of the current file's (or an imported file's) top-level bibliography element's reference elements (A.2.4).</p> <p>The OPTIONAL section argument specifies the section number, including any leading "section", "annex" or "appendix" text.</p> <p>Typically, processing tools will (a) validate the id, and (b) replace the template reference with something like "[id] section".</p> <p>Markup examples:</p> <pre> {{bibref 1}} {{bibref 1 section 3}} </pre>
Section separator	<pre> {{section category}} {{section}} </pre>	<p>The beginning or end of a section or category. This is a way of splitting the description into sections.</p> <p>If the category argument is present, this marks the end of the previous section (if any), and the beginning of a section of the specified category. The "table", "row" and "examples" categories are reserved for the obvious purposes.</p> <p>If the category argument is absent, this marks the end of the previous section (if any).</p> <p>Typically, processing tools will (a) validate the category, and (b) replace the template reference with a section marker.</p> <p>Markup examples:</p> <pre> {{section table}} {{section row}} {{section examples}} </pre>
Number of entries parameter description	<pre> {{numentries}} </pre>	<p>A description of a "NumberOfEntries" parameter.</p> <p>This template <b>SHOULD</b> be used for all such parameters. It will be expanded to something like "The number of entries in the &lt;table&gt; table."</p> <p>In most cases, the description will consist only of {{numentries}} but it <b>MAY</b> be followed by additional text if desired.</p>
Parameter and object reference	<pre> {{param ref}} {{param ref scope}} {{param}}  {{object ref}} {{object ref scope}} {{object}} </pre>	<p>A reference to the specified parameter or object.</p> <p>The OPTIONAL ref and scope arguments reference a parameter or object. Scope defaults to normal. Parameter and object names <b>SHOULD</b> adhere to the rules of A.2.3.4.</p> <p>Typically, processing tools will (a) validate the reference, and (b) replace the template reference with the ref argument or, if it is omitted, the current parameter or object name, possibly rendered in a distinctive font. Processing tools can use the scope to convert a relative path into an absolute path in order, for example, to generate a hyperlink.</p> <p>Markup examples:</p> <pre> {{param Enable}} {{object Stats.}} </pre>
Profile reference	<pre> {{profile ref}} {{profile}} </pre>	<p>A reference to the specified profile.</p> <p>The OPTIONAL ref argument references a profile.</p> <p>Typically, processing tools will (a) validate the reference, and (b) replace the template reference with the ref argument or, if it is omitted, the current profile name, possibly rendered in a distinctive font.</p> <p>Markup examples:</p> <pre> {{profile Baseline:1}} {{profile}} </pre>

Name	Markup Definition	Description
List description	<pre> {{list}} {{list arg}}  {{nolist}} </pre>	<p>A description of the current parameter's list attributes.</p> <p>This template SHOULD only be used within the description of a list-valued parameter (A.2.7.1).</p> <p>This is a hint to processing tools to replace the template reference with a description of the parameter's list attributes. This overrides processing tools' expected default behavior (unless suppressed by <code>{{nolist}}</code>) of describing the list attributes before the rest of the description.</p> <p>The OPTIONAL argument specifies a fragment of text that describes the list and SHOULD be incorporated into the template expansion.</p> <p>Typically processing tools will generate text of the form "Comma-separated list of &lt;dataType&gt;." Or "Comma-separated list of &lt;dataType&gt;, &lt;arg&gt;."</p>
Reference description	<pre> {{reference}} {{reference arg}}  {{noreference}} </pre>	<p>A description of the object or parameter that is referenced by the current parameter.</p> <p>This template SHOULD only be used within the description of a reference parameter (A.2.3.7).</p> <p>This is a hint to processing tools to replace the template reference with a description of the parameter's reference attributes. This overrides processing tools' expected default behavior (unless suppressed by <code>{{noreference}}</code>) of describing the reference attributes after the list attributes (for a list-valued parameter) or before the rest of the description (otherwise).</p> <p>The OPTIONAL argument is relevant only for a pathRef; it specifies a fragment of text that describes the referenced item and SHOULD be incorporated into the template expansion.</p> <p>Typically processing tools will generate text of the form "The value MUST be the full path name of &lt;arg&gt;...", in which the generated text can be expected to be sensitive to whether or not the parameter is list-valued.</p>
Named data type	<pre> {{datatype}}  {{nodatatype}} </pre>	<p>A description of the current parameter's named data type.</p> <p>This template SHOULD only be used within the description of a parameter of a named data type (A.2.3.1).</p> <p>This is a hint to processing tools to replace the template reference with an indication of the parameter's named data type, possibly including additional details or a hyperlink to such details. This overrides processing tools' expected default behavior (unless suppressed by <code>{{nodatatype}}</code>) of describing the named data type before the rest of the description.</p>
Profile description	<pre> {{profdesc}}  {{noprofdesc}} </pre>	<p>An auto-generated description of a profile.</p> <p>This template SHOULD only be used within the description of a profile (A.2.9).</p> <p>This is a hint to processing tools to replace the template reference with a description of the profile. This overrides processing tools' expected default behavior (unless suppressed by <code>{{noprofdesc}}</code>) of describing the profile before the rest of the description.</p> <p>Typically processing tools will generate text of the form "This table defines the &lt;profile:v&gt; profile for the &lt;object:m&gt; object. The minimum REQUIRED version for this profile is &lt;object:m.n&gt;." (or more complex text if the profile is based on or extends other profiles).</p>



Name	Markup Definition	Description
Enumeration reference	<pre> {{enum value}} {{enum value param}} {{enum value param scope}} {{enum}}  {{noenum}} </pre>	<p>A reference to the specified enumeration value.</p> <p>The OPTIONAL value argument specifies one of the enumeration values for the referenced parameter. If present, it <b>MUST</b> be a valid enumeration value for that parameter.</p> <p>The OPTIONAL param and scope arguments identify the referenced parameter. Scope defaults to normal. If present, param <b>SHOULD</b> adhere to the rules of A.2.3.4. If omitted, the current parameter is assumed.</p> <p>If the arguments are omitted, this is a hint to processing tools to replace the template reference with a list of the parameter's enumerations, possibly preceded by text such as "Enumeration of:". This overrides processing tools' expected default behavior (unless suppressed by {{noenum}}) of listing the parameter's enumerations after the rest of the description.</p> <p>Otherwise, typically processing tools will (a) validate that the enumeration value is valid, and (b) replace the template reference with the value and/or param arguments, appropriately formatted and with the value possibly rendered in a distinctive font. Processing tools can use the scope to convert a relative path into an absolute path in order, for example, to generate a hyperlink.</p> <p>Markup examples:</p> <pre> {{enum None}} {{enum None OtherParam}} </pre>
Pattern reference	<pre> {{pattern value}} {{pattern value param}} {{pattern value param scope}} {{pattern}}  {{nopattern}} </pre>	<p>A reference to the specified pattern value.</p> <p>The OPTIONAL value argument specifies one of the pattern values for the referenced parameter. If present, it <b>MUST</b> be a valid pattern value for that parameter.</p> <p>The OPTIONAL param and scope arguments identify the referenced parameter. Scope defaults to normal. If present, param <b>SHOULD</b> adhere to the rules of A.2.3.4. If omitted, the current parameter is assumed.</p> <p>If the arguments are omitted, this is a hint to processing tools to replace the template reference with a list of the parameter's patterns, possibly preceded by text such as "Possible patterns:". This overrides processing tools' expected default behavior (unless suppressed by {{nopattern}}) of listing the parameter's patterns after the rest of the description.</p> <p>Otherwise, typically processing tools will (a) validate that the pattern value is valid, and (b) replace the template reference with the value and/or param arguments, appropriately formatted and with the value possibly rendered in a distinctive font. Processing tools can use the scope to convert a relative path into an absolute path in order, for example, to generate a hyperlink.</p> <p>Markup examples:</p> <pre> {{pattern None}} {{pattern None OtherParam}} </pre>

Name	Markup Definition	Description
Hidden value	<pre> {{hidden}} {{hidden value}}  {{nohidden}} </pre>	<p>Text explaining that the value of the current parameter is hidden and cannot be read.</p> <p>This template SHOULD only be used within the description of a hidden parameter (A.2.7.1).</p> <p>This is a hint to processing tools to replace the template reference with text explaining that the value of the current parameter is hidden and cannot be read. This overrides processing tools' expected default behavior (unless suppressed by {{nohidden}}) of placing this text after the rest of the description.</p> <p>The OPTIONAL argument indicates the value that is returned when the current parameter is read. If omitted this defaults to the expansion of the {{null}} template.</p> <p>Typically, processing tools will generate text of the form "When read, this parameter returns &lt;arg&gt;, regardless of the actual value."</p>
Command parameter	<pre> {{command}}  {{nocommand}} </pre>	<p>Text explaining that the current parameter is a command parameter that triggers a CPE action.</p> <p>This template SHOULD only be used within the description of such a command parameter (A.2.7.1).</p> <p>This is a hint to processing tools to replace the template reference with text explaining that the current parameter is a command parameter that always reads back as {{null}}. This overrides processing tools' expected default behavior (unless suppressed by {{nocommand}}) of placing this text after the rest of the description.</p> <p>Typically, processing tools will generate text of the form "The value is not part of the device configuration and is always {{null}} when read."</p>
Factory default value	<pre> {{factory}}  {{nofactory}} </pre>	<p>Text listing the factory default for the current parameter.</p> <p>This template SHOULD only be used within the description of a parameter that has a factory default value.</p> <p>This is a hint to processing tools to replace the template reference with text listing the factory default value. This overrides processing tools' expected default behavior (unless suppressed by {{nofactory}}) of placing this text after the rest of the description.</p> <p>Typically, processing tools will generate text of the form "The factory default value MUST be &lt;value&gt;."</p>
Unique keys description	<pre> {{keys}}  {{nokeys}} </pre>	<p>A description of the current object's unique keys.</p> <p>This template SHOULD only be used within the description of a multi-instance (table) object that defines one or more unique keys (A.2.8.1).</p> <p>This is a hint to processing tools to replace the template reference with a description of the object's unique keys. This overrides processing tools' expected default behavior (unless suppressed by {{nokeys}}) of describing the unique keys after the description.</p>
Units reference	<pre> {{units}} </pre>	<p>The parameter's units string.</p> <p>Typically, processing tools will (a) check that the parameter has a units string, and (b) substitute the value of its units string.</p>
Boolean values	<pre> {{false}} {{true}} </pre>	<p>Boolean values.</p> <p>Typically, processing tools will substitute the value False or True, possibly rendered in a distinctive font.</p>
Miscellaneous	<pre> {{empty}} </pre>	<p>Represents an empty string. Typically, processing tools will render such values in a distinctive font, possibly using standard wording, such as &lt;Empty&gt; or "an empty string".</p>
	<pre> {{null}} </pre>	<p>Expands to the appropriate null value for the current parameter's data type (A.2.3.5), e.g. {{empty}}, {{false}} or 0.</p>

### A.2.2.5 HTML Example

This includes examples of most of the markup and templates.

```

<model name="Goo:1.1" base="Goo:1.0">
  <object name="GooTop." access="readOnly" minEntries="1" maxEntries="1">
    <parameter name="ExampleParam" access="readOnly">
      <description>
        {{section|Introduction}}This is an 'example' parameter that illustrates many of the
          '''formatting''' templates. For '''example''', this references {{bibref|TR-
            106a1|section 3.2}}.
        {{section|Usage}}This parameter is called {{object}}{{param}}. One can also reference other
          parameters in the same object, such as {{param|OtherParameter}}, and indicate
          that the parameter value is measured in {{units}}.

        One can also include bulleted lists:
        * level one
        ** level two
        * level one again
        ** level two again
        *** level three
        *: level one continued
        and numbered lists:
        # level one
        ## level two
        # level one again
        ## level two again
        ### level three
        #: level one continued
        and indented lists
        : level one
        :: level two
        : level one again
        :: level two again
        ::: level three
        and hyperlinks such as http://www.google.com
        and code examples:
        if (something) {
          /* do something */
        } else {
          /* do other */
        }
        If the parameter was Boolean, one could refer to its values {{false}} and {{true}}.
        One can refer to its enumerations individually, e.g. {{enum|Disabled}}, or to other parameters'
          enumerations, such as {{enum|Value|OtherParam}}, or can list them all. {{enum}}
        Finally, if there were any patterns they could be listed too. {{pattern}}
      </description>
      <syntax>
        <string>
          <enumeration value="A"/>
          <enumeration value="B"/>
          <units value="packets"/>
        </string>
      </syntax>
    </parameter>
  </object>
</model>

```

The resulting HTML would look something like this:

This is an *example* parameter that illustrates many of the **formatting** templates. For *example*, this references [TR-106a1] section 3.2.

This parameter is called *ParentObject.ExampleParam*. One can also reference other parameters in the same object, such as *OtherParameter*, and indicate that the parameter value is measured in packets.

One can also include bulleted lists:

- level one
  - level two
- level one again
  - level two again
    - level three

level one continued

and numbered lists:

1. level one
  1. level two
2. level one again
  1. level two again
    1. level three

level one continued

and indented lists

```

level one
  level two
level one again
  level two again
    level three
  
```

and hyperlinks such as <http://www.google.com>

and code examples:

```

if (something) {
  /* do something */
} else {
  /* do other */
}

```

If the parameter was Boolean, one could refer to its values *false* and *true*.

One can refer to its enumerations individually, e.g. *A*, or to other parameters' enumerations, such as *Value*, or can list them all. Possible values:

- *Disabled*
- *Enabled*
- *Error* (OPTIONAL)

Finally, if there were any patterns they could be listed too.

## A.2.3 Data Types

TR-069 [2] data models support only the primitive data types listed in the last row of Table 4 “on the wire”. However, the DM Schema allows data types to be derived from the primitive types or from other named data types. Such derived types can be named or anonymous.

### A.2.3.1 Named Data Types

Named data types are defined using the top-level `dataType` element. A DM Instance can contain zero or more top-level `dataType` elements.

When defining a new named data type, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 4 – XML Named Data Types**

Name	Description
name	The data type name.
base	The base type name, i.e. name of the data type from which this data type is derived. This is used only where the base type is itself a named data type, not a primitive type.
status	The data type's {current, deprecated, obsoleted, deleted} status. This defaults to current, and so is not likely to be specified for a new data type.
description	The data type's description (A.2.2).
size pathRef instanceRef range enumeration enumerationRef pattern units	Data type facets (A.2.3.3). These are permitted only when the base type is a named data type, i.e. when the base attribute is specified.
base64 boolean dateTime hexBinary int long string unsignedInt unsignedLong	Primitive data type definition. These are permitted only when the base type is primitive. There is an element for each primitive data type, and each element supports only the facets (A.2.3.3) that are appropriate to that data type.

For example:

```
<dataType name="String255">
  <string>
    <size maxLength="255" />
  </string>
</dataType>

<dataType name="String127" base="String255">
  <size maxLength="127" />
</dataType>
```

### A.2.3.2 Anonymous Data Types

Anonymous data types are defined within parameter syntax elements (A.2.7.1), and can apply only to the parameters within which they are defined. For example:

```
<parameter name="Example1" access="readOnly">
  <syntax>
    <string>
      <size maxLength="127" />
    </string>
  </syntax>
</parameter>

<parameter name="Example2" access="readOnly">
  <syntax>
    <dataType base="String255">
      <size maxLength="127" />
    </dataType>
  </syntax>
</parameter>
```

If an anonymous data type is modified in a later version of a data model, the modified anonymous data type is

regarded as being derived from the original anonymous data type. Therefore the base type restriction rules of A.2.3.8 MUST be obeyed.

### A.2.3.3 Data Type Facets

A facet specifies some aspect of a data type, e.g. its size, range or units.

Note that XML Schema [11] also associates facets with data types. The XML Schema and DM Schema concepts are the same, but the set of facets is not identical.

The DM Schema defines the following facets (normative requirements are specified in the schema):

**Table 5 – XML Data Type Facets**

Name	Description
size	Size ranges for the data type (applies to string, base64, hexBinary and their derived types). Note that the size facet always refers to the actual value, not to the base64- or hexBinary-encoded value. Prior to the definition of the DM Schema, the maximum sizes of base64 parameters referred to the base64-encoded values. Processing tools that generate reports from DM Instances SHOULD include explicit clarification of whether the size ranges refer to the actual or encoded values. Note that the size facet is also used to specify the size range for list-valued parameters, which are always strings (A.2.7.1).
pathRef	Details of how to reference parameters and objects via their path names (applies to string and its derived types; A.2.3.7).
instanceRef	Details of how to reference object instances (table rows) via their instance numbers (applies to int, unsignedInt and their derived types; A.2.3.7).
range	Value ranges for the data type (applies to numeric data types and their derived types).
enumeration	Enumerations for the data type (applies to string and its derived types).
enumerationRef	Enumerations for the data type, obtained at run-time from the value of a specified parameter (applies to string and its derived types; A.2.3.7).
pattern	Patterns for the data type (applies to string and its derived types). Pattern value syntax is the same as for XML Schema regular expressions. See [14] Section F.
units	Units for the data type (applies to numeric data types and their derived types).

It is important to note that the enumeration facet does not necessarily define all the valid values for a data type. This is for the following reasons:

- As specified in section 3.3, vendors are allowed to add additional enumeration values.
- A future version of a data model may need to add additional enumerations values.

### A.2.3.4 Reference Path Names

Some description templates (A.2.2.4), and all reference facets (A.2.3.7), need to specify parameter or object names. It is always possible to specify a full path name, but it is frequently necessary or convenient to specify a relative path name. For example, it might be necessary to reference another parameter in the current object. Any instance numbers in the parameter's full path name cannot be known at data model definition time, so this can only be done using a relative path name.

The following rules apply to all path names that are used in data model definitions for referencing parameters or objects:

- Path names MAY contain “{i}” placeholders, which MUST be interpreted as wild cards matching all instance numbers, e.g. “InternetGatewayDevice.WANDevice.{i}.” references all WANDevice instances.
- Path names MUST NOT contain instance numbers.

A path name is always associated with a path name scope, which defines the point in the naming hierarchy relative to which the path name applies.

**Table 6 – Path Name Scope Definition**

Name	Description
normal	This is a hybrid scope which usually gives the desired behavior: <ul style="list-style-type: none"> <li>• If the path begins with a “Device” or “InternetGatewayDevice” component, it is relative to the top of the naming hierarchy.</li> <li>• If the path begins with a dot, it is relative to the Root or Service Object (c.f. scope=model).</li> <li>• Otherwise, the path is relative to the current object (c.f. scope=object).</li> </ul>
model	The path is relative to the Root or Service Object.
object	The path is relative to the current object.

