

INTERNATIONAL STANDARD

Information technology – UPnP Device Architecture –
Part 3-12: Audio Video Device Control Protocol – Content Directory Service
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INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 3-12: Audio Video Device Control Protocol – Content Directory Service

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The list of all currently available parts of the ISO/IEC 29341 series, under the general title *Universal plug and play (UPnP) architecture*, can be found on the IEC web site.

This International Standard has been approved by vote of the member bodies, and the voting results may be obtained from the address given on the second title page.

ORIGINAL UPnP DOCUMENTS (informative)

Reference may be made in this document to original UPnP documents. These references are retained in order to maintain consistency between the specifications as published by ISO/IEC and by UPnP Implementers Corporation. The following table indicates the original UPnP document titles and the corresponding part of ISO/IEC 29341:

UPnP Document Title	ISO/IEC 29341 Part
UPnP Device Architecture 1.0	ISO/IEC 29341-1
UPnP Basic:1 Device	ISO/IEC 29341-2
UPnP AV Architecture:1	ISO/IEC 29341-3-1
UPnP MediaRenderer:1 Device	ISO/IEC 29341-3-2
UPnP MediaServer:1 Device	ISO/IEC 29341-3-3
UPnP AVTransport:1 Service	ISO/IEC 29341-3-10
UPnP ConnectionManager:1 Service	ISO/IEC 29341-3-11
UPnP ContentDirectory:1 Service	ISO/IEC 29341-3-12
UPnP RenderingControl:1 Service	ISO/IEC 29341-3-13
UPnP MediaRenderer:2 Device	ISO/IEC 29341-4-2
UPnP MediaServer:2 Device	ISO/IEC 29341-4-3
UPnP AV Datastructure Template:1	ISO/IEC 29341-4-4
UPnP AVTransport:2 Service	ISO/IEC 29341-4-10
UPnP ConnectionManager:2 Service	ISO/IEC 29341-4-11
UPnP ContentDirectory:2 Service	ISO/IEC 29341-4-12
UPnP RenderingControl:2 Service	ISO/IEC 29341-4-13
UPnP ScheduledRecording:1	ISO/IEC 29341-4-14
UPnP DigitalSecurityCamera:1 Device	ISO/IEC 29341-5-1
UPnP DigitalSecurityCameraMotionImage:1 Service	ISO/IEC 29341-5-10
UPnP DigitalSecurityCameraSettings:1 Service	ISO/IEC 29341-5-11
UPnP DigitalSecurityCameraStillImage:1 Service	ISO/IEC 29341-5-12
UPnP HVAC_System:1 Device	ISO/IEC 29341-6-1
UPnP HVAC_ZoneThermostat:1 Device	ISO/IEC 29341-6-2
UPnP ControlValve:1 Service	ISO/IEC 29341-6-10
UPnP HVAC_FanOperatingMode:1 Service	ISO/IEC 29341-6-11
UPnP FanSpeed:1 Service	ISO/IEC 29341-6-12
UPnP HouseStatus:1 Service	ISO/IEC 29341-6-13
UPnP HVAC_SetpointSchedule:1 Service	ISO/IEC 29341-6-14
UPnP TemperatureSensor:1 Service	ISO/IEC 29341-6-15
UPnP TemperatureSetpoint:1 Service	ISO/IEC 29341-6-16
UPnP HVAC_UserOperatingMode:1 Service	ISO/IEC 29341-6-17
UPnP BinaryLight:1 Device	ISO/IEC 29341-7-1
UPnP DimmableLight:1 Device	ISO/IEC 29341-7-2
UPnP Dimming:1 Service	ISO/IEC 29341-7-10
UPnP SwitchPower:1 Service	ISO/IEC 29341-7-11
UPnP InternetGatewayDevice:1 Device	ISO/IEC 29341-8-1
UPnP LANDevice:1 Device	ISO/IEC 29341-8-2
UPnP WANDevice:1 Device	ISO/IEC 29341-8-3
UPnP WANConnectionDevice:1 Device	ISO/IEC 29341-8-4
UPnP WLANAccessPointDevice:1 Device	ISO/IEC 29341-8-5
UPnP LANHostConfigManagement:1 Service	ISO/IEC 29341-8-10
UPnP Layer3Forwarding:1 Service	ISO/IEC 29341-8-11
UPnP LinkAuthentication:1 Service	ISO/IEC 29341-8-12
UPnP RadiusClient:1 Service	ISO/IEC 29341-8-13
UPnP WANCableLinkConfig:1 Service	ISO/IEC 29341-8-14
UPnP WANCommonInterfaceConfig:1 Service	ISO/IEC 29341-8-15
UPnP WANDSLLinkConfig:1 Service	ISO/IEC 29341-8-16
UPnP WANEthernetLinkConfig:1 Service	ISO/IEC 29341-8-17
UPnP WANIPConnection:1 Service	ISO/IEC 29341-8-18
UPnP WANPOTSLinkConfig:1 Service	ISO/IEC 29341-8-19
UPnP WANPPPConnection:1 Service	ISO/IEC 29341-8-20
UPnP WLANConfiguration:1 Service	ISO/IEC 29341-8-21
UPnP Printer:1 Device	ISO/IEC 29341-9-1
UPnP Scanner:1.0 Device	ISO/IEC 29341-9-2
UPnP ExternalActivity:1 Service	ISO/IEC 29341-9-10
UPnP Feeder:1.0 Service	ISO/IEC 29341-9-11
UPnP PrintBasic:1 Service	ISO/IEC 29341-9-12
UPnP Scan:1 Service	ISO/IEC 29341-9-13
UPnP QoS Architecture:1.0	ISO/IEC 29341-10-1
UPnP QoSDevice:1 Service	ISO/IEC 29341-10-10
UPnP QoSManager:1 Service	ISO/IEC 29341-10-11
UPnP QoSPolicyHolder:1 Service	ISO/IEC 29341-10-12
UPnP QoS Architecture:2	ISO/IEC 29341-11-1
UPnP QOS v2 Schema Files	ISO/IEC 29341-11-2