Formally, if the path name scope is normal:

- If the path is empty, it **MUST** be regarded as referring to the top of the naming hierarchy.
- Otherwise, if the path begins with a “Device” or “InternetGatewayDevice” component, it **MUST** be regarded as a full path name (these are the only two possible Root Device names).
- Otherwise, if the path begins with a dot (“.”), it **MUST** be regarded as a path relative to the Root or Service Object. For example, in the Device Root Object “.DeviceInfo.” means “Device.DeviceInfo.”, and in the Device.Services.ABCService.1 Service Object it means “Device.Services.ABCService.1.DeviceInfo.”.
- Otherwise, it **MUST** be regarded as a path relative to the current object. Any leading hash characters (“#”) cause it to be relative to the parent of the current object (or the parent’s parent, and so on) as described below. For example, if the current object is “Device.LAN.”, “IPAddress” means “Device.LAN.IPAddress”, “Stats.” means “Device.LAN.Stats.” and “#.DeviceInfo.” means “Device.DeviceInfo” (see below for more “#” examples).

If the path name scope is model:

- If the path is empty, it **MUST** be regarded as referring to the Root or Service Object.
- Otherwise, it **MUST** be regarded as a path relative to the Root or Service Object. Any leading dot **MUST** be ignored. Leading hash characters are not permitted.

If the path name scope is object:

- If the path is empty, it **MUST** be regarded as referring to the current object.
- Otherwise, it **MUST** be regarded as a path relative to the current object. Any leading dot **MUST** be ignored. Leading hash characters are not permitted.

As mentioned above, if the path name scope is normal, a leading hash character causes the path to be relative to the parent of the current object. Additional hash characters reference the parent’s parent, and so on, but they **MUST NOT** be used to reference beyond the Root or Service Object. Also, for object instances, “#.” always means the multi-instance object’s (table’s) parent rather than the multi-instance object (table).

In addition, within a component definition, items that are defined outside the component **MUST NOT** be referenced via relative paths. This is because components can be included anywhere within the data model tree.

For example, if the current object is “Device.LAN.DHCPOption.{i}.”:

- “#.” means “Device.LAN.” (the table’s parent, not the table).
- “#.DHCPOption.” means “Device.LAN.DHCPOption.” (the table).
- “#.Stats.” means “Device.LAN.Stats.”.
- “#.Stats.TotalBytesSent” means “Device.LAN.Stats.TotalBytesSent”.

The following examples would be invalid if LAN was defined within a component:

- “##.” means “Device.”.
- “##.DeviceInfo.” means “Device.DeviceInfo.”.
- “##.DeviceInfo.Manufacturer” means “Device.DeviceInfo.Manufacturer”.

The final example can never be valid:

- “###.” is not permitted (references beyond the Root Object).

Note that the term “Root or Service Object”, which is used several times above, means “if within a Service Object instance, the Service Object instance; otherwise, the Root Object”.

For example, the pathRef and instanceRef facets (A.2.3.7) have a targetParent attribute which specifies the possible parent(s) of the referenced parameter or object, and a targetParentScope attribute (defaulted to normal) which specifies targetParent’s scope. If the current object is within a Service Object instance, setting targetParentScope to model forces the referenced parameter or object to be in the same Service Object instance. Similarly, setting targetParentScope to object forces the referenced parameter or object to be in the same object or in a sub-object.

### A.2.3.5 Null Values and References

Each primitive data type has an associated null value that is used, for example, as the expansion of the {{null}} template (A.2.2.4). These null values are defined as follows:

- base64, hexBinary, string: an empty string
- unsignedInt, unsignedLong: 0
- int, long: -1
- boolean: false
- dateTime: 0001-01-01T00:00:00Z (the Unknown Time; see section 3.2.2)

A null reference indicates that a reference parameter is not currently referencing anything. The value that indicates a null reference is the null value for the reference parameter’s base data type, i.e.:

- **string**: an empty string
- **unsignedInt**: 0
- **int**: -1



### A.2.3.6 Reference Types

A reference to another parameter or object can be weak or strong:

- **weak:** it doesn't necessarily reference an existing parameter or object. For example, if the referenced parameter or object is deleted, the value of the reference parameter might not get updated.
- **strong:** it always either references a valid parameter or object, or else is a null reference (A.2.3.5). If the referenced parameter or object is deleted, the value of the reference parameter is always set to a null reference.

The following requirements relate to reference types and the associated CPE behavior.

- All read-only reference parameters **MUST** be declared as strong references.
- A CPE **MUST** reject an attempt to set a strong reference parameter if the new value does not reference an existing parameter or object.
- A CPE **MUST NOT** reject an attempt to set a weak reference parameter because the new value does not reference an existing parameter or object.
- A CPE **MUST** change the value of a non-list-valued strong reference parameter to a null reference when a referenced parameter or object is deleted.
- A CPE **MUST** remove the corresponding list item from a list-valued strong reference parameter when a referenced parameter or object is deleted.
- A CPE **MUST NOT** change the value of a weak reference parameter when a referenced parameter or object is deleted.

### A.2.3.7 Reference Facets

A reference facet specifies how a parameter can reference another parameter or object. There are three sorts of reference:

- **Path reference:** references another parameter or object via its path name. Details are specified via the pathRef facet, which applies to string and its derived types.
- **Instance reference:** references an object instance (table row) via its instance number. Details are specified via the instanceRef facet, which applies to int, unsignedInt and their derived types.
- **Enumeration reference:** references a list-valued parameter via its path name. The current value of the referenced parameter indicates the valid enumerations for this parameter. Details are specified via the enumerationRef facet, which applies to string and its derived types.

When defining a path reference, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 7 – PathRef Facet Definition**

Name	Description
targetParent	An XML list of path names that can restrict the set of parameters and objects that can be referenced. If the list is empty (the default), then anything can be referenced. Otherwise, only the immediate children of one of the specified objects can be referenced. A "{i}" placeholder in a path name acts as a wild card, e.g. "InternetGatewayDevice.WANDevice.{i}.WAN-ConnectionDevice.{i}.WANPPPPConnection.". Path names cannot contain explicit instance numbers.
targetParentScope	Specifies the point in the naming hierarchy relative to which targetParent applies (A.2.3.4): normal (default), model or object.

Name	Description
targetType	<p>Specifies what types of item can be referenced:</p> <ul style="list-style-type: none"> <li>• <b>any</b>: any parameter or object can be referenced (default)</li> <li>• <b>parameter</b>: any parameter can be referenced</li> <li>• <b>object</b>: any object can be referenced</li> <li>• <b>single</b>: any single-instance object can be referenced</li> <li>• <b>table</b>: any multi-instance object (table) can be referenced</li> <li>• <b>row</b>: any multi-instance object (table) instance (row) can be referenced</li> </ul>
targetDataType	<p>Specifies the valid data types for the referenced parameter. Is relevant only when targetType is any or parameter.</p> <p>Possible values are as follows:</p> <ul style="list-style-type: none"> <li>• <b>any</b>: a parameter of any data type can be referenced (default)</li> <li>• <b>base64</b>: only a base64 parameter can be referenced</li> <li>• <b>boolean</b>: only a boolean parameter can be referenced</li> <li>• <b>dateTime</b>: only a dateTime parameter can be referenced</li> <li>• <b>hexBinary</b>: only a hexBinary parameter can be referenced</li> <li>• <b>integer</b>: only an integer (int, long, unsignedInt or unsignedLong) parameter can be referenced</li> <li>• <b>int</b>: only an int parameter can be referenced</li> <li>• <b>long</b>: only a long (or int) parameter can be referenced</li> <li>• <b>string</b>: only a string parameter can be referenced</li> <li>• <b>unsignedInt</b>: only an unsignedInt parameter can be referenced</li> <li>• <b>unsignedLong</b>: only an unsignedLong (or unsignedInt) parameter can be referenced</li> <li>• <b>&lt;named data type&gt;</b>: only a parameter of the named data type can be referenced</li> </ul> <p>In addition, a parameter whose data type is derived from the specified data type can be referenced. The built-in type hierarchy (a simplified version of the XML Schema type hierarchy) is as follows:</p> <pre> any   base64   boolean   dateTime   hexBinary   integer   long   int   unsignedLong   unsignedInt   string </pre> <p>Note that <i>any</i> and <i>integer</i> are not valid parameter data types. They are included in order to support “can reference any data type” and “can reference any numeric data type”.</p>
refType	Specifies the reference type (0): weak or strong.

When defining an instance reference, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 8 – InstanceRef Facet Definition**

Name	Description
targetParent	Specifies the path name of the multi-instance object (table) of which an instance (row) is being referenced. “{i}” placeholders and explicit instance numbers are not permitted in the path name. targetParentScope can be used to specify path names relative to the Root or Service Object or the current object.
targetParentScope	Specifies the point in the naming hierarchy relative to which targetParent applies (A.2.3.4): normal (default), model or object.
refType	Specifies the reference type (0): weak or strong.

When defining an enumeration reference, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 9 – EnumerationRef Facet Definition**

Name	Description
targetParam	Specifies the path name of the list-valued parameter whose current value indicates the valid enumerations for this parameter.
targetParamScope	Specifies the point in the naming hierarchy relative to which targetParam applies (A.2.3.4): normal (default), model or object.
nullValue	Specifies the parameter value that indicates that none of the values of the referenced parameter currently apply (if not specified, no such value is designated). Note that if this parameter is list-valued then nullValue is not relevant, because this condition will be indicated by an empty list.

The following examples illustrate the various possible types of reference.

```

<object name="PeriodicStatistics.SampleSet.{i}.Parameter.{i}." ...>
  ...
  <parameter name="Reference" access="readWrite">
    <description>Reference to the parameter that is associated with this object instance.
    This MUST be the parameter's full path name.</description>
    <syntax>
      <string>
        <size maxLength="256"/>
        <pathRef targetType="parameter" refType="weak"/>
      </string>
      <default type="object" value="" />
    </syntax>
  </parameter>

```

```

<object name="StorageService.{i}.StorageArray.{i}." ...>
  ...
  <parameter name="PhysicalMediumReference" access="readWrite">
    <description>A comma-separated list of Physical Medium references. Each Physical Medium
    referenced by this parameter MUST exist within the same StorageService instance.
    A Physical Medium MUST only be referenced by one Storage Array instance. Each
    reference can be either in the form of ".PhysicalMedium.{i}" or a fully
    qualified object name...</description>
    <syntax>
      <list>
        <size maxLength="1024"/>
      </list>
      <string>
        <pathRef targetParent=".PhysicalMedium." targetParentScope="model" targetType="row"
        refType="strong"/>
      </string>
    </syntax>
  </parameter>

```

```

<object name="InternetGatewayDevice.QueueManagement.Classification.{i}." access="readWrite"
  minEntries="0" maxEntries="unbounded"
  entriesParameter="ClassificationNumberOfEntries">
  <description>Classification table.</description>
  <parameter name="ClassQueue" access="readWrite">
    <description>Classification result. Instance number...</description>
    <syntax>
      <int>
        <instanceRef targetParent=".QueueManagement.Queue." refType="strong"/>
      </int>
    </syntax>
  </parameter>

```

```

<object name="STBService.{i}.Components.FrontEnd.{i}.IP.Inbound.{i}." ...>
...
<parameter name="StreamingControlProtocol" access="readOnly">
  <description>Network protocol currently used for controlling streaming of the source content, or
  an empty string if the content is not being streamed or is being streamed but is
  not being controlled.
  If non-empty, the string MUST be one of the .Capabilities.FrontEnd.IP.StreamingControlProtocols
  values.</description>
  <syntax>
    <string>
      <enumerationRef targetParam=".Capabilities.FrontEnd.IP.StreamingControlProtocols"
        nullValue="" />
    </string>
  </syntax>
</parameter>

<parameter name="StreamingTransportProtocol" access="readOnly">
  <description>Network protocol currently used for streaming the source content, or an empty
  string if the content is not being streamed.
  If non-empty, the string MUST be one of the .Capabilities.FrontEnd.IP.StreamingTransportProtocols
  values.</description>
  <syntax>
    <string>
      <enumerationRef targetParam=".Capabilities.FrontEnd.IP.StreamingTransportProtocols"
        nullValue="" />
    </string/>
  </syntax>
</parameter>

```

```

<object name="InternetGatewayDevice.LANDevice.{i}.WLANConfiguration.{i}.WPS." ...>
...
<parameter name="ConfigMethodsEnabled" access="readWrite">
  <description>Comma-separated list of the WPS configuration methods enabled on the device. Each
  entry in the list MUST be a member of the list reported by the
  ConfigMethodsSupported parameter...</description>
  <syntax>
    <list/>
    <string>
      <enumerationRef targetParam="ConfigMethodsSupported" />
    </string>
  </syntax>
</parameter>

```

**A.2.3.8 Base Type Restriction**

A new data type MUST always be a restriction of its base type, meaning that a valid value of the new data type will always be a valid value for its base type. This is the case for the examples of A.2.3.1, which involve three different data types:

- string of unlimited length
- string of maximum length 255
- string of maximum length 127

Clearly a string of length 100 is valid for all three data types, but a string of length 200 is only valid for the first two data types.

The examples of A.2.3.1 considered only the size facet, but in general all facets that are applicable to the data type have to be considered. The base type restriction requirements for each facet are as follows:

**Table 10 – XML Facet Inheritance Rules**

Facet	Requirements
size	The derived data type can define sizes in any way, provided that the new sizes do not permit any values that are not valid for the base type.

Facet	Requirements
pathRef	The derived data type can modify the data type in the following ways: <ul style="list-style-type: none"> <li>By "promoting" status to a "higher" value, where the lowest to highest ordering is: current, deprecated, obsoleted, deleted. For example, current can be changed to deprecated, and obsoleted can be changed to deleted, but deleted can't be changed back to obsoleted. When promoting status, the deprecation, obsolescence and deletion rules of section 2.4 MUST be obeyed.</li> <li>By changing targetParent to narrow the set of possible parent objects.</li> <li>By changing targetType to narrow the set of possible target types.</li> <li>By changing targetDataType to narrow the set of possible target data types.</li> </ul>
instanceRef	The derived data type can modify the data type in the following ways: <ul style="list-style-type: none"> <li>By "promoting" status to a "higher" value, as described for pathRef.</li> <li>By changing targetParent to narrow the set of possible parent objects.</li> </ul>
range	The derived data type can define ranges in any way, provided that the new ranges do not permit any values that are not valid for the base type.
enumeration	The derived data type can modify existing enumeration values in the following ways: <ul style="list-style-type: none"> <li>By "promoting" access from readOnly to readWrite.</li> <li>By "promoting" status to a "higher" value, as described for pathRef.</li> <li>By "promoting" optional from False to True.</li> <li>By adding a code, if none was previously specified.</li> <li>By using the action attribute to extend or replace the description (see below).</li> </ul> The derived data type can add new enumeration values.
enumerationRef	The derived data type can modify the data type in the following ways: <ul style="list-style-type: none"> <li>By "promoting" status to a "higher" value, as described for pathRef.</li> </ul>
pattern	The derived data type can modify existing pattern values by changing access, status, optional and description exactly as for enumerations. The derived data type can add new patterns and/or replace existing patterns with new patterns, provided that the new patterns do not permit any values that are not valid for the base type. For example a single pattern "[AB]" could be replaced with "A" and "B", but "C" could not be added.
units	The derived data type can add units if the base type didn't specify any.

Most of the above requirements are non-normative, because it has to be possible to correct errors. For example, if the base type supports a range of [-1:4095] but the values 0 and 4095 were included in error, it would be permissible for a derived type to support ranges of [-1:-1] and [1:4094]. Processing tools SHOULD be able to detect and warn about such cases.

When defining a new data type, if a facet is omitted, the new data type will inherit that facet from its base type. If a facet is present, it MUST be fully specified (except that special rules apply to descriptions; see below). For example, this means that a derived type that adds additional enumeration values has also to re-declare the enumeration values of the base type.

For example, in the following, the derived type inherits the units facet from its parent but it does not inherit the range facet, so the PacketCounter range is [10:] and the PacketCounter2 range is [15:20].

```
<dataType name="PacketCounter">
  <unsignedLong>
    <range minInclusive="10"/>
    <units value="packets"/>
  </unsignedLong>
</dataType>

<dataType name="PacketCounter2" base="PacketCounter">
  <range minInclusive="15" maxInclusive="20"/>
</dataType>
```

Similarly, in the following, the enumeration values for ABCD are not A, B, C and D, but are just C and D. This is an error (because the derived type cannot remove enumeration values), and processing tools SHOULD detect and warn about such cases.

```

<dataType name="AB">
  <string>
    <enumeration value="A"/>
    <enumeration value="B"/>
  </string>
</dataType>

<dataType name="ABCD" base="AB">
  <string>
    <enumeration value="C"/>
    <enumeration value="D"/>
  </string>
</dataType>

```

A derived data type and any of its facets that support descriptions will inherit those descriptions from the base type. Facet descriptions are inherited regardless of whether the facet is present in the derived type. For any descriptions that are explicitly specified in the derived type, the action attribute controls whether they will be extended or replaced.

For example, in the following, the description of Z (which is not changed) does not have to be repeated.

```

<dataType name="XY">
  <description>This is XY.</description>
  <string>
    <enumeration value="X">
      <description>This is X.</description>
    </enumeration>
    <enumeration value="Y">
      <description>This is Y.</description>
    </enumeration>
    <enumeration value="Z">
      <description>This is Z.</description>
    </enumeration>
  </string>
</dataType>

<dataType name="XY2" base="XY">
  <description action="replace">This is all about XY.</description>
  <enumeration value="X">
    <description action="append">This is more about X, added at the end.</description>
  </enumeration>
  <enumeration value="Y">
    <description action="prefix">This is more about Y, inserted at the beginning.</description>
  </enumeration>
  <enumeration value="Z"/>
</dataType>

```

## A.2.4 Bibliography

The bibliography is defined using the top-level bibliography element, which can contain zero or more (bibliographic) reference elements.

When defining a new bibliographic reference, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 11 – XML Bibliographic References**

Name	Description
id	The bibliographic reference ID.
name	The name by which the referenced document is usually known.
title	The document title.
organization	The organization that published the referenced document, e.g. BBF, IEEE, IETF.
category	The document category, e.g. TR (BBF), RFC (IETF).
date	The publication date.
hyperlink	Hyperlink(s) to the document.

The bibliographic reference ID is intended to uniquely identify this reference across all instance documents. Therefore, for instance documents that are published by the BBF, IDs MUST obey the following rules:

- For a BBF Technical Report, it MUST be of the form “TR-*nnnixaycz*”, where TR is the literal “TR”, *nnn* is the Technical Report number (including leading zeros), *i*, *a* and *c* are literal letters, and *x*, *y*, and *z* are the issue, amendment and corrigendum numbers respectively. The issue number (*ix*) is omitted if it is issue 1 and the amendment number (*ay*) is omitted if it is amendment 0. For example, “TR-106a2” refers to TR-106 (Issue 1) Amendment 2. If the corrigendum number (*cz*) is omitted, the most recent corrigendum is assumed.
- For an IETF RFC, it MUST be of the form “RFC*nnn*”, where RFC is the literal “RFC” and *nnn* is the RFC number (no leading zeros).
- For an IEEE specification, it SHOULD be of the form “*nnn.ml-dddd*”, where *nnn.m* is the IEEE group, *l* is the spec letter(s), and *dddd* is the publication year. For example, “802.1D-2004”.
- For an ETSI specification (which includes DVB specifications), it SHOULD be of the form “TT*nnnnnnva.b.c*” where TT is the specification type, usually “TS” (Technical Specification), *nnnnnn* is the specification number, and *a.b.c* is the version number.
- For specifications issued by other standards organizations, or by vendors, it SHOULD be of a standard form if one is defined.

Processing tools SHOULD be lenient when comparing bibliographic reference IDs. Specifically, they SHOULD ignore all whitespace, punctuation, leading zeros in numbers, and upper / lower case. So, for example, “rfc 1234” and “RFC1234” would be regarded as the same ID, as would “TR-069” and “TR69”.

Processing tools SHOULD detect and report inconsistent bibliographic references, e.g. a reference with the same ID (i.e. an ID that compares as equal) as one that was encountered in a different file, but with a different name or hyperlink.

Formally, bibliographic reference IDs in instance documents that are published by the BBF and the other organizations mentioned above are defined as follows:

```

ReferenceID = BBFID
            | RFCID
            | IEEEID
            | ETSIID
            | OtherID

BBFID = "TR-" BBFNumber BBFIssue BBFAmendment BBFCorrigendum

BBFNumber = [DIGIT]{3,} // including leading zeros, e.g. 069

BBFIssue = "i" <number greater than one>
          | "" // empty means Issue 1

BBFAmendment = "a" <number greater than zero>
              | "" // empty means Amendment 0

BBFCorrigendum = "c" <number greater than zero>
                 | "" // empty means the most recent Corrigendum

RFCID = "RFC" RFCNumber

RFCNumber = NONZERODIGIT [DIGIT]*
           // no leading zeros, e.g. 123

IEEEID = IEEEGroup IEEEspec IEEEDate
        | <for other IEEE specifications, of a standard form if one is defined>

IEEEGroup = <group number> "." <group sub-number>
           // e.g. 802.1

IEEEspec = <spec letter(s)> // e.g. D

IEEEDate = "-" <publication year>
           // e.g. -2004
           | "" // can be empty

ETSIID = ETSISpecType ETSINumber ETSIVersion
        | <for other ETSI specifications, of a standard form if one is defined>

ETSIspecType = "TR" // Technical Report
              | "TS" // Technical Specification
              | "ES" // ETSI Specification
              | "EN" // European Standard

ETSIINumber = [DIGIT]{6} // e.g. 102034

ETSIVersion = "v" <version number as specified by ETSI>
             | "" // can be empty

OtherURI = <of a standard form if one is defined>

```

## A.2.5 Components

A component is a way of defining a named set of parameters, objects and/or profiles to be used wherever such a group is needed in more than one place (or just to structure the definitions). A DM Instance can contain zero or more top-level component elements.

When defining a new component, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 12 – XML Component Definition**

Name	Description
name	The component name.
description	The component's description (A.2.2).
component	The other components that are referenced (included) by this component.
parameter	The component's top-level parameter definitions (A.2.7).



Name	Description
object	The component's object definitions (A.2.8).
profile	The component's profile definitions (0).

Referencing (including) a component can be thought of as textual substitution. A component has no version number and isn't tied to a particular Root or Service Object.

The following is a simple example of component definition and reference.

```

<component name="ByteStats">
  <parameter name="BytesSent" access="readOnly">
    <description>Number of bytes sent.</description>
    <syntax><unsignedInt/></syntax>
  </parameter>
  <parameter name="BytesReceived" access="readOnly">
    <description>Number of bytes received.</description>
    <syntax><unsignedInt/></syntax>
  </parameter>
</component>

<model name="InternetGatewayDevice:1.4">
  <object name="InternetGatewayDevice." access="readOnly" minEntries="1" maxEntries="1">
    ...
    <component ref="ByteStats"/>
    ...
  </object>
  ...
</model>

```

Here the component is referenced from within an object definition. Components can be referenced from within component, model and object definitions. Parameter, object and profile definitions within components are relative to the point of inclusion unless overridden using the path attribute.

## A.2.6 Root and Service Objects

Root and Service Objects are defined using the model element and an associated top-level object element. A DM Instance can contain zero or more top-level model elements.

When defining a new model, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 13 – XML Root and Service Objects**

Name	Description
name	The model name, including its major and minor version numbers (3.7).
base	The name of the previous version of the model (for use when the model version is greater than 1.0).
isService	Whether it's a Service Object. This defaults to False and so can be omitted for Root Objects.
description	The model's description (A.2.2).
component	The components that are referenced (included) by the model.
parameter	The model's top-level parameter definitions (A.2.7).
object	The model's top-level and other object definitions (A.2.8).
profile	The model's profile definitions (0).

Once a given version has been defined, it cannot be modified; instead, a new version of the object has to be defined. For example, the following example defines v1.0 and v1.1 of a notional Service Object.

```

<model name="DemoService:1.0" isService="true">
  <parameter name="DemoServiceNumberOfEntries" access="readOnly"/>
  <object name="DemoService.{i}." access="readOnly" minEntries="0" maxEntries="unbounded"
    entriesParameter="DemoServiceNumberOfEntries"/>
</model>

<model name="DemoService:1.1" base="DemoService:1.0" isService="true">
  <object base="DemoService.{i}." access="readOnly" minEntries="0" maxEntries="unbounded"/>
</model>

```

## A.2.7 Parameters

Parameters are defined using the parameter element, which can occur within component, model and object elements. When defining a new parameter, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 14 – XML Parameter Definition**

Name	Description
name	The parameter name (3.1).
access	Whether the parameter can be writable (readWrite) or not (readOnly).
status	The parameter's {current, deprecated, obsoleted, deleted} status. This defaults to current, and so is not likely to be specified for a new parameter.
activeNotify	The parameter's {normal, forceEnabled, ForceDefault, canDeny} Active Notification status. This defaults to normal, and so is not often specified for a new parameter.
forcedInform	The parameter's Forced Inform status. This defaults to False, and so is not often specified for a new parameter.
description	The parameter's description (A.2.2).
syntax	The parameter's syntax (A.2.7.1).

### A.2.7.1 Parameter Syntax

Parameter syntax is defined using the syntax element, which can occur only within parameter elements. When defining a new parameter, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 15 – XML Parameter Syntax**

Name	Description
hidden	Whether the value is hidden on readback. This defaults to False, and so is not often specified for a new parameter.
command	Whether setting the parameter triggers a CPE action. This defaults to False, and so is not often specified for a new parameter.
list	If the parameter is list-valued, details of the list value. This allows specification of the maximum and minimum number of items in the list, and also supports a size facet for the list (A.2.3.3). Note that a list-valued parameter is always a string as far as TR-069 [2] is concerned. For a list, the rest of the syntax specification refers to the individual list items, not to the parameter value.
base64 boolean dateTime hexBinary int long string unsignedInt unsignedLong	If the parameter is of a primitive data type, specifies a primitive data type reference, e.g. <int/>. If the parameter data type is derived from a primitive data type, specifies an anonymous primitive data type definition (A.2.3.2), e.g. <int><range maxInclusive="255"/></int>. Each primitive data type element supports only the facets (A.2.3.3) that are appropriate to that data type.
dataType	If the parameter is of a named data type, specifies a named data type (A.2.3.1) reference, e.g. <dataType ref="IPAddress"/>. If the parameter data type is derived from a named data type, specifies an anonymous named data type (A.2.3.2) definition, e.g. <dataType base="IPAddress"><size maxLength="15"/></dataType>.

## A.2.8 Objects

Objects are defined using the object element, which can occur within component and model elements. When defining a new object, the following attributes and elements are relevant (normative requirements are specified in the schema).

**Table 16 – XML Object Definition**

Name	Description
name	The object name, specified as a partial path (3.1).
access	Whether object instances can be Added or Deleted (readWrite) or not (readOnly). Adding or deleting instances is meaningful only for a multi-instance (table) object.
minEntries	The minimum number of instances of this object (always less than or equal to maxEntries).
maxEntries	The maximum number of instances of this object (can be “unbounded”). minEntries and maxEntries allow the object to be placed into one of three categories: <ul style="list-style-type: none"> <li>• <b>minEntries=0, maxEntries=1:</b> single-instance object which might not be allowed to exist, e.g. because only one of it and another object can exist at the same time.</li> <li>• <b>minEntries=1, maxEntries=1:</b> single-instance object that is always allowed to exist.</li> <li>• <b>All other cases:</b> multi-instance (table) object (A.2.8.1).</li> </ul>
status	The object’s {current, deprecated, obsoleted, deleted} status. This defaults to current, and so is not likely to be specified for a new object.
description	The object’s description (A.2.2).
component	The components that are referenced (included) by the object.
parameter	The object’s parameter definitions (A.2.7).

### A.2.8.1 Tables

If an object is a table, several other attributes and elements are relevant (normative requirements are specified in the schema).

**Table 17 – XML Table Definition**

Name	Description
name	For a table, the last part of the name has to be “{i}” (3.1).
entriesParameter	The name of the parameter (in the parent object) that contains the number of entries in the table. Such a parameter is needed whenever there is a variable number of entries, i.e. whenever maxEntries is unbounded or is greater than minEntries.
enableParameter	The name of the parameter (in each table entry) that enables and disables that table entry. Such a parameter is needed whenever access is readWrite (so the ACS might be able to create entries) and at least one uniqueKey element that defines a functional key is present.
uniqueKey	An element that specifies a unique key by referencing those parameters that constitute the unique key. For a non-functional key, or if the table has no enableParameter, the uniqueness requirement always applies. For a functional key, and if the table has an enableParameter, the uniqueness requirement applies only to enabled table entries.

Each unique key is either functional or non-functional:

- A functional key references at least one parameter that relates to the purpose (or function) of the table, e.g. a DHCP option tag in a DHCP option table, or an external port number in a port mapping table.
- A non-functional key references only parameters that do not relate to the purpose (or function) of the table, e.g. an Alias or Name parameter.

A unique key is assumed to be functional unless explicitly marked as non-functional by setting the unique key’s functional attribute to false.

As can be seen from the description in Table 17, non-functional keys are always required to be unique, regardless of whether the table has an enableParameter, or is enabled or disabled.

## A.2.9 Profiles

Profiles are defined using the profile element, which can occur within component and model elements. When defining a new profile, the following attributes and elements are always relevant (normative requirements are specified in the schema).

**Table 18 – XML Profile Definition**

Name	Description
name	The profile name, including its version number (2.3.3).
base	The name of the previous version of the profile (for use when the profile version is greater than 1).
extends	A list of the names of the profiles that this profile extends.
description	The profile's description (A.2.2).
parameter	The profile's parameter requirements, which can include descriptions, references to the parameters in question, and the parameter access requirement.
object	The profile's object requirements, which can include descriptions, references to the objects in question, the object access requirements, and requirements for the object's parameters.

## A.2.10 Modifications

New data types, components, models and profiles can be created based on existing items. This doesn't modify the existing item.

Parameters, objects and profiles can be modified "in place", i.e. without creating a new item. This still uses the parameter, object and profile elements, and is indicated by using the base, rather than the name, attribute. The base attribute specifies the name of the existing item that is to be modified.

The syntax for modifying an item is the same as for creating an item, but there are rules. These rules are not specified in the DM Schema.

### A.2.10.1 Parameter Modifications

The following rules govern parameter modifications.

**Table 19 – XML Parameter Modification**

Name	Description
access	Can be "promoted" from readOnly to readWrite.
status	Can be "promoted" to a "higher" value, where the lowest to highest ordering is: current, deprecated, obsoleted, deleted. For example, current can be changed to deprecated, and obsoleted can be changed to deleted, but deleted can't be changed back to obsoleted. When promoting status, the deprecation, obsolescence and deletion rules of section 2.4 MUST be obeyed.
activeNotify	Can be changed from forceEnabled to forceDefaultEnabled. No other changes are permitted.
forcedInform	Cannot be changed.
description	Can be extended or replaced via use of the action attribute. When changing the description, behavioral backwards compatibility MUST be preserved.
syntax/hidden	Cannot be changed.
syntax/list	Can add or modify the list element in the following ways: <ul style="list-style-type: none"> <li>Can convert a non-list string parameter to a list provided that an empty string was already a valid value with the appropriate meaning.</li> <li>Can adjust limits on numbers of items, and on the list size, provided that the new rules do not permit any values that were not valid for the previous version of the parameter.</li> </ul>
syntax/int etc syntax/dataType	Can make any change that follows the base type restriction rules of A.2.3.8, e.g. can add enumerations.
syntax/default	A default can be added if the parameter didn't already have one.

Most of the above requirements are non-normative, because it has to be possible to correct errors in a previous version of a parameter. Processing tools SHOULD be able to detect and warn when a parameter is modified in a way that contravenes the above rules.

### A.2.10.2 Object Modifications

The following rules govern object modifications.

**Table 20 – XML Object Modification**

Name	Description
access	Can be “promoted” from readOnly to readWrite.
minEntries	Cannot be changed.
maxEntries	Cannot be changed.
entriesParameter	Cannot be changed, unless was previously missing, in which case can be added.
enableParameter	Cannot be changed, unless was previously missing, in which case can be added.
status	Can be “promoted” to a “higher” value, where the lowest to highest ordering is: current, deprecated, obsoleted, deleted. For example, current can be changed to deprecated, and obsoleted can be changed to deleted, but deleted can’t be changed back to obsoleted. When promoting status, the deprecation, obsolescence and deletion rules of section 2.4 MUST be obeyed.
description	Can be extended or replaced via use of the action attribute. When changing the description, behavioral backwards compatibility MUST be preserved.
uniqueKey	Cannot be changed.
component	Can reference (include) new components.
parameter	Can add new parameters.

Most of the above requirements are non-normative, because it has to be possible to correct errors in a previous version of an object. Processing tools SHOULD be able to detect and warn when an object is modified in a way that contravenes the above rules.

### A.2.10.3 Profile Modifications

The following rules govern profile modifications. They apply to the profile element, and to its nested parameter and object elements.

**Table 21 – XML Profile Modification**

Name	Description
status	Can be “promoted” to a “higher” value, where the lowest to highest ordering is: current, deprecated, obsoleted, deleted. For example, current can be changed to deprecated, and obsoleted can be changed to deleted, but deleted can’t be changed back to obsoleted. When promoting status, the deprecation, obsolescence and deletion rules of section 2.4 MUST be obeyed.
description	Can be extended or replaced via use of the action attribute. When changing the description, behavioral backwards compatibility MUST be preserved.

Most of the above requirements are non-normative, because it has to be possible to correct errors in a profile. Indeed, since profiles are immutable, the only valid reason for changing a profile is to correct errors. Processing tools SHOULD be able to detect and warn when a profile is modified in a way that contravenes the above rules.

## A.3 DM Schema

The DM Schema is specified below. The normative version can be found at <http://www.broadband-forum.org/cwmp/cwmp-datamodel-1-3.xsd>. Please be aware that a new version of the DM Schema might be published at any time, in which case the version in this document would become out of date. Any conflict MUST be resolved in favor of the normative version on the web site.

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <!--
3   TR-069 Data Model Definition Schema (DM Schema) v1.3
4
5   Notice:
6   The Broadband Forum is a non-profit corporation organized to create
7   guidelines for broadband network system development and deployment.
8   This Broadband Forum Document has been approved by members of the
9   Forum. This Broadband Forum Document is not binding on the Broadband
10  Forum, any of its members, or any developer or service provider.
11  This Broadband Forum Document is subject to change, but only with
12  approval of members of the Forum. This Document is copyrighted by
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14  Document may be copyrighted by Broadband Forum members.
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16  This Broadband Forum Document is provided AS IS, WITH ALL FAULTS.
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19  BY LAW ANY REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED,
20  INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY:
21
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30
31  By using this Broadband Forum Document, users acknowledge that
32  implementation may require licenses to patents. The Broadband Forum
33  encourages but does not require its members to identify such
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36  is given that licenses to patents necessary to implement this
37  Document will be available for license at all or on reasonable and
38  non-discriminatory terms.
39
40  ANY PERSON HOLDING A COPYRIGHT IN THIS BROADBAND FORUM DOCUMENT, OR
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44  RELATED TO THE USE OF OR RELIANCE UPON THIS DOCUMENT; AND (B) ANY
45  OBLIGATION TO UPDATE OR CORRECT THIS DOCUMENT.
46
47  Broadband Forum Documents may be copied, downloaded, stored on a
48  server or otherwise re-distributed in their entirety only, and may
49  not be modified without the advance written permission of the
50  Broadband Forum.
51
52  The text of this notice must be included in all copies of this
53  Broadband Forum Document.
54
55  Summary:
56  TR-069 Data Model Definition Schema (DM Schema). DM Instances define TR-069
57  data models. Within the schema, elements are grouped by category (simple
58  types, complex types etc), and are in alphabetical order within each
59  category.
60
61  Version History:
62  November 2008: cwmp-datamodel-1-0.xsd, corresponds to TR-106 Amendment 2
63  September 2009: cwmp-datamodel-1-1.xsd, corresponds to TR-106 Amendment 3
64  - made import/@file a URI and optional (in line with DT Schema)
65  - added RangeFacet step attribute
66  March 2010: cwmp-datamodel-1-2.xsd, corresponds to TR-106 Amendment 4
67  - added uniqueKey/@functional attribute
68  - supported #.A relative path syntax (parent)
69  December 2010: cwmp-datamodel-1-3.xsd, corresponds to TR-106 Amendment 5
70  - removed the referential check done on object/@enableParameter
71  - removed the referential check done on object/uniqueKey/parameter/@ref
```