UPnP Document Title	ISO/IEC 29341 Part
UPnP QosDevice:2 Service	ISO/IEC 29341-11-10
UPnP QosManager:2 Service	ISO/IEC 29341-11-11
UPnP QosPolicyHolder:2 Service	ISO/IEC 29341-11-12
UPnP RemoteUIClientDevice:1 Device	ISO/IEC 29341-12-1
UPnP RemoteUIServerDevice:1 Device	ISO/IEC 29341-12-2
UPnP RemoteUIClient:1 Service	ISO/IEC 29341-12-10
UPnP RemoteUIServer:1 Service	ISO/IEC 29341-12-11
UPnP DeviceSecurity:1 Service	ISO/IEC 29341-13-10
UPnP SecurityConsole:1 Service	ISO/IEC 29341-13-11

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1. Overview and Scope

This service template is compliant with the UPnP Device Architecture version 1.0. It defines a service type referred to herein as Content Directory Service (CDS).

1.1. Introduction

Many devices within the home network contain various types of content that other devices would like to access (e.g. music, videos, still images, etc). As an example, a “Media Server” device might contain a significant portion of the homeowner’s audio, video, and still-image library. In order for the homeowner to enjoy this content, the homeowner must be able to browse the objects stored on the Media Server, select a specific one, and cause it to be “played” on an appropriate rendering device (e.g. an audio player for music objects, a TV for video content, an Electronic Picture Frame for still-images, etc).

For maximum convenience, it is highly desirable to allow the homeowner to initiate these operations from a variety of UI devices. In most cases, these UI devices will either be a UI built into the rendering device, or it will be a stand-alone UI device such as a wireless PDA or tablet. In any case, it is unlikely that the homeowner will interact directly with the device containing the content (i.e. the homeowner won’t have to walk over to the server device). In order to enable this capability, the service device needs to provide a uniform mechanism for UI devices to browse the content on the server and to obtain detailed information about individual content objects. This is the purpose of the Content Directory Service

The Content Directory Service additionally provides a lookup/storage service that allows clients (e.g. UI devices) to locate (and possibly store) individual objects (e.g. songs, movies, pictures, etc) that the (server) device is capable of providing. For example, this service can be used to enumerate a list of songs stored on an MP3 player, a list of still-images comprising various slide-shows, a list of movies stored in a DVD-Jukebox, a list of TV shows currently being broadcast (a.k.a an EPG), a list of songs stored in a CD-Jukebox, a list of programs stored on a PVR (Personal Video Recorder) device, etc. Nearly any type of content can be enumerated via this Content Directory service. For those devices that contain multiple types of content (e.g. MP3, MPEG2, JPEG, etc), a single instance of the Content Directory Service can be used to enumerate all objects, regardless of their type.