```

72     - updated all of the unique parameter-name constraints so that the
73     parameter/@base attribute is also considered.
74     - updated all of the unique object-name constraints so that the
75     object/@base attribute is also considered.
76     - added "prefix" option to the description/@action attribute
77     - made import/@file attribute required for import element
78     - removed size facet's default maxLength on string/base64/hexBinary
79     parameters
80     - added syntax/@command attribute to the syntax element
81 -->
82
83 <!DOCTYPE cwmp-datamodel [
84   <!ENTITY colon ":">
85   <!ENTITY hash "#">
86   <!ENTITY dot ".">
87   <!ENTITY inst "\\{i\\}">
88   <!ENTITY name "([\\i-[:]]\\c-[:\\.]]*)">
89   <!ENTITY Name "([\\i-[a-z:]]\\c-[:\\.]]*)">
90   <!ENTITY num "(\\d+)">
91 ]>
92
93 <xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:tns="urn:broadband-forum-
94           org:cwmp:datamodel-1-3" targetNamespace="urn:broadband-forum-
95           org:cwmp:datamodel-1-3" elementFormDefault="unqualified"
96           attributeFormDefault="unqualified">
97   <!-- Simple types -->
98   <xs:simpleType name="ActiveNotify">
99     <xs:annotation>
100      <xs:documentation>Parameter active notify support.</xs:documentation>
101    </xs:annotation>
102    <xs:restriction base="xs:token">
103      <xs:enumeration value="normal"/>
104      <xs:enumeration value="forceEnabled"/>
105      <xs:enumeration value="forceDefaultEnabled"/>
106      <xs:enumeration value="canDeny"/>
107    </xs:restriction>
108  </xs:simpleType>
109  <xs:simpleType name="AnyTypeName">
110    <xs:annotation>
111      <xs:documentation>Built-in or derived type name.</xs:documentation>
112    </xs:annotation>
113    <xs:union memberTypes="tns:BuiltInTypeName tns:DataTypeName"/>
114  </xs:simpleType>
115  <xs:simpleType name="BibrefId">
116    <xs:annotation>
117      <xs:documentation>Bibliographic reference ID; SHOULD uniquely identify this reference
118      across all instance documents.
119      For BBF DM Instances, the bibliographic reference ID rules specified in A.2.4 MUST be used. For
120      example, to reference TR-106 Issue 1 Amendment 2, the value of this
121      attribute would be TR-106a2.</xs:documentation>
122    </xs:annotation>
123    <xs:restriction base="xs:token"/>
124  </xs:simpleType>
125  <xs:simpleType name="BuiltInTypeName">
126    <xs:annotation>
127      <xs:documentation>Built-in type name.
128      The type hierarchy is as for XML Schema, with "any" and "base64" mapping to the "anySimpleType"
129      and "base64Binary" XML Schema types respectively.</xs:documentation>
130    </xs:annotation>
131    <xs:restriction base="xs:token">
132      <xs:enumeration value="any"/>
133      <xs:enumeration value="base64"/>
134      <xs:enumeration value="boolean"/>
135      <xs:enumeration value="dateTime"/>
136      <xs:enumeration value="hexBinary"/>
137      <xs:enumeration value="integer"/>
138      <xs:enumeration value="int"/>
139      <xs:enumeration value="long"/>
140      <xs:enumeration value="string"/>
141      <xs:enumeration value="unsignedInt"/>
142      <xs:enumeration value="unsignedLong"/>

```

```

143     </xs:restriction>
144 </xs:simpleType>
145 <xs:simpleType name="ComponentName">
146   <xs:annotation>
147     <xs:documentation>Component name; the same as xs:NCName except that dots are not
148       permitted.</xs:documentation>
149   </xs:annotation>
150   <xs:restriction base="xs:token">
151     <xs:pattern value="&name;"/>
152   </xs:restriction>
153 </xs:simpleType>
154 <xs:simpleType name="DataTypeName">
155   <xs:annotation>
156     <xs:documentation>Data type name; the same as xs:NCName except that cannot start with
157       lower-case letter (to avoid conflict with built-in data type names) and
158       dots are not permitted.</xs:documentation>
159   </xs:annotation>
160   <xs:restriction base="xs:token">
161     <xs:pattern value="&Name;"/>
162   </xs:restriction>
163 </xs:simpleType>
164 <xs:simpleType name="DefaultType">
165   <xs:annotation>
166     <xs:documentation>Type of default.</xs:documentation>
167   </xs:annotation>
168   <xs:restriction base="xs:token">
169     <xs:enumeration value="factory">
170       <xs:annotation>
171         <xs:documentation>Default from standard, e.g. RFC. Also applies on object
172           creation.</xs:documentation>
173       </xs:annotation>
174     </xs:enumeration>
175     <xs:enumeration value="object">
176       <xs:annotation>
177         <xs:documentation>Default on object creation.</xs:documentation>
178       </xs:annotation>
179     </xs:enumeration>
180   </xs:restriction>
181 </xs:simpleType>
182 <xs:simpleType name="DescriptionAction">
183   <xs:annotation>
184     <xs:documentation>Description action.</xs:documentation>
185   </xs:annotation>
186   <xs:restriction base="xs:token">
187     <xs:enumeration value="create"/>
188     <xs:enumeration value="prefix"/>
189     <xs:enumeration value="append"/>
190     <xs:enumeration value="replace"/>
191   </xs:restriction>
192 </xs:simpleType>
193 <xs:simpleType name="MaxEntries">
194   <xs:annotation>
195     <xs:documentation>Positive integer or "unbounded".</xs:documentation>
196   </xs:annotation>
197   <xs:union memberTypes="xs:positiveInteger">
198     <xs:simpleType>
199       <xs:restriction base="xs:token">
200         <xs:enumeration value="unbounded"/>
201       </xs:restriction>
202     </xs:simpleType>
203   </xs:union>
204 </xs:simpleType>
205 <xs:simpleType name="ModelName">
206   <xs:annotation>
207     <xs:documentation>Model name, including major and minor versions. The name part is the
208       same as xs:NCName except that dots are not permitted.</xs:documentation>
209   </xs:annotation>
210   <xs:restriction base="xs:token">
211     <xs:pattern value="&name;&colon;&num;&dot;&num;"/>
212   </xs:restriction>
213 </xs:simpleType>

```



```

214 <xs:simpleType name="ObjectName">
215   <xs:annotation>
216     <xs:documentation>Object name (maximum length 256). Each component is the same as
217       xs:NCName except that dots are not permitted. This name MUST in addition
218       follow the vendor-specific object name requirements of section
219       3.3.</xs:documentation>
220   </xs:annotation>
221   <xs:restriction base="xs:token">
222     <xs:maxLength value="256"/>
223     <xs:pattern value="(&name;&dot;(&inst;&dot;)?)+"/>
224   </xs:restriction>
225 </xs:simpleType>
226 <xs:simpleType name="ObjectReference">
227   <xs:annotation>
228     <xs:documentation>Object path that cannot contain "{i}" placeholders and that therefore
229       references a single object. The path MUST follow the requirements of
230       A.2.3.4 (its scope will typically be specified via an attribute of type
231       PathScope).</xs:documentation>
232   </xs:annotation>
233   <xs:restriction base="xs:token">
234     <xs:pattern value="&hash;*&dot;?(&name;&dot;)*"/>
235   </xs:restriction>
236 </xs:simpleType>
237 <xs:simpleType name="ObjectReferencePattern">
238   <xs:annotation>
239     <xs:documentation>Object path that can contain "{i}" placeholders and that can therefore
240       references multiple objects. The path MUST follow the requirements of
241       A.2.3.4 (its scope will typically be specified via an attribute of type
242       PathScope).</xs:documentation>
243   </xs:annotation>
244   <xs:restriction base="xs:token">
245     <xs:pattern value="&hash;*&dot;?(&name;&dot;(&inst;&dot;)?)*"/>
246   </xs:restriction>
247 </xs:simpleType>
248 <xs:simpleType name="ObjectReferencePatterns">
249   <xs:annotation>
250     <xs:documentation>List of object paths, each of which can contain "{i}"
251       placeholders.</xs:documentation>
252   </xs:annotation>
253   <xs:list itemType="tns:ObjectReferencePattern"/>
254 </xs:simpleType>
255 <xs:simpleType name="OpaqueID">
256   <xs:annotation>
257     <xs:documentation>Opaque ID.</xs:documentation>
258   </xs:annotation>
259   <xs:restriction base="xs:token">
260     <xs:maxLength value="256"/>
261   </xs:restriction>
262 </xs:simpleType>
263 <xs:simpleType name="ParameterName">
264   <xs:annotation>
265     <xs:documentation>Parameter name (maximum length 256); the same as xs:NCName except that
266       dots are not permitted. This name MUST in addition follow the vendor-
267       specific parameter name requirements of section 3.3.</xs:documentation>
268   </xs:annotation>
269   <xs:restriction base="xs:token">
270     <xs:maxLength value="256"/>
271     <xs:pattern value="&name;"/>
272   </xs:restriction>
273 </xs:simpleType>
274 <xs:simpleType name="ParameterReference">
275   <xs:annotation>
276     <xs:documentation>Parameter path that cannot contain "{i}" placeholders and that therefore
277       references a single parameter. The path MUST follow the requirements of
278       A.2.3.4 (its scope will typically be specified via an attribute of type
279       PathScope).</xs:documentation>
280   </xs:annotation>
281   <xs:restriction base="xs:token">
282     <xs:pattern value="&hash;*&dot;?(&name;&dot;)*&name;"/>
283   </xs:restriction>
284 </xs:simpleType>

```

```

285 <xs:simpleType name="PathScope">
286   <xs:annotation>
287     <xs:documentation>Object / parameter path name scope (A.2.3.4).</xs:documentation>
288   </xs:annotation>
289   <xs:restriction base="xs:token">
290     <xs:enumeration value="normal"/>
291     <xs:enumeration value="model"/>
292     <xs:enumeration value="object"/>
293   </xs:restriction>
294 </xs:simpleType>
295 <xs:simpleType name="ProfileName">
296   <xs:annotation>
297     <xs:documentation>Profile name, including version. The name part is the same as xs:NCName
298       except that dots are not permitted.</xs:documentation>
299   </xs:annotation>
300   <xs:restriction base="xs:token">
301     <xs:pattern value="&name;&colon;&num;"/>
302   </xs:restriction>
303 </xs:simpleType>
304 <xs:simpleType name="ProfileNames">
305   <xs:annotation>
306     <xs:documentation>List of profile names.</xs:documentation>
307   </xs:annotation>
308   <xs:list itemType="tns:ProfileName"/>
309 </xs:simpleType>
310 <xs:simpleType name="ProfileObjectAccess">
311   <xs:annotation>
312     <xs:documentation>Object access (within profile).</xs:documentation>
313   </xs:annotation>
314   <xs:restriction base="xs:token">
315     <xs:enumeration value="notSpecified"/>
316     <xs:enumeration value="present"/>
317     <xs:enumeration value="create"/>
318     <xs:enumeration value="delete"/>
319     <xs:enumeration value="createDelete"/>
320   </xs:restriction>
321 </xs:simpleType>
322 <xs:simpleType name="ReadWriteAccess">
323   <xs:annotation>
324     <xs:documentation>Read-write access.</xs:documentation>
325   </xs:annotation>
326   <xs:restriction base="xs:token">
327     <xs:enumeration value="readOnly"/>
328     <xs:enumeration value="readWrite"/>
329   </xs:restriction>
330 </xs:simpleType>
331 <xs:simpleType name="ReferenceType">
332   <xs:annotation>
333     <xs:documentation>Reference type (A.2.3.6).</xs:documentation>
334   </xs:annotation>
335   <xs:restriction base="xs:token">
336     <xs:enumeration value="weak"/>
337     <xs:enumeration value="strong"/>
338   </xs:restriction>
339 </xs:simpleType>
340 <xs:simpleType name="Status">
341   <xs:annotation>
342     <xs:documentation>Item status (applies to most types of item).</xs:documentation>
343   </xs:annotation>
344   <xs:restriction base="xs:token">
345     <xs:enumeration value="current"/>
346     <xs:enumeration value="deprecated"/>
347     <xs:enumeration value="obsoleted"/>
348     <xs:enumeration value="deleted"/>
349   </xs:restriction>
350 </xs:simpleType>
351 <xs:simpleType name="TargetType">
352   <xs:annotation>
353     <xs:documentation>(Reference) target type (used in path references).</xs:documentation>
354   </xs:annotation>
355   <xs:restriction base="xs:token">

```

```

356     <xs:enumeration value="any"/>
357     <xs:enumeration value="parameter"/>
358     <xs:enumeration value="object"/>
359     <xs:enumeration value="single"/>
360     <xs:enumeration value="table"/>
361     <xs:enumeration value="row"/>
362   </xs:restriction>
363 </xs:simpleType>
364 <xs:simpleType name="UnitsString">
365   <xs:annotation>
366     <xs:documentation>Units string.</xs:documentation>
367   </xs:annotation>
368   <xs:restriction base="xs:token">
369     <xs:maxLength value="32"/>
370   </xs:restriction>
371 </xs:simpleType>
372 <!-- Model groups -->
373 <xs:group name="AllBuiltinDataTypes">
374   <xs:annotation>
375     <xs:documentation>All built-in data types.</xs:documentation>
376   </xs:annotation>
377   <xs:choice>
378     <xs:element name="base64">
379       <xs:complexType>
380         <xs:sequence>
381           <xs:choice minOccurs="0" maxOccurs="unbounded">
382             <xs:element name="size" type="tns:SizeFacet">
383               <xs:annotation>
384                 <xs:documentation>Length is that of the actual string, not the base64-encoded
385                   string. See A.2.3.3.</xs:documentation>
386               </xs:annotation>
387             </xs:element>
388           </xs:choice>
389           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
390         </xs:sequence>
391         <xs:anyAttribute namespace="##other"/>
392       </xs:complexType>
393     </xs:element>
394     <xs:element name="boolean">
395       <xs:complexType>
396         <xs:sequence>
397           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
398         </xs:sequence>
399         <xs:anyAttribute namespace="##other"/>
400       </xs:complexType>
401     </xs:element>
402     <xs:element name="dateTime">
403       <xs:complexType>
404         <xs:sequence>
405           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
406         </xs:sequence>
407         <xs:anyAttribute namespace="##other"/>
408       </xs:complexType>
409     </xs:element>
410     <xs:element name="hexBinary">
411       <xs:complexType>
412         <xs:sequence>
413           <xs:choice minOccurs="0" maxOccurs="unbounded">
414             <xs:element name="size" type="tns:SizeFacet">
415               <xs:annotation>
416                 <xs:documentation>Length is that of the actual string, not the hexBinary-
417                   encoded string. See A.2.3.3.</xs:documentation>
418               </xs:annotation>
419             </xs:element>
420           </xs:choice>
421           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
422         </xs:sequence>
423         <xs:anyAttribute namespace="##other"/>
424       </xs:complexType>
425     </xs:element>
426     <xs:element name="int">

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427     <xs:complexType>
428       <xs:sequence>
429         <xs:choice minOccurs="0" maxOccurs="unbounded">
430           <xs:element name="instanceRef" type="tns:InstanceRefFacet"/>
431           <xs:element name="range" type="tns:RangeFacet"/>
432           <xs:element name="units" type="tns:UnitsFacet"/>
433         </xs:choice>
434         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
435       </xs:sequence>
436       <xs:anyAttribute namespace="##other"/>
437     </xs:complexType>
438   </xs:element>
439   <xs:element name="long">
440     <xs:complexType>
441       <xs:sequence>
442         <xs:choice minOccurs="0" maxOccurs="unbounded">
443           <xs:element name="range" type="tns:RangeFacet"/>
444           <xs:element name="units" type="tns:UnitsFacet"/>
445         </xs:choice>
446         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
447       </xs:sequence>
448       <xs:anyAttribute namespace="##other"/>
449     </xs:complexType>
450   </xs:element>
451   <xs:element name="string">
452     <xs:complexType>
453       <xs:sequence>
454         <xs:choice minOccurs="0" maxOccurs="unbounded">
455           <xs:element name="size" type="tns:SizeFacet"/>
456           <xs:element name="pathRef" type="tns:PathRefFacet"/>
457           <xs:element name="enumeration" type="tns:EnumerationFacet"/>
458           <xs:element name="enumerationRef" type="tns:EnumerationRefFacet"/>
459           <xs:element name="pattern" type="tns:PatternFacet"/>
460         </xs:choice>
461         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
462       </xs:sequence>
463       <xs:anyAttribute namespace="##other"/>
464     </xs:complexType>
465     <xs:unique name="stringEnumerationValue">
466       <xs:selector xpath="enumeration"/>
467       <xs:field xpath="@value"/>
468     </xs:unique>
469     <xs:unique name="stringPatternValue">
470       <xs:selector xpath="pattern"/>
471       <xs:field xpath="@value"/>
472     </xs:unique>
473   </xs:element>
474   <xs:element name="unsignedInt">
475     <xs:complexType>
476       <xs:sequence>
477         <xs:choice minOccurs="0" maxOccurs="unbounded">
478           <xs:element name="instanceRef" type="tns:InstanceRefFacet"/>
479           <xs:element name="range" type="tns:RangeFacet"/>
480           <xs:element name="units" type="tns:UnitsFacet"/>
481         </xs:choice>
482         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
483       </xs:sequence>
484       <xs:anyAttribute namespace="##other"/>
485     </xs:complexType>
486   </xs:element>
487   <xs:element name="unsignedLong">
488     <xs:complexType>
489       <xs:sequence>
490         <xs:choice minOccurs="0" maxOccurs="unbounded">
491           <xs:element name="range" type="tns:RangeFacet"/>
492           <xs:element name="units" type="tns:UnitsFacet"/>
493         </xs:choice>
494         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
495       </xs:sequence>
496       <xs:anyAttribute namespace="##other"/>
497     </xs:complexType>

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498     </xs:element>
499   </xs:choice>
500 </xs:group>
501 <xs:group name="AllFacets">
502   <xs:annotation>
503     <xs:documentation>All facets.</xs:documentation>
504   </xs:annotation>
505   <xs:choice>
506     <xs:element name="size" type="tns:SizeFacet">
507       <xs:annotation>
508         <xs:documentation>Size facets, taken together, define the valid size ranges, e.g. (0:0)
509           and (6:6) mean that the size has to be 0 or 6.
510 The size facet MUST NOT be specified for non-string data types, i.e. data types that are not
511   derived from base64, hexBinary or string.</xs:documentation>
512       </xs:annotation>
513     </xs:element>
514     <xs:element name="instanceRef" type="tns:InstanceRefFacet">
515       <xs:annotation>
516         <xs:documentation>InstanceRef facets specify how a parameter can reference an object
517           instance (table row) via its instance number.
518 The instanceRef facet MUST NOT be specified for data types that are not derived from int or
519   unsignedInt.</xs:documentation>
520       </xs:annotation>
521     </xs:element>
522     <xs:element name="pathRef" type="tns:PathRefFacet">
523       <xs:annotation>
524         <xs:documentation>PathRef facets specify how a parameter can reference a parameter or
525           object via its path name.
526 The pathRef facet MUST NOT be specified for data types that are not derived from
527   string.</xs:documentation>
528       </xs:annotation>
529     </xs:element>
530     <xs:element name="range" type="tns:RangeFacet">
531       <xs:annotation>
532         <xs:documentation>Range facets, taken together, define the valid value ranges, e.g. [-
533           1:-1] and [1:4094] mean that the value has to be -1 or 1:4094 (it cannot be
534           0).
535 The range facet MUST NOT be specified for non-numeric data types, i.e. data types that are not
536   derived from one of the integer types.</xs:documentation>
537       </xs:annotation>
538     </xs:element>
539     <xs:element name="enumeration" type="tns:EnumerationFacet">
540       <xs:annotation>
541         <xs:documentation>Enumeration facets, taken together, define the valid values, e.g. "a"
542           and "b" mean that the value has to be a or b.
543 The enumeration facet MUST NOT be specified for data types that are not derived from string.
544 Derived types MAY add additional enumeration values. See A.2.5.</xs:documentation>
545       </xs:annotation>
546     </xs:element>
547     <xs:element name="enumerationRef" type="tns:EnumerationRefFacet">
548       <xs:annotation>
549         <xs:documentation>EnumerationRef facets allow a parameter's valid values to be obtained
550           from another parameter.
551 The enumerationRef facet MUST NOT be specified for data types that are not derived from
552   string.</xs:documentation>
553       </xs:annotation>
554     </xs:element>
555     <xs:element name="pattern" type="tns:PatternFacet">
556       <xs:annotation>
557         <xs:documentation>Pattern attributes, taken together, define valid patterns, e.g. ""
558           and "[0-9A-Fa-f]{6}" means that the value has to be empty or a 6 digit hex
559           string.
560 The pattern facet MUST NOT be specified for data types that are not derived from string.
561 Pattern syntax is the same as for XML Schema regular expressions. See
562   http://www.w3.org/TR/xmlschema-2/#regexs.</xs:documentation>
563       </xs:annotation>
564     </xs:element>
565     <xs:element name="units" type="tns:UnitsFacet">
566       <xs:annotation>
567         <xs:documentation>Multiple units facets MUST NOT be specified.

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568 The units facet MUST NOT be specified for data types that are not numeric, i.e. data types that
569 are not derived from one of the integer types.</xs:documentation>
570     </xs:annotation>
571   </xs:element>
572 </xs:choice>
573 </xs:group>
574 <!-- Complex types -->
575 <xs:complexType name="BaseStatusFacet" abstract="true">
576   <xs:annotation>
577     <xs:documentation>Base facet (status attribute).</xs:documentation>
578   </xs:annotation>
579   <xs:sequence>
580     <xs:element name="description" type="tns:Description" minOccurs="0"/>
581     <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
582   </xs:sequence>
583   <xs:attribute name="status" type="tns:Status" default="current"/>
584   <xs:anyAttribute namespace="##other"/>
585 </xs:complexType>
586 <xs:complexType name="BaseAccessFacet" abstract="true">
587   <xs:annotation>
588     <xs:documentation>Base facet (access, status and optional attributes).</xs:documentation>
589   </xs:annotation>
590   <xs:complexContent>
591     <xs:extension base="tns:BaseStatusFacet">
592       <xs:attribute name="access" type="tns:ReadWriteAccess" default="readWrite"/>
593       <xs:attribute name="optional" type="xs:boolean" default="false"/>
594     </xs:extension>
595   </xs:complexContent>
596 </xs:complexType>
597 <xs:complexType name="Bibliography">
598   <xs:annotation>
599     <xs:documentation>Bibliography definition.</xs:documentation>
600   </xs:annotation>
601   <xs:sequence>
602     <xs:element name="description" type="tns:Description" minOccurs="0"/>
603     <xs:element name="reference" minOccurs="0" maxOccurs="unbounded">
604       <xs:complexType>
605         <xs:sequence>
606           <xs:element name="name" type="xs:token">
607             <xs:annotation>
608               <xs:documentation>Name by which the referenced document is usually known, e.g.
609                 TR-069, RFC 2863.</xs:documentation>
610             </xs:annotation>
611           </xs:element>
612           <xs:element name="title" type="xs:token" minOccurs="0"/>
613           <xs:element name="organization" type="xs:token" minOccurs="0">
614             <xs:annotation>
615               <xs:documentation>Organization that published the referenced document, e.g. BBF,
616                 IEEE, IETF.</xs:documentation>
617             </xs:annotation>
618           </xs:element>
619           <xs:element name="category" type="xs:token" minOccurs="0">
620             <xs:annotation>
621               <xs:documentation>Document category, e.g. TR (BBF), RFC
622                 (IETF).</xs:documentation>
623             </xs:annotation>
624           </xs:element>
625           <xs:element name="date" type="xs:token" minOccurs="0">
626             <xs:annotation>
627               <xs:documentation>Publication date.</xs:documentation>
628             </xs:annotation>
629           </xs:element>
630           <xs:choice minOccurs="0" maxOccurs="unbounded">
631             <xs:element name="hyperlink" type="xs:anyURI"/>
632           </xs:choice>
633           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
634         </xs:sequence>
635       <xs:attribute name="id" type="tns:BibrefId" use="required">
636         <xs:annotation>

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637         <xs:documentation>Uniquely identifies the reference (this is checked by schema
638         validation). Can be referenced from descriptions by using the {{bibref}}
639         template. See A.2.2.4.</xs:documentation>
640     </xs:annotation>
641 </xs:attribute>
642 <xs:anyAttribute namespace="##other"/>
643 </xs:complexType>
644 </xs:element>
645 </xs:sequence>
646 </xs:complexType>
647 <xs:complexType name="ComponentDefinition">
648     <xs:annotation>
649         <xs:documentation>Component definition.</xs:documentation>
650     </xs:annotation>
651 <xs:sequence>
652     <xs:element name="description" type="tns:Description" minOccurs="0"/>
653     <xs:choice minOccurs="0" maxOccurs="unbounded">
654         <xs:element name="component" type="tns:ComponentReference"/>
655         <xs:element name="parameter" type="tns:ModelParameter"/>
656         <xs:element name="object" type="tns:ModelObject">
657             <xs:unique name="componentObjectParameterName">
658                 <xs:selector xpath="parameter"/>
659                 <xs:field xpath="@name|@base"/>
660             </xs:unique>
661         </xs:element>
662     </xs:choice>
663     <xs:choice minOccurs="0" maxOccurs="unbounded">
664         <xs:element name="profile" type="tns:Profile"/>
665     </xs:choice>
666     <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
667 </xs:sequence>
668 <xs:attribute name="name" type="tns:ComponentName" use="required">
669     <xs:annotation>
670         <xs:documentation>MUST be unique within the document, including imported components (this
671         is checked by schema validation).</xs:documentation>
672     </xs:annotation>
673 </xs:attribute>
674 <xs:attribute name="status" type="tns:Status" default="current"/>
675 <xs:attribute name="id" type="tns:OpaqueID"/>
676 <xs:anyAttribute namespace="##other"/>
677 </xs:complexType>
678 <xs:complexType name="ComponentReference">
679     <xs:annotation>
680         <xs:documentation>Component reference.</xs:documentation>
681     </xs:annotation>
682     <xs:attribute name="ref" type="tns:ComponentName" use="required">
683         <xs:annotation>
684             <xs:documentation>Name of component to be referenced (included).</xs:documentation>
685         </xs:annotation>
686     </xs:attribute>
687     <xs:attribute name="path" type="tns:ObjectName">
688         <xs:annotation>
689             <xs:documentation>If specified, is relative path between point of reference (inclusion)
690             and the component's items. If not specified, behavior is as if an empty
691             relative path was specified.</xs:documentation>
692         </xs:annotation>
693     </xs:attribute>
694     <xs:anyAttribute namespace="##other"/>
695 </xs:complexType>
696 <xs:complexType name="DataTypeDefinition">
697     <xs:annotation>
698         <xs:documentation>Parameter data type definition.</xs:documentation>
699     </xs:annotation>
700 <xs:sequence>
701     <xs:element name="description" type="tns:Description" minOccurs="0"/>
702     <xs:choice>
703         <xs:group ref="tns:AllFacets" minOccurs="0" maxOccurs="unbounded">
704             <xs:annotation>
705                 <xs:documentation>Facets MUST NOT be specified if the base attribute is
706                 omitted.</xs:documentation>
707             </xs:annotation>

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708     </xs:group>
709     <xs:group ref="tns:AllBuiltinDataTypes" minOccurs="0">
710       <xs:annotation>
711         <xs:documentation>A built-in data type element MUST NOT be specified if the base
712           attribute is present.
713 See tns:AllFacets for notes and requirements on individual facets.</xs:documentation>
714       </xs:annotation>
715     </xs:group>
716   </xs:choice>
717   <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
718 </xs:sequence>
719 <xs:attribute name="name" type="tns:DataTypeName" use="required">
720   <xs:annotation>
721     <xs:documentation>MUST be unique within the document, including imported data types (this
722       is checked by schema validation).
723 Cannot begin with a lower-case letter, in order to avoid confusion with built-in data
724       types.</xs:documentation>
725   </xs:annotation>
726 </xs:attribute>
727 <xs:attribute name="base" type="tns:DataTypeName">
728   <xs:annotation>
729     <xs:documentation>MUST be present if and only if deriving from a non-built-in data type.
730       See A.2.3.1.</xs:documentation>
731   </xs:annotation>
732 </xs:attribute>
733 <xs:attribute name="status" type="tns:Status" default="current"/>
734 <xs:attribute name="id" type="tns:OpaqueID"/>
735 <xs:anyAttribute namespace="##other"/>
736 </xs:complexType>
737 <xs:complexType name="DataTypeReference">
738   <xs:annotation>
739     <xs:documentation>Parameter data type reference or anonymous restriction /
740       extension.</xs:documentation>
741   </xs:annotation>
742   <xs:sequence>
743     <xs:group ref="tns:AllFacets" minOccurs="0" maxOccurs="unbounded"/>
744     <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
745   </xs:sequence>
746   <xs:attribute name="ref" type="tns:DataTypeName">
747     <xs:annotation>
748       <xs:documentation>If specified, content MUST be empty.</xs:documentation>
749     </xs:annotation>
750   </xs:attribute>
751   <xs:attribute name="base" type="tns:DataTypeName">
752     <xs:annotation>
753       <xs:documentation>If specified, content MUST NOT be empty.</xs:documentation>
754     </xs:annotation>
755   </xs:attribute>
756   <xs:anyAttribute namespace="##other"/>
757 </xs:complexType>
758 <xs:complexType name="DefaultFacet">
759   <xs:annotation>
760     <xs:documentation>Default facet.</xs:documentation>
761   </xs:annotation>
762   <xs:complexContent>
763     <xs:extension base="tns:BaseStatusFacet">
764       <xs:attribute name="type" type="tns:DefaultType" use="required"/>
765       <xs:attribute name="value" type="xs:string" use="required">
766         <xs:annotation>
767           <xs:documentation>Value MUST be valid for the data type.</xs:documentation>
768         </xs:annotation>
769       </xs:attribute>
770     </xs:extension>
771   </xs:complexContent>
772 </xs:complexType>
773 <xs:complexType name="Description">
774   <xs:annotation>
775     <xs:documentation>Description: free text which MAY contain a limited amount of mediawiki-
776       like markup as specified in A.2.2. For example, use "*" at the start of a
777       line to indicate a bulleted list.
778 To avoid confusion, the description SHOULD NOT contain tab characters.

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779 For BBF standards, the character set MUST be restricted to printable characters in the Basic
780 Latin Unicode block, i.e. to characters whose decimal ASCII representations
781 are in the (inclusive) ranges 9-10 and 32-126.</xs:documentation>
782 </xs:annotation>
783 <xs:simpleContent>
784 <xs:extension base="xs:string">
785 <xs:attribute name="action" type="tns:DescriptionAction" default="create">
786 <xs:annotation>
787 <xs:documentation>This MUST be specified when the description modifies that of a
788 previously defined item.
789 Specify "prefix" to prefix the previous description, "append" to append to the previous
790 description, or "replace" to replace the previous
791 description.</xs:documentation>
792 </xs:annotation>
793 </xs:attribute>
794 <xs:anyAttribute namespace="##other" />
795 </xs:extension>
796 </xs:simpleContent>
797 </xs:complexType>
798 <xs:complexType name="EnumerationFacet">
799 <xs:annotation>
800 <xs:documentation>Enumeration facet.</xs:documentation>
801 </xs:annotation>
802 <xs:complexContent>
803 <xs:extension base="tns:BaseAccessFacet">
804 <xs:attribute name="value" type="xs:string" use="required" />
805 <xs:attribute name="code" type="xs:integer" />
806 </xs:extension>
807 </xs:complexContent>
808 </xs:complexType>
809 <xs:complexType name="EnumerationRefFacet">
810 <xs:annotation>
811 <xs:documentation>Enumeration reference facet.</xs:documentation>
812 </xs:annotation>
813 <xs:complexContent>
814 <xs:extension base="tns:BaseStatusFacet">
815 <xs:attribute name="targetParam" type="tns:ParameterReference" use="required">
816 <xs:annotation>
817 <xs:documentation>MUST reference a list-valued parameter.</xs:documentation>
818 </xs:annotation>
819 </xs:attribute>
820 <xs:attribute name="targetParamScope" type="tns:PathScope" default="normal">
821 <xs:annotation>
822 <xs:documentation>Specifies the point in the naming hierarchy relative to which
823 targetParam applies (A.2.3.4).</xs:documentation>
824 </xs:annotation>
825 </xs:attribute>
826 <xs:attribute name="nullValue" type="xs:token">
827 <xs:annotation>
828 <xs:documentation>Specifies the value that indicates that none of the values of the
829 referenced parameter currently apply.</xs:documentation>
830 </xs:annotation>
831 </xs:attribute>
832 </xs:extension>
833 </xs:complexContent>
834 </xs:complexType>
835 <xs:complexType name="Import">
836 <xs:annotation>
837 <xs:documentation>Import data types, components and models (Root and Service Objects) from
838 external documents. All such items MUST be imported (this is checked by
839 schema validation).
840 The optional ref attribute MAY be used in order to avoid name conflicts between imported and
841 locally-defined items.</xs:documentation>
842 </xs:annotation>
843 <xs:sequence>
844 <xs:choice minOccurs="0" maxOccurs="unbounded">
845 <xs:element name="dataType">
846 <xs:complexType>
847 <xs:attribute name="name" type="tns:DataTypeName" use="required" />
848 <xs:attribute name="ref" type="tns:DataTypeName">
849 <xs:annotation>

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850         <xs:documentation>If omitted, data type is known by the same name in both this
851             and the referenced document.</xs:documentation>
852     </xs:annotation>
853 </xs:attribute>
854 </xs:complexType>
855 </xs:element>
856 <xs:element name="component">
857     <xs:complexType>
858         <xs:attribute name="name" type="tns:ComponentName" use="required"/>
859         <xs:attribute name="ref" type="tns:ComponentName">
860             <xs:annotation>
861                 <xs:documentation>If omitted, component is known by the same name in both this
862                     and the referenced document.</xs:documentation>
863             </xs:annotation>
864         </xs:attribute>
865     </xs:complexType>
866 </xs:element>
867 <xs:element name="model">
868     <xs:complexType>
869         <xs:attribute name="name" type="tns:ModelName" use="required"/>
870         <xs:attribute name="ref" type="tns:ModelName">
871             <xs:annotation>
872                 <xs:documentation>If omitted, model is known by the same name in both this and
873                     the referenced document.</xs:documentation>
874             </xs:annotation>
875         </xs:attribute>
876     </xs:complexType>
877 </xs:element>
878 </xs:choice>
879 <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
880 </xs:sequence>
881 <xs:attribute name="file" type="xs:anyURI" use="required">
882     <xs:annotation>
883         <xs:documentation>MUST be used to locate the DM Instance (A.2.1).</xs:documentation>
884     </xs:annotation>
885 </xs:attribute>
886 <xs:attribute name="spec" type="xs:anyURI">
887     <xs:annotation>
888         <xs:documentation>If specified, processing tools MUST regard a mismatch between this and
889             the external document's spec attribute as an error.
890 </xs:documentation>
891 </xs:annotation>
892 </xs:attribute>
893 <xs:anyAttribute namespace="##other"/>
894 </xs:complexType>
895 <xs:complexType name="InstanceRefFacet">
896     <xs:annotation>
897         <xs:documentation>Instance number reference facet.</xs:documentation>
898     </xs:annotation>
899     <xs:complexContent>
900         <xs:extension base="tns:BaseStatusFacet">
901             <xs:attribute name="refType" type="tns:ReferenceType" use="required">
902                 <xs:annotation>
903                     <xs:documentation>Specifies the type of reference (A.2.3.6).</xs:documentation>
904                 </xs:annotation>
905             </xs:attribute>
906             <xs:attribute name="targetParent" type="tns:ObjectReference" use="required">
907                 <xs:annotation>
908                     <xs:documentation>MUST reference a multi-instance object (table)
909                         (A.2.3.4).</xs:documentation>
910                 </xs:annotation>
911             </xs:attribute>
912             <xs:attribute name="targetParentScope" type="tns:PathScope" default="normal">
913                 <xs:annotation>
914                     <xs:documentation>Specifies the point in the naming hierarchy relative to which
915                         targetParent applies (A.2.3.4).</xs:documentation>
916                 </xs:annotation>
917             </xs:attribute>
918         </xs:extension>
919     </xs:complexContent>
920 </xs:complexType>