2. Service Modeling Definitions

2.1. Service Type

The following service type identifies a service that is compliant with this template:

urn:schemas-upnp-org:service:ContentDirectory:1

Content Directory Service (CDS) is used herein to refer to this service type.

2.2. References

This section lists the normative references used in this document and includes the tag inside square brackets that is used for each such reference:

[DEVICE] - UPnP Device Architecture, version 1.0.

[XML] - “Extensible Markup Language (XML) 1.0 (Second Edition)”, T. Bray, J. Paoli, C. M. Sperberg-McQueen, E. Maler, eds. W3C Recommendation, 6 October 2000. Available at: <http://www.w3.org/TR/2000/REC-xml-20001006>.

[EBNF] ISO/IEC 14977, *Information technology - Syntactic metalanguage - Extended BNF*, December 1996.

[DIDL] ISO/IEC CD 21000-2:2001, *Information Technology - Multimedia Framework - Part 2: Digital Item Declaration*, July 2001.

[RFC 2396] Tim Berners-Lee, et. al. *RFC 2396: Uniform Resource Identifiers (URI): Generic Syntax.* 1998. Available at: <http://www.ietf.org/rfc/rfc2396.txt>

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2.3. Terms

Table 1: Terms

Term	Description
object	Any data entity that can be returned by a Content Directory Service from a browsing or searching action. The Content Directory Service defines a class system to represent the different types of objects that are ‘managed’ by the CDS. The base class, from which all other classes are derived, is named object . The class object cannot be instantiated.
property	A property represents a CDS or client-defined characteristic of an object . The Content Directory Service expresses properties in XML as either elements or attributes. When expressed as an element, the property is addressed via its property/element tag name (including namespace other than DIDL-Lite) e.g. dc:title , upnp:class . When expressed as an attribute, the property is addressed with its parent expression, the @ delimiter and its property name e.g. res@size , res@protocolInfo , upnp:class@name . One exception is if the property is expressed as an attribute of an element which is a top-level object tag (item , container , etc.) in which case it is simply addressed with the @ delimiter and its property name e.g. @id , @parentID , @restricted , @childCount etc. Properties declared in this specification come from one of three metadata namespaces: DIDL-Lite, Dublin Core (dc) or UPnP (upnp). Their data types and meanings are defined in Annex B.
class	A class is used to assign a type to an object , and identifies the minimum required and optional set of properties that must be present on that object. Classes are organized in a hierarchy with certain classes being derived from others as in a typical object oriented system. At the root of the class hierarchy is the object base class. Examples are object.item.audioItem.musicTrack and object.container.album.musicAlbum . See section 2.4 for a definition of the format of the class specification for an object.
item	item is a first-level class derived directly from object . An item most often represents a single piece of AV data, such as a CD track, a movie or an audio file. Items may be playable, meaning they have information that can be played on a rendering device. Any object which derives from the item class is expressed via the DIDL-Lite item structure.
container	container is a first-level class derived directly from object . A container represents a collection of objects. Containers can represent the physical organization of objects (storage containers) or logical collections. Logical collections can have formal definitions of their contents or they can be arbitrary collections. Containers can be either homogeneous, containing objects that are all of the same class, or heterogeneous, containing objects of mixed class. Containers can contain other containers. Any object derived from the container class is expressed via the DIDL-Lite container structure. A CDS is required to maintain a ContainerUpdateID for each of its containers. This value is maintained internally, does not appear in any XML expression of the container, and cannot be used in a search or sort criterion.