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921 <xs:complexType name="ListFacet">
922   <xs:annotation>
923     <xs:documentation>List facet.</xs:documentation>
924   </xs:annotation>
925   <xs:complexContent>
926     <xs:extension base="tns:BaseStatusFacet">
927       <xs:sequence>
928         <xs:choice minOccurs="0" maxOccurs="unbounded">
929           <xs:element name="size" type="tns:SizeFacet">
930             <xs:annotation>
931               <xs:documentation>This specifies the size of the TR-069 list-valued parameter,
932                 not of the individual list items.</xs:documentation>
933             </xs:annotation>
934           </xs:element>
935         </xs:choice>
936       </xs:sequence>
937       <xs:attribute name="minItems" type="xs:nonNegativeInteger" default="0"/>
938       <xs:attribute name="maxItems" type="tns:MaxEntries" default="unbounded"/>
939     </xs:extension>
940   </xs:complexContent>
941 </xs:complexType>
942 <xs:complexType name="Model">
943   <xs:annotation>
944     <xs:documentation>Model (Root or Service Object) definition and
945       reference.</xs:documentation>
946   </xs:annotation>
947   <xs:sequence>
948     <xs:element name="description" type="tns:Description" minOccurs="0"/>
949     <xs:choice minOccurs="0" maxOccurs="unbounded">
950       <xs:element name="component" type="tns:ComponentReference"/>
951       <xs:element name="parameter" type="tns:ModelParameter"/>
952       <xs:element name="object" type="tns:ModelObject">
953         <xs:unique name="objectParameterName">
954           <xs:selector xpath="parameter"/>
955           <xs:field xpath="@name|@base"/>
956         </xs:unique>
957       </xs:element>
958     </xs:choice>
959     <xs:choice minOccurs="0" maxOccurs="unbounded">
960       <xs:element name="profile" type="tns:Profile"/>
961     </xs:choice>
962     <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
963   </xs:sequence>
964   <xs:attribute name="name" type="tns:ModelName" use="required">
965     <xs:annotation>
966       <xs:documentation>MUST be unique within the document, including imported models (this is
967         checked by schema validation).</xs:documentation>
968     </xs:annotation>
969   </xs:attribute>
970   <xs:attribute name="base" type="tns:ModelName">
971     <xs:annotation>
972       <xs:documentation>MUST be present if and only if extending an existing model. See
973         A.2.10.</xs:documentation>
974     </xs:annotation>
975   </xs:attribute>
976   <xs:attribute name="isService" type="xs:boolean" default="false"/>
977   <xs:attribute name="status" type="tns:Status" default="current"/>
978   <xs:attribute name="id" type="tns:OpaqueID"/>
979   <xs:anyAttribute namespace="##other"/>
980 </xs:complexType>
981 <xs:complexType name="ModelObject">
982   <xs:annotation>
983     <xs:documentation>Object definition and reference. See A.2.8.1 for details of how tables
984       are represented.</xs:documentation>
985   </xs:annotation>
986   <xs:sequence>
987     <xs:element name="description" type="tns:Description" minOccurs="0"/>
988     <xs:element name="uniqueKey" minOccurs="0" maxOccurs="unbounded">
989       <xs:annotation>
990         <xs:documentation>MUST NOT be present if the object is not a table (see maxEntries).
991         The parameters referenced by each unique key element MUST constitute a unique key.

```

992 For a non-functional key, or if the table has no enableParameter, the uniqueness requirement  
 993 always applies.  
 994 For a functional key, and if the table has an enableParameter, the uniqueness requirement applies  
 995 only to enabled table entries.</xs:documentation>  
 996 </xs:annotation>  
 997 <xs:complexType>  
 998 <xs:sequence>  
 999 <xs:element name="parameter" maxOccurs="unbounded">  
 1000 <xs:complexType>  
 1001 <xs:attribute name="ref" type="tns:ParameterName" use="required"/>  
 1002 </xs:complexType>  
 1003 </xs:element>  
 1004 </xs:sequence>  
 1005 <xs:attribute name="functional" type="xs:boolean" default="true">  
 1006 <xs:annotation>  
 1007 <xs:documentation>Indicates whether this is a functional (true) or non-functional  
 1008 (false) key.</xs:documentation>  
 1009 </xs:annotation>  
 1010 </xs:attribute>  
 1011 </xs:complexType>  
 1012 <xs:unique name="uniqueKeyParameterRef">  
 1013 <xs:selector xpath="parameter"/>  
 1014 <xs:field xpath="@ref"/>  
 1015 </xs:unique>  
 1016 </xs:element>  
 1017 <xs:choice minOccurs="0" maxOccurs="unbounded">  
 1018 <xs:element name="component" type="tns:ComponentReference"/>  
 1019 <xs:element name="parameter" type="tns:ModelParameter"/>  
 1020 </xs:choice>  
 1021 <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>  
 1022 </xs:sequence>  
 1023 <xs:attribute name="name" type="tns:ObjectName">  
 1024 <xs:annotation>  
 1025 <xs:documentation>MUST be unique within the component or model (this is checked by schema  
 1026 validation).  
 1027 MUST be present if and only if defining a new object.  
 1028 If the object is a table (see maxEntries), the final part of the name MUST be  
 1029 "{i}."</xs:documentation>  
 1030 </xs:annotation>  
 1031 </xs:attribute>  
 1032 <xs:attribute name="base" type="tns:ObjectName">  
 1033 <xs:annotation>  
 1034 <xs:documentation>MUST be present if and only if modifying an existing  
 1035 object.</xs:documentation>  
 1036 </xs:annotation>  
 1037 </xs:attribute>  
 1038 <xs:attribute name="access" type="tns:ReadWriteAccess" use="required"/>  
 1039 <xs:attribute name="minEntries" type="xs:nonNegativeInteger" use="required">  
 1040 <xs:annotation>  
 1041 <xs:documentation>minEntries MUST be less than or equal to maxEntries (all values are  
 1042 regarded as being less than "unbounded").</xs:documentation>  
 1043 </xs:annotation>  
 1044 </xs:attribute>  
 1045 <xs:attribute name="maxEntries" type="tns:MaxEntries" use="required">  
 1046 <xs:annotation>  
 1047 <xs:documentation>minEntries and maxEntries indicate whether the object is a table:  
 1048 \* minEntries=0, maxEntries=1 : single-instance object which might not be allowed to exist, e.g.  
 1049 because only one of it and another object can exist at the same time  
 1050 \* minEntries=1, maxEntries=1 : single-instance object that is always allowed to exist  
 1051 \* all other cases : object is a table</xs:documentation>  
 1052 </xs:annotation>  
 1053 </xs:attribute>  
 1054 <xs:attribute name="numEntriesParameter" type="tns:ParameterName">  
 1055 <xs:annotation>  
 1056 <xs:documentation>MUST be specified for a table with a variable number of entries, i.e.  
 1057 for which maxEntries is greater than minEntries ("unbounded" is regarded as  
 1058 being greater than all values).</xs:documentation>  
 1059 </xs:annotation>  
 1060 </xs:attribute>  
 1061 <xs:attribute name="enableParameter" type="tns:ParameterName">  
 1062 <xs:annotation>

```

1063         <xs:documentation>MUST be specified for a table in which the ACS can create entries and
1064             which has one or more uniqueKey elements that define functional
1065             keys.</xs:documentation>
1066     </xs:annotation>
1067 </xs:attribute>
1068 <xs:attribute name="status" type="tns:Status" default="current"/>
1069 <xs:attribute name="id" type="tns:OpaqueID"/>
1070 <xs:anyAttribute namespace="##other"/>
1071 </xs:complexType>
1072 <xs:complexType name="ModelParameter">
1073     <xs:annotation>
1074         <xs:documentation>Parameter definition and reference.</xs:documentation>
1075     </xs:annotation>
1076     <xs:sequence>
1077         <xs:element name="description" type="tns:Description" minOccurs="0"/>
1078         <xs:element name="syntax" type="tns:Syntax" minOccurs="0"/>
1079         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
1080     </xs:sequence>
1081     <xs:attribute name="name" type="tns:ParameterName">
1082         <xs:annotation>
1083             <xs:documentation>MUST be unique within the parent object (this is checked by schema
1084                 validation).
1085             MUST be present if and only if defining a new parameter.</xs:documentation>
1086         </xs:annotation>
1087     </xs:attribute>
1088     <xs:attribute name="base" type="tns:ParameterName">
1089         <xs:annotation>
1090             <xs:documentation>MUST be present if and only if modifying an existing
1091                 parameter.</xs:documentation>
1092         </xs:annotation>
1093     </xs:attribute>
1094     <xs:attribute name="access" type="tns:ReadWriteAccess" use="required"/>
1095     <xs:attribute name="status" type="tns:Status" default="current"/>
1096     <xs:attribute name="activeNotify" type="tns:ActiveNotify" default="normal"/>
1097     <xs:attribute name="forcedInform" type="xs:boolean" default="false"/>
1098     <xs:attribute name="id" type="tns:OpaqueID"/>
1099     <xs:anyAttribute namespace="##other"/>
1100 </xs:complexType>
1101 <xs:complexType name="PathRefFacet">
1102     <xs:annotation>
1103         <xs:documentation>Path name reference facet.</xs:documentation>
1104     </xs:annotation>
1105     <xs:complexContent>
1106         <xs:extension base="tns:BaseStatusFacet">
1107             <xs:attribute name="refType" type="tns:ReferenceType" use="required">
1108                 <xs:annotation>
1109                     <xs:documentation>Specifies the type of reference (A.2.3.6).</xs:documentation>
1110                 </xs:annotation>
1111             </xs:attribute>
1112             <xs:attribute name="targetParent" type="tns:ObjectReferencePatterns" default="">
1113                 <xs:annotation>
1114                     <xs:documentation>If the list is non-empty, this parameter MUST only reference
1115                         immediate children of matching objects (A.2.3.4).</xs:documentation>
1116                 </xs:annotation>
1117             </xs:attribute>
1118             <xs:attribute name="targetParentScope" type="tns:PathScope" default="normal">
1119                 <xs:annotation>
1120                     <xs:documentation>Specifies the point in the naming hierarchy relative to which
1121                         targetParent applies (A.2.3.4).</xs:documentation>
1122                 </xs:annotation>
1123             </xs:attribute>
1124             <xs:attribute name="targetType" type="tns:TargetType" default="any">
1125                 <xs:annotation>
1126                     <xs:documentation>Specifies the type of item that can be
1127                         referenced.</xs:documentation>
1128                 </xs:annotation>
1129             </xs:attribute>
1130             <xs:attribute name="targetDataType" type="tns:AnyTypeName" default="any">
1131                 <xs:annotation>
1132                     <xs:documentation>Specifies the valid data types for a referenced
1133                         parameter.</xs:documentation>

```

```

1134         </xs:annotation>
1135     </xs:attribute>
1136 </xs:extension>
1137 </xs:complexContent>
1138 </xs:complexType>
1139 <xs:complexType name="PatternFacet">
1140     <xs:annotation>
1141         <xs:documentation>Pattern facet (pattern syntax is as in XML Schema).</xs:documentation>
1142     </xs:annotation>
1143     <xs:complexContent>
1144         <xs:extension base="tns:BaseAccessFacet">
1145             <xs:attribute name="value" type="xs:string" use="required"/>
1146         </xs:extension>
1147     </xs:complexContent>
1148 </xs:complexType>
1149 <xs:complexType name="Profile">
1150     <xs:annotation>
1151         <xs:documentation>Profile definition and reference.</xs:documentation>
1152     </xs:annotation>
1153     <xs:sequence>
1154         <xs:element name="description" type="tns:Description" minOccurs="0">
1155             <xs:annotation>
1156                 <xs:documentation>If the extends attribute is insufficient to express general profile
1157                     requirements, any additional requirements MUST be specified
1158                     here.</xs:documentation>
1159             </xs:annotation>
1160         </xs:element>
1161         <xs:choice minOccurs="0" maxOccurs="unbounded">
1162             <xs:element name="parameter" type="tns:ProfileParameter"/>
1163             <xs:element name="object" type="tns:ProfileObject"/>
1164         </xs:choice>
1165         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
1166     </xs:sequence>
1167     <xs:attribute name="name" type="tns:ProfileName">
1168         <xs:annotation>
1169             <xs:documentation>MUST be unique within the model (this is checked by schema validation).
1170             MUST be present if and only if defining a new profile.</xs:documentation>
1171         </xs:annotation>
1172     </xs:attribute>
1173     <xs:attribute name="base" type="tns:ProfileName">
1174         <xs:annotation>
1175             <xs:documentation>MUST specify base if modifying an existing profile or if the profile
1176                 version is greater than 1.</xs:documentation>
1177         </xs:annotation>
1178     </xs:attribute>
1179     <xs:attribute name="extends" type="tns:ProfileNames">
1180         <xs:annotation>
1181             <xs:documentation>MUST specify extends if the profile extends other
1182                 profile(s).</xs:documentation>
1183         </xs:annotation>
1184     </xs:attribute>
1185     <xs:attribute name="status" type="tns:Status" default="current"/>
1186     <xs:attribute name="id" type="tns:OpaqueID"/>
1187     <xs:anyAttribute namespace="##other"/>
1188 </xs:complexType>
1189 <xs:complexType name="ProfileObject">
1190     <xs:annotation>
1191         <xs:documentation>Profile object definition.</xs:documentation>
1192     </xs:annotation>
1193     <xs:sequence>
1194         <xs:element name="description" type="tns:Description" minOccurs="0">
1195             <xs:annotation>
1196                 <xs:documentation>If the requirement attribute is insufficient to express the
1197                     requirement, any additional requirements MUST be specified here and MAY
1198                     override the attribute.</xs:documentation>
1199             </xs:annotation>
1200         </xs:element>
1201         <xs:element name="parameter" type="tns:ProfileParameter" minOccurs="0"
1202             maxOccurs="unbounded"/>
1203     </xs:sequence>
1204     <xs:attribute name="ref" type="tns:ObjectName" use="required"/>

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1205     <xs:attribute name="requirement" type="tns:ProfileObjectAccess" use="required"/>
1206     <xs:attribute name="status" type="tns:Status" default="current"/>
1207     <xs:anyAttribute namespace="##other"/>
1208 </xs:complexType>
1209 <xs:complexType name="ProfileParameter">
1210   <xs:annotation>
1211     <xs:documentation>Profile parameter definition.</xs:documentation>
1212   </xs:annotation>
1213   <xs:sequence>
1214     <xs:element name="description" type="tns:Description" minOccurs="0">
1215       <xs:annotation>
1216         <xs:documentation>If the requirement attribute is insufficient to express the
1217           requirement, any additional requirements MUST be specified here and MAY
1218           override the attribute.</xs:documentation>
1219       </xs:annotation>
1220     </xs:element>
1221   </xs:sequence>
1222   <xs:attribute name="ref" type="tns:ParameterName" use="required"/>
1223   <xs:attribute name="requirement" type="tns:ReadWriteAccess" use="required"/>
1224   <xs:attribute name="status" type="tns:Status" default="current"/>
1225   <xs:anyAttribute namespace="##other"/>
1226 </xs:complexType>
1227 <xs:complexType name="RangeFacet">
1228   <xs:annotation>
1229     <xs:documentation>Range facet.</xs:documentation>
1230   </xs:annotation>
1231   <xs:complexContent>
1232     <xs:extension base="tns:BaseAccessFacet">
1233       <xs:attribute name="minInclusive" type="xs:integer"/>
1234       <xs:attribute name="maxInclusive" type="xs:integer"/>
1235       <xs:attribute name="step" type="xs:positiveInteger" default="1"/>
1236     </xs:extension>
1237   </xs:complexContent>
1238 </xs:complexType>
1239 <xs:complexType name="SizeFacet">
1240   <xs:annotation>
1241     <xs:documentation>Size facet.</xs:documentation>
1242   </xs:annotation>
1243   <xs:complexContent>
1244     <xs:extension base="tns:BaseAccessFacet">
1245       <xs:attribute name="minLength" type="xs:nonNegativeInteger" default="0"/>
1246       <xs:attribute name="maxLength" type="xs:nonNegativeInteger"/>
1247     </xs:extension>
1248   </xs:complexContent>
1249 </xs:complexType>
1250 <xs:complexType name="UnitsFacet">
1251   <xs:annotation>
1252     <xs:documentation>Units facet.</xs:documentation>
1253   </xs:annotation>
1254   <xs:complexContent>
1255     <xs:extension base="tns:BaseStatusFacet">
1256       <xs:attribute name="value" type="tns:UnitsString" use="required"/>
1257     </xs:extension>
1258   </xs:complexContent>
1259 </xs:complexType>
1260 <xs:complexType name="Syntax">
1261   <xs:annotation>
1262     <xs:documentation>Parameter syntax specification.</xs:documentation>
1263   </xs:annotation>
1264   <xs:sequence>
1265     <xs:element name="list" type="tns:ListFacet" minOccurs="0">
1266       <xs:annotation>
1267         <xs:documentation>For lists, the TR-069 parameter is always a string and the data type
1268           specification applies to individual list items, not to the parameter
1269           value.</xs:documentation>
1270       </xs:annotation>
1271     </xs:element>
1272   <xs:choice>
1273     <xs:group ref="tns:AllBuiltinDataTypes">
1274       <xs:annotation>

```

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1275         <xs:documentation>Direct use of built-in data type, possibly modified via use of
1276             facets.</xs:documentation>
1277     </xs:annotation>
1278 </xs:group>
1279 <xs:element name="dataType" type="tns:DataTypeReference">
1280     <xs:annotation>
1281         <xs:documentation>Use of named data type, possibly modified via use of
1282             facets.</xs:documentation>
1283     </xs:annotation>
1284     <xs:unique name="dtRefEnumerationValue">
1285         <xs:selector xpath="enumeration"/>
1286         <xs:field xpath="@value"/>
1287     </xs:unique>
1288     <xs:unique name="dtRefPatternValue">
1289         <xs:selector xpath="pattern"/>
1290         <xs:field xpath="@value"/>
1291     </xs:unique>
1292 </xs:element>
1293 </xs:choice>
1294 <xs:element name="default" type="tns:DefaultFacet" minOccurs="0"/>
1295 </xs:sequence>
1296 <xs:attribute name="hidden" type="xs:boolean" default="false">
1297     <xs:annotation>
1298         <xs:documentation>If true, MUST always read back as the null value for the parameter's
1299             base data type (A.2.3.5).</xs:documentation>
1300     </xs:annotation>
1301 </xs:attribute>
1302 <xs:attribute name="command" type="xs:boolean" default="false">
1303     <xs:annotation>
1304         <xs:documentation>If true, setting this parameter triggers a CPE action. Such a
1305             parameter is not part of the device configuration and MUST always read back
1306             as the null value for the parameter's base data type
1307             (A.2.3.5).</xs:documentation>
1308     </xs:annotation>
1309 </xs:attribute>
1310 <xs:anyAttribute namespace="##other"/>
1311 </xs:complexType>
1312 <!-- Elements -->
1313 <xs:element name="document">
1314     <xs:annotation>
1315         <xs:documentation>CWMP Data Model Definition XML Schema (DM Schema) instance documents can
1316             contain any or all of the following:
1317 * Data type definitions
1318 * Root Object definitions (including profiles)
1319 * Service Object definitions (including profiles)
1320 * Component definitions
1321 * Vendor extension definitions</xs:documentation>
1322     </xs:annotation>
1323 <xs:complexType>
1324     <xs:sequence>
1325         <xs:element name="description" type="tns:Description" minOccurs="0">
1326             <xs:annotation>
1327                 <xs:documentation>Top-level description.</xs:documentation>
1328             </xs:annotation>
1329         </xs:element>
1330         <xs:element name="import" type="tns:Import" minOccurs="0" maxOccurs="unbounded">
1331             <xs:annotation>
1332                 <xs:documentation>Imported data types, components and models (Root and Service
1333                     Objects).</xs:documentation>
1334             </xs:annotation>
1335         </xs:element>
1336         <xs:element name="dataType" type="tns:DataTypeDefinition" minOccurs="0"
1337             maxOccurs="unbounded">
1338             <xs:annotation>
1339                 <xs:documentation>Top-level data type definitions.</xs:documentation>
1340             </xs:annotation>
1341             <xs:unique name="dtDefEnumerationValue">
1342                 <xs:selector xpath="enumeration"/>
1343                 <xs:field xpath="@value"/>
1344             </xs:unique>
1345             <xs:unique name="dtDefPatternValue">

```



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1346         <xs:selector xpath="pattern"/>
1347         <xs:field xpath="@value"/>
1348     </xs:unique>
1349 </xs:element>
1350 <xs:element name="bibliography" type="tns:Bibliography" minOccurs="0">
1351     <xs:annotation>
1352         <xs:documentation>Bibliographic references.</xs:documentation>
1353     </xs:annotation>
1354 </xs:element>
1355 <xs:choice minOccurs="0" maxOccurs="unbounded">
1356     <xs:element name="component" type="tns:ComponentDefinition">
1357         <xs:annotation>
1358             <xs:documentation>Component definitions.</xs:documentation>
1359         </xs:annotation>
1360         <xs:unique name="componentParameterName">
1361             <xs:selector xpath="parameter"/>
1362             <xs:field xpath="@name|@base"/>
1363         </xs:unique>
1364         <xs:unique name="componentObjectName">
1365             <xs:selector xpath="object"/>
1366             <xs:field xpath="@name|@base"/>
1367         </xs:unique>
1368         <xs:unique name="componentProfileName">
1369             <xs:selector xpath="profile"/>
1370             <xs:field xpath="@name"/>
1371         </xs:unique>
1372     </xs:element>
1373     <xs:element name="model" type="tns:Model">
1374         <xs:annotation>
1375             <xs:documentation>Model (Root and Service Object) definitions.</xs:documentation>
1376         </xs:annotation>
1377         <xs:unique name="modelParameterName">
1378             <xs:selector xpath="parameter"/>
1379             <xs:field xpath="@name|@base"/>
1380         </xs:unique>
1381         <xs:unique name="modelObjectName">
1382             <xs:selector xpath="object"/>
1383             <xs:field xpath="@name|@base"/>
1384         </xs:unique>
1385         <xs:unique name="modelProfileName">
1386             <xs:selector xpath="profile"/>
1387             <xs:field xpath="@name"/>
1388         </xs:unique>
1389     </xs:element>
1390 </xs:choice>
1391 <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
1392 </xs:sequence>
1393 <xs:attribute name="spec" use="required">
1394     <xs:annotation>
1395         <xs:documentation>URI of the associated specification document, e.g. the BBF Technical
1396             Report. This URI SHOULD uniquely identify the specification. More than
1397             one DM Schema instance document MAY reference the same specification.
1398 Where the specification is a BBF document, the URI naming rules specified in A.2.1.1 MUST be
1399             used. For example, to reference TR-106 Issue 1 Amendment 2, the value of
1400             this attribute would be urn:broadband-forum-org:tr-106-1-
1401             2.</xs:documentation>
1402     </xs:annotation>
1403     <xs:simpleType>
1404         <xs:restriction base="xs:anyURI">
1405             <xs:pattern value=".+"/>
1406         </xs:restriction>
1407     </xs:simpleType>
1408 </xs:attribute>
1409 <xs:anyAttribute namespace="##other"/>
1410 </xs:complexType>
1411 <xs:unique name="dataTypeName">
1412     <xs:selector xpath="dataType|import/dataType"/>
1413     <xs:field xpath="@name"/>
1414 </xs:unique>
1415 <xs:unique name="componentName">
1416     <xs:selector xpath="component|import/component"/>

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```
1417     <xs:field xpath="@name" />
1418 </xs:unique>
1419 <xs:unique name="modelName">
1420   <xs:selector xpath="model|import/model" />
1421   <xs:field xpath="@name" />
1422 </xs:unique>
1423 <xs:unique name="bibId">
1424   <xs:selector xpath="bibliography/reference" />
1425   <xs:field xpath="@id" />
1426 </xs:unique>
1427 <xs:keyref name="dataTypeBase" refer="tns:dataTypeName">
1428   <xs:selector xpath="dataType|../parameter/syntax/dataType" />
1429   <xs:field xpath="@base" />
1430 </xs:keyref>
1431 <xs:keyref name="dataTypeRef" refer="tns:dataTypeName">
1432   <xs:selector xpath="../parameter/syntax/dataType" />
1433   <xs:field xpath="@ref" />
1434 </xs:keyref>
1435 <xs:keyref name="componentRef" refer="tns:componentName">
1436   <xs:selector xpath="../component" />
1437   <xs:field xpath="@ref" />
1438 </xs:keyref>
1439 <xs:keyref name="modelBase" refer="tns:modelName">
1440   <xs:selector xpath="model" />
1441   <xs:field xpath="@base" />
1442 </xs:keyref>
1443 </xs:element>
1444 </xs:schema>
```

# Annex B. CWMP Device Type XML Schema

## B.1 Introduction

The CWMP Device Type XML Schema [11], or DT Schema, is used for describing a device's supported data model. It is specified in B.4.

DT Schema instance documents can contain the following:

- Imports (from DM Schema instance documents) of Root or Service Object definitions
- Declarations of which features of imported Root or Service Objects are supported

DT Schema instance documents cannot contain definitions of Root or Service Objects. All such definitions have to reside in DM Schema instance documents.

## B.2 Normative Information

It is possible to create instance documents that conform to the DT Schema but nevertheless are not valid device type specifications. This is because it is not possible to specify all the normative device type specification requirements using the XML Schema language. Therefore, the schema contains additional requirements written using the usual normative language. Instance documents that conform to the DT Schema and meet these additional requirements are referred to as DT Instances.

The question of the location of the definitive normative information therefore arises. The answer is as follows:

- All the normative information in the main part of the document remains normative.
- The DT Schema, and the additional requirements therein, are normative. Some of these additional requirements are duplicated (for emphasis) in this Annex.
- The DT Schema references additional material in this Annex. Such material is normative.
- If the DT Schema conflicts with a normative requirement in the main part of the document, this is an error in the DT Schema, and the requirement in the main part of the document takes precedence.

### B.2.1 Importing DM Instances

DM Instances are imported using the top-level import element, which differs from the DM Schema import element in that only data types and models can be imported (components cannot be imported because they are not used in DT Instances).

*Note – the rules for importing DM Instances into DT Instances are consistent with those given in A.2.1 for importing DM Instances into other DM Instances. The only difference is an additional rule governing the use, when available, of the DT Instance URL.*

The DT Schema specifies that the DM Instance is located via the file attribute.

The rules governing the file attribute's value and its use for locating the DM Instance are as follows:

- It MUST be a URL adhering to RFC 3986 [7].
- If the URL includes a scheme, it MUST be http, https or ftp.

- If the URL includes an authority, it **MUST NOT** include credentials.
- For standard BBF DM Instances, the rules that apply to the filename part (final path segment) of the A.2.1.1 BBFURL **MUST** be applied to the filename part of this URL. This means that the corrigendum number can be omitted in order to refer to the latest corrigendum.
- If the URL is a relative reference, processing tools **MUST** apply their own logic, e.g. apply a search path. If a DT Instance URL is available, the relative reference **MUST** be interpreted relative to the DT Instance URL.

## B.2.2 Features

The feature element provides a simple way for a DT Instance to indicate whether a given feature is supported. The current set of standard features is as follows:

Feature	Description
DNSClient	Device contains a DNS client.
DNSServer	Device contains a DNS server.
Firewall	Device contains a firewall.
IPv6	Device supports IPv6.
NAT	Device supports NAT.
Router	Device is a router.

Vendor-specific features **MAY** be supported, and if so the feature name **MUST** begin with X\_<VENDOR>\_, where <VENDOR> **MUST** be as defined in section 3.3.

This example feature declaration illustrates the use of annotation:

```
<feature name="DNSServer">
  <annotation>Supports a DNS Server and XYZ.</annotation>
</feature>
```

In order to make it easy to add new features, standard feature names are defined in a separate DT Features Schema that is imported by the DT Schema. The DT Features Schema is unversioned, so the DT Schema need not be changed when new standard feature names are added. In order to preserve backwards compatibility, standard feature names, once added, **MUST NOT** ever be deleted.

## B.3 DT Features Schema

The DT Features Schema is specified below. The normative version can be found at <http://www.broadband-forum.org/cwmp/cwmp-devicetype-features.xsd>. Please be aware that a new version of the DT Features Schema might be published at any time, in which case the version in this document would become out of date. Any conflict **MUST** be resolved in favor of the normative version on the web site.

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <!--
3   TR-069 DT (Device Type) Features Schema
4
5   Notice:
6   The Broadband Forum is a non-profit corporation organized to create
7   guidelines for broadband network system development and deployment. This
8   XML Schema has been approved by members of the Forum. This document is
9   not binding on the Broadband Forum, any of its members, or any developer
10  or service provider. This document is subject to change, but only with
11  approval of members of the Forum.
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15  extent permitted by law any representation or warranty, express or implied,
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27  For a list of declarations made by Broadband Forum member companies,
28  please see http://www.broadband-forum.org.
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30  Copyright The Broadband Forum. All Rights Reserved.
31
32  Broadband Forum XML Schemas may be copied, downloaded, stored on a server or
33  otherwise re-distributed in their entirety only. The text of this
34  notice must be included in all copies.
35
36  Summary:
37  TR-069 DT (Device Type) Features Schema. Defines device features that
38  can be described in DT Instances.
39
40  Version History:
41  September 2009: cwmp-devicetype-features.xsd, corresponds to TR-106
42  Amendment 3
43  -->
44  <xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:tns="urn:broadband-forum-
45  org:cwmp:devicetype-features" targetNamespace="urn:broadband-forum-
46  org:cwmp:devicetype-features" elementFormDefault="unqualified"
47  attributeFormDefault="unqualified">
48  <xs:simpleType name="FeatureName">
49  <xs:restriction base="xs:NCName">
50  <xs:pattern value="DNSClient"/>
51  <xs:pattern value="DNSServer"/>
52  <xs:pattern value="Firewall"/>
53  <xs:pattern value="IPv6"/>
54  <xs:pattern value="NAT"/>
55  <xs:pattern value="Router"/>
56  <xs:pattern value="X_+"/>
57  </xs:restriction>
58  </xs:simpleType>
59  </xs:schema>

```

## B.4 DT Schema

The DT Schema is specified below. The normative version can be found at <http://www.broadband-forum.org/cwmp/cwmp-devicetype-1-1.xsd>. Please be aware that a new version of the DT Schema might be published at any time, in which case the version in this document would become out of date. Any conflict MUST be resolved in favor of the normative version on the web site.

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <!--
3   TR-069 Device Type Schema (DT Schema) v1.1
4
5   Notice:
6   The Broadband Forum is a non-profit corporation organized to create
7   guidelines for broadband network system development and deployment.
8   This Broadband Forum Document has been approved by members of the
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49  not be modified without the advance written permission of the
50  Broadband Forum.
51
52  The text of this notice must be included in all copies of this
53  Broadband Forum Document.
54
55  Summary:
56  TR-069 Device Type Schema (DT Schema). DT Instances describe individual
57  devices' support for TR-069 data models.
58
59  Version History:
60  September 2009: cwmp-devicetype-1-0.xsd, corresponds to TR-106 Amendment 3
61  December 2010: cwmp-devicetype-1-1.xsd, corresponds to TR-106 Amendment 5
62  - made import/@file attribute required for import element
63  - removed size facet's default maxLength on string/base64/hexBinary
64  parameters
65  -->
66
67  <xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema" xmlns:tns="urn:broadband-forum-
68  org:cwmp:devicetype-1-1" xmlns:dm="urn:broadband-forum-org:cwmp:datamodel-
69  1-3" xmlns:dtf="urn:broadband-forum-org:cwmp:devicetype-features"
70  targetNamespace="urn:broadband-forum-org:cwmp:devicetype-1-1"
71  elementFormDefault="unqualified" attributeFormDefault="unqualified">

```

```

72 <xs:import namespace="urn:broadband-forum-org:cwmp:datamodel-1-3" schemaLocation="cwmp-
73     datamodel-1-3.xsd"/>
74 <xs:import namespace="urn:broadband-forum-org:cwmp:devicetype-features" schemaLocation="cwmp-
75     devicetype-features.xsd"/>
76 <!-- Simple types -->
77 <xs:simpleType name="ActiveNotify">
78   <xs:annotation>
79     <xs:documentation>Parameter active notify support (based on
80       dm:activeNotify).</xs:documentation>
81   </xs:annotation>
82   <xs:restriction base="xs:token">
83     <xs:enumeration value="normal"/>
84     <xs:enumeration value="willDeny"/>
85   </xs:restriction>
86 </xs:simpleType>
87 <xs:simpleType name="ObjectAccess">
88   <xs:annotation>
89     <xs:documentation>Object access (based on dm:ProfileObjectAccess).</xs:documentation>
90   </xs:annotation>
91   <xs:restriction base="xs:token">
92     <xs:enumeration value="readOnly"/>
93     <xs:enumeration value="create"/>
94     <xs:enumeration value="delete"/>
95     <xs:enumeration value="createDelete"/>
96   </xs:restriction>
97 </xs:simpleType>
98 <!-- Model groups -->
99 <xs:group name="AllBuiltinDataTypes">
100   <xs:annotation>
101     <xs:documentation>All built-in data types.</xs:documentation>
102   </xs:annotation>
103   <xs:choice>
104     <xs:element name="base64">
105       <xs:complexType>
106         <xs:sequence>
107           <xs:choice minOccurs="0" maxOccurs="unbounded">
108             <xs:element name="size" type="tns:SizeFacet"/>
109           </xs:choice>
110           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
111         </xs:sequence>
112         <xs:anyAttribute namespace="##other"/>
113       </xs:complexType>
114     </xs:element>
115     <xs:element name="boolean">
116       <xs:complexType>
117         <xs:sequence>
118           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
119         </xs:sequence>
120         <xs:anyAttribute namespace="##other"/>
121       </xs:complexType>
122     </xs:element>
123     <xs:element name="dateTime">
124       <xs:complexType>
125         <xs:sequence>
126           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
127         </xs:sequence>
128         <xs:anyAttribute namespace="##other"/>
129       </xs:complexType>
130     </xs:element>
131     <xs:element name="hexBinary">
132       <xs:complexType>
133         <xs:sequence>
134           <xs:choice minOccurs="0" maxOccurs="unbounded">
135             <xs:element name="size" type="tns:SizeFacet"/>
136           </xs:choice>
137           <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
138         </xs:sequence>
139         <xs:anyAttribute namespace="##other"/>
140       </xs:complexType>
141     </xs:element>
142     <xs:element name="int">

```



```

143     <xs:complexType>
144       <xs:sequence>
145         <xs:choice minOccurs="0" maxOccurs="unbounded">
146           <xs:element name="instanceRef" type="tns:InstanceRefFacet"/>
147           <xs:element name="range" type="tns:RangeFacet"/>
148           <xs:element name="units" type="tns:UnitsFacet"/>
149         </xs:choice>
150         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
151       </xs:sequence>
152       <xs:anyAttribute namespace="##other"/>
153     </xs:complexType>
154   </xs:element>
155   <xs:element name="long">
156     <xs:complexType>
157       <xs:sequence>
158         <xs:choice minOccurs="0" maxOccurs="unbounded">
159           <xs:element name="range" type="tns:RangeFacet"/>
160           <xs:element name="units" type="tns:UnitsFacet"/>
161         </xs:choice>
162         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
163       </xs:sequence>
164       <xs:anyAttribute namespace="##other"/>
165     </xs:complexType>
166   </xs:element>
167   <xs:element name="string">
168     <xs:complexType>
169       <xs:sequence>
170         <xs:choice minOccurs="0" maxOccurs="unbounded">
171           <xs:element name="size" type="tns:SizeFacet"/>
172           <xs:element name="pathRef" type="tns:PathRefFacet"/>
173           <xs:element name="enumeration" type="tns:EnumerationFacet"/>
174           <xs:element name="enumerationRef" type="tns:EnumerationRefFacet"/>
175           <xs:element name="pattern" type="tns:PatternFacet"/>
176         </xs:choice>
177         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
178       </xs:sequence>
179       <xs:anyAttribute namespace="##other"/>
180     </xs:complexType>
181     <xs:unique name="stringEnumerationValue">
182       <xs:selector xpath="enumeration"/>
183       <xs:field xpath="@value"/>
184     </xs:unique>
185     <xs:unique name="stringPatternValue">
186       <xs:selector xpath="pattern"/>
187       <xs:field xpath="@value"/>
188     </xs:unique>
189   </xs:element>
190   <xs:element name="unsignedInt">
191     <xs:complexType>
192       <xs:sequence>
193         <xs:choice minOccurs="0" maxOccurs="unbounded">
194           <xs:element name="instanceRef" type="tns:InstanceRefFacet"/>
195           <xs:element name="range" type="tns:RangeFacet"/>
196           <xs:element name="units" type="tns:UnitsFacet"/>
197         </xs:choice>
198         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
199       </xs:sequence>
200       <xs:anyAttribute namespace="##other"/>
201     </xs:complexType>
202   </xs:element>
203   <xs:element name="unsignedLong">
204     <xs:complexType>
205       <xs:sequence>
206         <xs:choice minOccurs="0" maxOccurs="unbounded">
207           <xs:element name="range" type="tns:RangeFacet"/>
208           <xs:element name="units" type="tns:UnitsFacet"/>
209         </xs:choice>
210         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
211       </xs:sequence>
212       <xs:anyAttribute namespace="##other"/>
213     </xs:complexType>

```

```

214     </xs:element>
215   </xs:choice>
216 </xs:group>
217 <xs:group name="AllFacets">
218   <xs:annotation>
219     <xs:documentation>All facets.</xs:documentation>
220   </xs:annotation>
221   <xs:choice>
222     <xs:element name="size" type="tns:SizeFacet"/>
223     <xs:element name="instanceRef" type="tns:InstanceRefFacet"/>
224     <xs:element name="pathRef" type="tns:PathRefFacet"/>
225     <xs:element name="range" type="tns:RangeFacet"/>
226     <xs:element name="enumeration" type="tns:EnumerationFacet"/>
227     <xs:element name="enumerationRef" type="tns:EnumerationRefFacet"/>
228     <xs:element name="pattern" type="tns:PatternFacet"/>
229     <xs:element name="units" type="tns:UnitsFacet"/>
230   </xs:choice>
231 </xs:group>
232 <!-- Complex types -->
233 <xs:complexType name="Annotation">
234   <xs:annotation>
235     <xs:documentation>Annotation.</xs:documentation>
236   </xs:annotation>
237   <xs:simpleContent>
238     <xs:extension base="xs:string">
239       <xs:anyAttribute namespace="##other"/>
240     </xs:extension>
241   </xs:simpleContent>
242 </xs:complexType>
243 <xs:complexType name="BaseAccessFacet" abstract="true">
244   <xs:annotation>
245     <xs:documentation>Base facet (access attribute).</xs:documentation>
246   </xs:annotation>
247   <xs:complexContent>
248     <xs:extension base="tns:BaseStatusFacet">
249       <xs:attribute name="access" type="dm:ReadWriteAccess" default="readWrite"/>
250     </xs:extension>
251   </xs:complexContent>
252 </xs:complexType>
253 <xs:complexType name="BaseStatusFacet" abstract="true">
254   <xs:annotation>
255     <xs:documentation>Base facet (no attributes).</xs:documentation>
256   </xs:annotation>
257   <xs:sequence>
258     <xs:element name="annotation" type="tns:Annotation" minOccurs="0"/>
259     <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
260   </xs:sequence>
261   <xs:anyAttribute namespace="##other"/>
262 </xs:complexType>
263 <xs:complexType name="DefaultFacet">
264   <xs:annotation>
265     <xs:documentation>Default facet.</xs:documentation>
266   </xs:annotation>
267   <xs:complexContent>
268     <xs:extension base="tns:BaseStatusFacet">
269       <xs:attribute name="type" type="dm:DefaultType" use="required"/>
270       <xs:attribute name="value" type="xs:string" use="required">
271         <xs:annotation>
272           <xs:documentation>Value MUST be valid for the data type.</xs:documentation>
273         </xs:annotation>
274       </xs:attribute>
275     </xs:extension>
276   </xs:complexContent>
277 </xs:complexType>
278 <xs:complexType name="EnumerationFacet">
279   <xs:annotation>
280     <xs:documentation>Enumeration facet.</xs:documentation>
281   </xs:annotation>
282   <xs:complexContent>
283     <xs:extension base="tns:BaseAccessFacet">
284       <xs:attribute name="value" type="xs:string" use="required"/>

```