Term	Description
container modification	<p>A container is considered modified when any of the following occurs:</p> <ul style="list-style-type: none"> A property of the container is added, removed or changed in value. A direct child element, whether object-derived or ordinary element, is added to or removed from the container. A direct, non-container-derived, child object has one of its properties or child elements added, removed or changed. A direct container-derived child element has one of its properties or non-object-derived child elements added, removed or changed. <p><i>Note to implementors: since ‘ContainerUpdateID’ is not a formal property of a container, a modification to a direct child container that affects that child’s ‘ContainerUpdateID’ does not propagate upward to the parent container.</i></p>
XML fragment	<p>In this document, XML fragment refers to a string that represents one element from a valid XML document. Individual uses of ‘XML fragment’ do not always specify the exact XML context that would be required to validate the fragment. If a “qualifying name” is given, the name defines the root element tag of the fragment. For example, ‘DIDL-Lite XML fragment’ means a string of the form “<DIDL-Lite ...>...</DIDL-Lite>”. In addition, any AV-defined XML fragment is permitted to be fully compliant XML. Any extraneous headers/tags should be gracefully ignored by the code processing the fragment.</p>
CDS	Content Directory Service
ContainerUpdateID	<p>An unsigned integer associated with each container. The integer value is incremented each time the container is modified (see the entry in this ‘Terms’ table for the precise definition of ‘container modification’). Upon reaching the value $2^{32}-1$, the next update rolls the value back to zero. Initial value of ContainerUpdateID for any newly created container is unspecified, but recommended to be zero. Implementers should maintain the same value for each container’s ContainerUpdateID through power cycles and any other disappearance/reappearance on the network.</p>

2.3.1. Notation: Strings Embedded in Other Strings

Some string variables and arguments described in this document contain substrings that must be independently identifiable and extractable for other processing. This requires the definition of appropriate substring delimiters and an escaping mechanism so that these delimiters can also appear as ordinary characters in the string and/or its independent substrings. This document uses embedded strings in two contexts—Comma Separated Value (CSV) lists (see Section 2.5.1.1 below) and property values in search criteria strings. Escaping conventions use the backslash character, ‘\’ (UTF-8 character code 0x5C), as follows:

- a. Backslash (‘\’) is represented as ‘\\’ in both contexts.
- b. Comma (‘,’) is
 1. represented as ‘\,’ in individual substring entries in CSV lists
 2. not escaped in search strings
- c. Double quote (‘”’) is
 1. not escaped in CSV lists
 2. not escaped in search strings when it appears as the start or end delimiter of a property value
 3. represented as ‘\”’ in search strings when it appears as a character that is part of the property value

2.3.2. Notation: Extended Backus-Naur Form

Extended Backus-Naur Form is used in this document for a formal syntax description of certain constructs. The usage here is according to the reference [EBNF].

Typographic conventions for EBNF

Symbol names in monospace font are non-terminal symbols. Character sequences between ‘single quotes’ are terminal strings and must appear literally in valid expressions. Character sequences between (*comment delimiters*) are English language definitions or supplementary explanations of their associated symbols. White space in the EBNF is used to separate elements of the EBNF, not to represent white space in search strings. White space usage in actual search strings is described explicitly in the EBNF. Finally, the EBNF uses the following four operators:

Operator	Semantics
::=	definition — the non-terminal symbol on the left is defined by one or more alternative sequences of terminals and/or non-terminals to its right.
	alternative separator — separates sequences on the right that are independently allowed definitions for the non-terminal on the left.
*	“null” repetition — means the expression to its left may occur zero or more times
+	“non-null” repetition — means the expression to its left must occur at least once and may occur more times

2.4. Class Hierarchy

The ContentDirectory service exposes a class hierarchy which is used to type all objects that can be retrieved from it. The ContentDirectory service exposes a class hierarchy which is used to type all objects that can be retrieved from it. Each class is named using a string of the form described in 2.4.1 below. Each class definition includes a list of properties. Some properties are required while others are optional. Some properties are ‘multi-valued’ for a class, meaning that, in an XML instance of the class, the property may occur more than once. A class that is derived from another class must include all the required properties of the base class. The definition of a subclass may make some optional properties of the base class required. Each property will be expressed in XML as either an XML Element or XML Attribute.

This section will describe three classes, **object**, **object.item** and **object.container** which make up the base hierarchy from which all other classes (UPnP- or vendor-defined) derive, see Annex C.

2.4.1. Class name syntax

Class name syntax is formally described using EBNF as described in section 2.3.2.

```

className ::= baseName | derivedName

baseName ::= 'object'

derivedName ::= ( baseName | derivedName ) '.' shortName

shortName ::= (* valid XML name, excluding the characters
               ‘.’ — UTF-8 code 0x2E and
               ‘.’ — UTF-8 code 0x3A *)

```