```

285         <xs:attribute name="code" type="xs:integer"/>
286     </xs:extension>
287 </xs:complexContent>
288 </xs:complexType>
289 <xs:complexType name="EnumerationRefFacet">
290     <xs:annotation>
291         <xs:documentation>Enumeration reference facet.</xs:documentation>
292     </xs:annotation>
293     <xs:complexContent>
294         <xs:extension base="tns:BaseStatusFacet"/>
295     </xs:complexContent>
296 </xs:complexType>
297 <xs:complexType name="Import">
298     <xs:annotation>
299         <xs:documentation>Import data types and models (Root and Service Objects) from DM
300             Instances. All such items MUST be imported (this is checked by schema
301             validation).</xs:documentation>
302     </xs:annotation>
303     <xs:sequence>
304         <xs:choice minOccurs="0" maxOccurs="unbounded">
305             <xs:element name="dataType">
306                 <xs:complexType>
307                     <xs:attribute name="name" type="dm:DataTypeName" use="required"/>
308                 </xs:complexType>
309             </xs:element>
310             <xs:element name="model">
311                 <xs:complexType>
312                     <xs:attribute name="name" type="dm:ModelName" use="required"/>
313                 </xs:complexType>
314             </xs:element>
315         </xs:choice>
316         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
317     </xs:sequence>
318     <xs:attribute name="file" type="xs:anyURI" use="required">
319         <xs:annotation>
320             <xs:documentation>MUST be used to locate the DM Instance (B.2.1).</xs:documentation>
321         </xs:annotation>
322     </xs:attribute>
323     <xs:attribute name="spec" type="xs:anyURI">
324         <xs:annotation>
325             <xs:documentation>If specified, processing tools MUST regard a mismatch between this and
326             the external document's spec attribute as an error.
327         </xs:documentation>
328     </xs:annotation>
329 </xs:attribute>
330 <xs:anyAttribute namespace="##other"/>
331 </xs:complexType>
332 <xs:complexType name="InstanceRefFacet">
333     <xs:annotation>
334         <xs:documentation>Instance number reference facet.</xs:documentation>
335     </xs:annotation>
336     <xs:complexContent>
337         <xs:extension base="tns:BaseStatusFacet">
338             <xs:attribute name="targetParent" type="dm:ObjectReference" use="required"/>
339         </xs:extension>
340     </xs:complexContent>
341 </xs:complexType>
342 <xs:complexType name="ListFacet">
343     <xs:annotation>
344         <xs:documentation>List facet.</xs:documentation>
345     </xs:annotation>
346     <xs:complexContent>
347         <xs:extension base="tns:BaseStatusFacet">
348             <xs:sequence>
349                 <xs:choice minOccurs="0" maxOccurs="unbounded">
350                     <xs:element name="size" type="tns:SizeFacet">
351                         <xs:annotation>
352                             <xs:documentation>This specifies the size of the TR-069 list-valued parameter,
353                             not of the individual list items.</xs:documentation>
354                         </xs:annotation>
355                     </xs:element>

```

```

356         </xs:choice>
357     </xs:sequence>
358     <xs:attribute name="minItems" type="xs:nonNegativeInteger" default="0"/>
359     <xs:attribute name="maxItems" type="dm:MaxEntries" default="unbounded"/>
360 </xs:extension>
361 </xs:complexContent>
362 </xs:complexType>
363 <xs:complexType name="Model">
364     <xs:annotation>
365         <xs:documentation>Model (Root and Service Object) support details.</xs:documentation>
366     </xs:annotation>
367     <xs:sequence>
368         <xs:element name="annotation" type="tns:Annotation" minOccurs="0"/>
369         <xs:choice minOccurs="0" maxOccurs="unbounded">
370             <xs:element name="parameter" type="tns:ModelParameter"/>
371             <xs:element name="object" type="tns:ModelObject">
372                 <xs:unique name="objectParameterName">
373                     <xs:selector xpath="parameter"/>
374                     <xs:field xpath="@ref"/>
375                 </xs:unique>
376             </xs:element>
377         </xs:choice>
378         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
379     </xs:sequence>
380     <xs:attribute name="ref" type="dm:ModelName" use="required"/>
381     <xs:anyAttribute namespace="##other"/>
382 </xs:complexType>
383 <xs:complexType name="ModelObject">
384     <xs:annotation>
385         <xs:documentation>Object support details</xs:documentation>
386     </xs:annotation>
387     <xs:sequence>
388         <xs:element name="annotation" type="tns:Annotation" minOccurs="0"/>
389         <xs:choice minOccurs="0" maxOccurs="unbounded">
390             <xs:element name="parameter" type="tns:ModelParameter"/>
391         </xs:choice>
392         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
393     </xs:sequence>
394     <xs:attribute name="ref" type="dm:ObjectName" use="required"/>
395     <xs:attribute name="access" type="tns:ObjectAccess" use="required"/>
396     <xs:attribute name="minEntries" type="xs:nonNegativeInteger" use="required">
397         <xs:annotation>
398             <xs:documentation>minEntries MUST be greater than or equal to minEntries(DM), and less
399                 than or equal to maxEntries (all values are regarded as being less than
400                 "unbounded").</xs:documentation>
401         </xs:annotation>
402     </xs:attribute>
403     <xs:attribute name="maxEntries" type="dm:MaxEntries" use="required">
404         <xs:annotation>
405             <xs:documentation>maxEntries MUST be less than or equal to maxEntries(DM) (all values are
406                 regarded as being less than "unbounded").</xs:documentation>
407         </xs:annotation>
408     </xs:attribute>
409     <xs:anyAttribute namespace="##other"/>
410 </xs:complexType>
411 <xs:complexType name="ModelParameter">
412     <xs:annotation>
413         <xs:documentation>Parameter support details.</xs:documentation>
414     </xs:annotation>
415     <xs:sequence>
416         <xs:element name="annotation" type="tns:Annotation" minOccurs="0"/>
417         <xs:element name="syntax" type="tns:Syntax" minOccurs="0"/>
418         <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
419     </xs:sequence>
420     <xs:attribute name="ref" type="dm:ParameterName" use="required"/>
421     <xs:attribute name="access" type="dm:ReadWriteAccess" use="required"/>
422     <xs:attribute name="activeNotify" type="tns:ActiveNotify" default="normal"/>
423     <xs:anyAttribute namespace="##other"/>
424 </xs:complexType>
425 <xs:complexType name="PathRefFacet">
426     <xs:annotation>

```

```

427     <xs:documentation>Path name reference facet.</xs:documentation>
428 </xs:annotation>
429 <xs:complexContent>
430   <xs:extension base="tns:BaseStatusFacet">
431     <xs:attribute name="targetParent" type="dm:ObjectReferencePatterns" default=""/>
432     <xs:attribute name="targetType" type="dm:TargetType" default="any"/>
433     <xs:attribute name="targetDataType" type="dm:AnyTypeName" default="any"/>
434   </xs:extension>
435 </xs:complexContent>
436 </xs:complexType>
437 <xs:complexType name="PatternFacet">
438   <xs:annotation>
439     <xs:documentation>Pattern facet (pattern syntax is as in XML Schema).</xs:documentation>
440   </xs:annotation>
441   <xs:complexContent>
442     <xs:extension base="tns:BaseAccessFacet">
443       <xs:attribute name="value" type="xs:string" use="required"/>
444     </xs:extension>
445   </xs:complexContent>
446 </xs:complexType>
447 <xs:complexType name="RangeFacet">
448   <xs:annotation>
449     <xs:documentation>Range facet.</xs:documentation>
450   </xs:annotation>
451   <xs:complexContent>
452     <xs:extension base="tns:BaseAccessFacet">
453       <xs:attribute name="minInclusive" type="xs:integer"/>
454       <xs:attribute name="maxInclusive" type="xs:integer"/>
455     </xs:extension>
456   </xs:complexContent>
457 </xs:complexType>
458 <xs:complexType name="SizeFacet">
459   <xs:annotation>
460     <xs:documentation>Size facet.</xs:documentation>
461   </xs:annotation>
462   <xs:complexContent>
463     <xs:extension base="tns:BaseAccessFacet">
464       <xs:attribute name="minLength" type="xs:nonNegativeInteger" default="0"/>
465       <xs:attribute name="maxLength" type="xs:nonNegativeInteger"/>
466     </xs:extension>
467   </xs:complexContent>
468 </xs:complexType>
469 <xs:complexType name="DataTypeReference">
470   <xs:annotation>
471     <xs:documentation>Parameter data type anonymous restriction / extension.</xs:documentation>
472   </xs:annotation>
473   <xs:sequence>
474     <xs:group ref="tns:AllFacets" minOccurs="0" maxOccurs="unbounded"/>
475     <xs:any namespace="##other" minOccurs="0" maxOccurs="unbounded"/>
476   </xs:sequence>
477   <xs:attribute name="base" type="dm:DataTypeName">
478     <xs:annotation>
479       <xs:documentation>If specified, content MUST NOT be empty.</xs:documentation>
480     </xs:annotation>
481   </xs:attribute>
482   <xs:anyAttribute namespace="##other"/>
483 </xs:complexType>
484 <xs:complexType name="Syntax">
485   <xs:annotation>
486     <xs:documentation>Parameter syntax support details.</xs:documentation>
487   </xs:annotation>
488   <xs:sequence>
489     <xs:element name="list" type="tns:ListFacet" minOccurs="0"/>
490     <xs:choice>
491       <xs:group ref="tns:AllBuiltinDataTypes">
492         <xs:annotation>
493           <xs:documentation>Direct use of built-in data type, possibly modified via use of
494             facets.</xs:documentation>
495         </xs:annotation>
496       </xs:group>
497     </xs:choice>
498     <xs:element name="dataType" type="tns:DataTypeReference">

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498     <xs:annotation>
499       <xs:documentation>Use of named data type, possibly modified via use of
500         facets.</xs:documentation>
501     </xs:annotation>
502     <xs:unique name="dtRefEnumerationValue">
503       <xs:selector xpath="enumeration"/>
504       <xs:field xpath="@value"/>
505     </xs:unique>
506     <xs:unique name="dtRefPatternValue">
507       <xs:selector xpath="pattern"/>
508       <xs:field xpath="@value"/>
509     </xs:unique>
510   </xs:element>
511 </xs:choice>
512 <xs:element name="default" type="tns:DefaultFacet" minOccurs="0"/>
513 </xs:sequence>
514 <xs:anyAttribute namespace="##other"/>
515 </xs:complexType>
516 <xs:complexType name="ToplevelFeature">
517   <xs:annotation>
518     <xs:documentation>Top-level feature.</xs:documentation>
519   </xs:annotation>
520   <xs:sequence>
521     <xs:element name="annotation" type="tns:Annotation" minOccurs="0"/>
522   </xs:sequence>
523   <xs:attribute name="name" type="dtf:FeatureName" use="required"/>
524 </xs:complexType>
525 <xs:complexType name="UnitsFacet">
526   <xs:annotation>
527     <xs:documentation>Units facet.</xs:documentation>
528   </xs:annotation>
529   <xs:complexContent>
530     <xs:extension base="tns:BaseStatusFacet">
531       <xs:attribute name="value" type="dm:UnitsString" use="required"/>
532     </xs:extension>
533   </xs:complexContent>
534 </xs:complexType>
535 <!-- Elements -->
536 <xs:element name="document">
537   <xs:annotation>
538     <xs:documentation>CWMP Device Type XML Schema (DT Schema) instance documents can contain
539       the following:
540 * Imports (from DM Schema instance documents) of Root or Service Object definitions
541 * Declarations of which features of imported Root or Service Objects are
542   supported</xs:documentation>
543   </xs:annotation>
544   <xs:complexType>
545     <xs:sequence>
546       <xs:element name="annotation" type="tns:Annotation" minOccurs="0">
547         <xs:annotation>
548           <xs:documentation>Top-level annotation.</xs:documentation>
549         </xs:annotation>
550       </xs:element>
551       <xs:element name="import" type="tns:Import" minOccurs="0" maxOccurs="unbounded">
552         <xs:annotation>
553           <xs:documentation>Imported models (Root and Service Objects).</xs:documentation>
554         </xs:annotation>
555       </xs:element>
556       <xs:element name="bibliography" type="dm:Bibliography" minOccurs="0">
557         <xs:annotation>
558           <xs:documentation>Bibliographic references.</xs:documentation>
559         </xs:annotation>
560       </xs:element>
561       <xs:element name="feature" type="tns:ToplevelFeature" minOccurs="0"
562         maxOccurs="unbounded">
563         <xs:annotation>
564           <xs:documentation>Top-level features.</xs:documentation>
565         </xs:annotation>
566       </xs:element>
567       <xs:element name="model" type="tns:Model" minOccurs="0" maxOccurs="unbounded">
568         <xs:annotation>

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569         <xs:documentation>Details of support for model (Root and Service
570             Object).</xs:documentation>
571     </xs:annotation>
572     <xs:unique name="modelName">
573         <xs:selector xpath="parameter"/>
574         <xs:field xpath="@ref"/>
575     </xs:unique>
576     <xs:unique name="modelObjectName">
577         <xs:selector xpath="object"/>
578         <xs:field xpath="@ref"/>
579     </xs:unique>
580 </xs:element>
581 </xs:sequence>
582 <xs:attribute name="deviceType" use="required">
583     <xs:annotation>
584         <xs:documentation>URI indicating the device type associated with this DT
585             Instance.</xs:documentation>
586     </xs:annotation>
587     <xs:simpleType>
588         <xs:restriction base="xs:anyURI">
589             <xs:pattern value=".+"/>
590         </xs:restriction>
591     </xs:simpleType>
592 </xs:attribute>
593 </xs:complexType>
594 <xs:unique name="dataTypeName">
595     <xs:selector xpath="import/dataType"/>
596     <xs:field xpath="@name"/>
597 </xs:unique>
598 <xs:keyref name="dataTypeBase" refer="tns:dataTypeName">
599     <xs:selector xpath="./parameter/syntax/dataType"/>
600     <xs:field xpath="@base"/>
601 </xs:keyref>
602 <xs:unique name="modelName">
603     <xs:selector xpath="import/model"/>
604     <xs:field xpath="@name"/>
605 </xs:unique>
606 <xs:unique name="modelRef">
607     <xs:selector xpath="model"/>
608     <xs:field xpath="@ref"/>
609 </xs:unique>
610 <xs:keyref name="modelDef" refer="tns:modelName">
611     <xs:selector xpath="model"/>
612     <xs:field xpath="@ref"/>
613 </xs:keyref>
614 </xs:element>
615 </xs:schema>

```

# Appendix I. HTML Data Model Reports

## I.1 Introduction

TR-106 Amendment 2 published the first version of the DM Schema. Since then the normative definitions of all TR-069 data models have been published as DM Instances (XML documents that conform to the DM Schema). Since these XML data models might not be easily read by a human, corresponding non-normative HTML data model reports have also been published (see <http://www.broadband-forum.org/cwmp.php#DMD>).

This appendix briefly discusses these HTML reports.

## I.2 Report Types

There are two types of HTML reports published for a given version of a data model:

- a full report, covering the given version and all preceding versions of the data model
- a partial report, covering only the given version of the data model (i.e. excluding content specific to earlier versions of the data model); i.e. last only changes

For example, TR-181 Issue 1 defined the Device:1.5 data model revision, declared in tr-181-1-0-0.xml. The full report is in tr-181-1-0-0.html, and includes the aggregate data model definitions from Device:1.5 and earlier (back to Device:1.0 inclusive). The partial report is in tr-181-1-0-0-last.html, and only includes the data model definitions added or changed by TR-181 Issue 1.

## I.3 Report Layout

Each HTML data model report contains the following sections:

Notice	The legal notice, lifted from the top of the associated XML data model file.
Summary	Describes the reason for this data model version. This is lifted from the associated XML data model file's document description.
Table of Contents	Hyperlinks to the various sections within the report, as well as links to each Object and Profile definition within the report.
Data Types	Named data type definitions (i.e. not built-in types) that are used to define Parameters within the report. Each data type definition consists of name, type, and description.
References	Hyperlinks to external bibliography references cited by Object, Parameter, and Profile descriptions within the report.
Data model definition	Object and Parameter definitions. Which Object and Parameter definitions are included depends on whether it is a full or partial (last only) report.
Inform and Notification Requirements	Lists those Parameters within the report that are: forced inform parameters, forced active notification parameters, and parameters for which active notification can be denied.
Profile Definitions	Profile definitions, showing Object and Parameter requirements. Which Profiles are included depends on whether it is a full or partial (last only) report.

## I.4 Data Model Definition

Parameters make use of a limited subset of the default SOAP data types [5]. The notation used to represent these types within the report is listed in the following table.



Type	Description
object	A container for parameters and/or other objects. The full path name of a parameter is given by the parameter name appended to the full path name of the object it is contained within.
string	For strings, a minimum and maximum allowed length can be indicated using the form string(Min:Max), where Min and Max are the minimum and maximum string length in characters. If either Min or Max are missing, this indicates no limit, and if Min is missing the colon can also be omitted, as in string(Max). Multiple comma-separated ranges can be specified, in which case the string length will be in one of the ranges.
int	Integer in the range $-2147483648$ to $+2147483647$ , inclusive. For some int types, a value range is given using the form int[Min:Max], where the Min and Max values are inclusive. If either Min or Max are missing, this indicates no limit. Multiple comma-separated ranges can be specified, in which case the value will be in one of the ranges.
long	Long integer in the range $-9223372036854775808$ to $9223372036854775807$ , inclusive. For some long types, a value range is given using the form long[Min:Max], where the Min and Max values are inclusive. If either Min or Max are missing, this indicates no limit. Multiple comma-separated ranges can be specified, in which case the value will be in one of the ranges.
unsignedInt	Unsigned integer in the range 0 to 4294967295, inclusive. For some unsignedInt types, a value range is given using the form unsignedInt[Min:Max], where the Min and Max values are inclusive. If either Min or Max are missing, this indicates no limit. Multiple comma-separated ranges can be specified, in which case the value will be in one of the ranges.
unsignedLong	Unsigned long integer in the range 0 to 18446744073709551615, inclusive. For some unsignedLong types, a value range is given using the form unsignedLong[Min:Max], where the Min and Max values are inclusive. If either Min or Max are missing, this indicates no limit. Multiple comma-separated ranges can be specified, in which case the value will be in one of the ranges.
boolean	Boolean, where the allowed values are "0" or "1" (or equivalently, "true" or "false").
dateTime	The subset of the ISO 8601 date-time format defined by the SOAP dateTime type.
base64	Base64 encoded binary (no line-length limitation). A minimum and maximum allowed length can be indicated using the form base64(Min:Max), where Min and Max are the minimum and maximum length in characters before Base64 encoding. If either Min or Max are missing, this indicates no limit, and if Min is missing the colon can also be omitted, as in base64(Max). Multiple comma-separated ranges can be specified, in which case the length MUST be in one of the ranges.
hexBinary	Hex encoded binary. A minimum and maximum allowed length can be indicated using the form hexBinary(Min:Max), where Min and Max are the minimum and maximum length in characters before Hex Binary encoding. If either Min or Max are missing, this indicates no limit, and if Min is missing the colon can also be omitted, as in hexBinary(Max). Multiple comma-separated ranges can be specified, in which case the length MUST be in one of the ranges.

Note: A Parameter that is defined to be one of the named data types, is reported as such at the beginning of the Parameter's description via a reference back to the associated data type definition (e.g. [MacAddress]). However, such parameters still indicate their SOAP data type (as discussed in the table above).