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Information technology – UPnP device architecture – Part 15-10: Content Synchronization Device Control Protocol – Synchronization Service

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Part 15-10: Content Synchronization Device Control Protocol – Synchronization Service

FOREWORD

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The list of all currently available parts of the ISO/IEC 29341 series, under the general title *Information technology – UPnP device 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.

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1 UPnP Forum Steering committee, UPnP Forum, 3855 SW 153rd Drive, Beaverton, Oregon 97006 USA. See also "Introduction".

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1 Overview and Scope

This service definition is compliant with the UPnP Device Architecture version *1.0*.

1.1 Introduction

Content Synchronization service enables two or more ContentDirectory services [CDS] to synchronize content with each other. This service also enables a UPnP control point to synchronize content with a ContentDirectory service. We refer this service as “CSS” or “ContentSync service” from hereon. If a CDS wants to support synchronization of objects and its resources with other CDSs, the implementation MUST enable this ContentSync service (CSS). CSS keeps change log as part of CDS object property that describe which CDS objects are added or modified or deleted since it has synchronized last. Since synchronization enables interaction between ContentSync services, each service has a Control Point (CP) functionality that invokes actions to other ContentSync service to achieve synchronization of contents with each other.

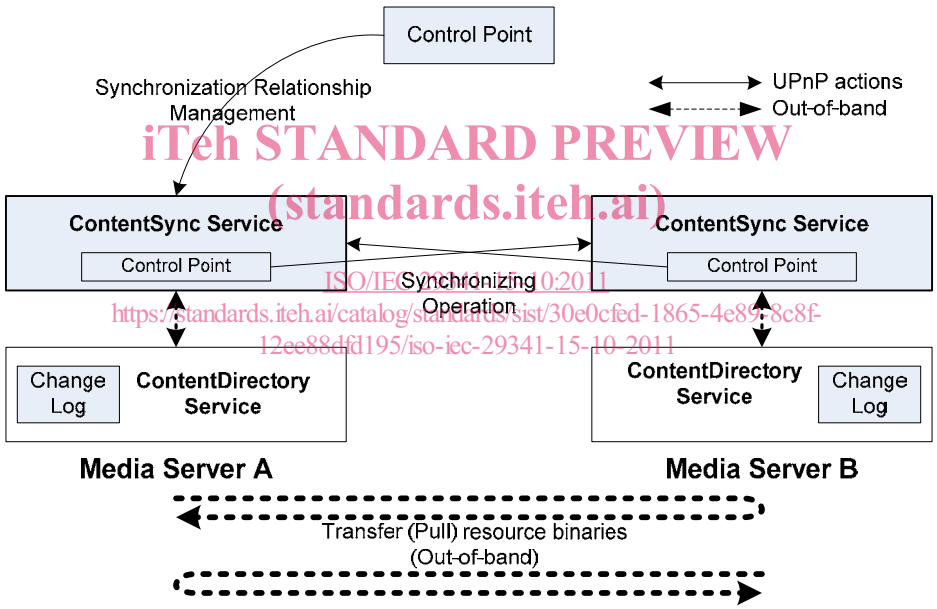

Figure 1 — Content Synchronization Model

Figure 1 shows how synchronization is accomplished between two CSSs. In the figure above, a stand alone control point is managing the synchronization between two CSSs. This includes management of content synchronization data structure (i.e., creating, browsing and deleting of synchronization data structure) and invocation of synchronization operation, etc. An embedded control point in the CSS has the role of performing the actual synchronization of objects which include retrieving the change log for objects that have changed, monitoring the status of the other CSS and updating the synchronization data structure when an object is successfully synchronized etc.

Figure 2 shows a high-level flow diagram of how Content Sync services, ContentDirectory services and Control Point interact with each other to achieve content synchronization..

Firstly, a stand-alone control point (controlled by a user) creates a synchronization relationship that describes which devices to participate in the synchronization, which objects

are to be synchronized, and how to resolve conflicts and so on. When the control point creates a synchronization relationship, it MUST be responsible to define valid information for the CSS. If the synchronization relationship is successfully created, the CDS implementation that supports CSS MUST keep track of change log of the objects that are subject to synchronization. When a synchronization relationship is created between two devices, identical synchronization data structure information is maintained in both devices.

Once a synchronization relationship is created, a stand-alone control point can trigger a synchronization operation on either of CSSs. If the CSS is ready to synchronize (i.e. successfully respond to the trigger from the stand-alone control point), the embedded control point in the CSS retrieves change log from the other partner device.

After obtaining the change log, the CSS parses and interprets the change log. The CSS then updates the CDS by retrieving object information from the partner device based on the change log and the rule defined in this specification. In this step, the CSS notifies the CSS of the partner device whenever an object in the change log is dealt with regardless of success or failure. If successful update for an object is notified, the CSS implementation MUST clear the change log for that object and the CDS must keep track of new change log since this last synchronization.

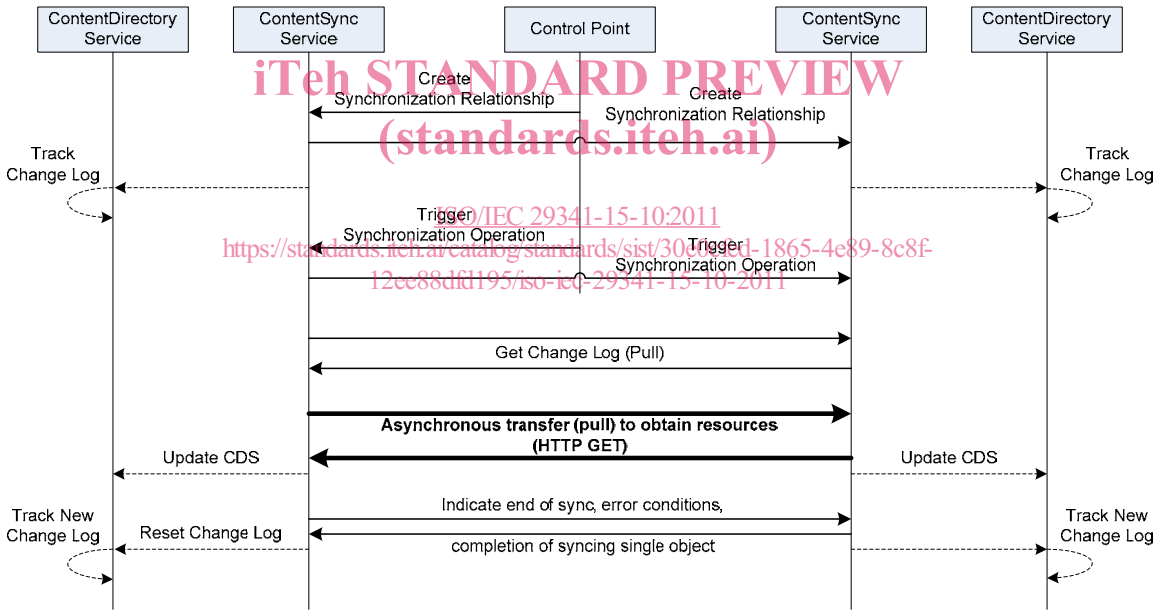

Figure 2 — High-level Synchronization Flow Diagram

The ContentSync service also provides a functionality by which a control point can only track changes of objects that the control point is interested in. This functionality is helpful for unidirectional synchronization. Figure 3 shows such a scenario. In this scenario, a control point with its own local storage (not compliant to CDS) can synchronize with a CDS by its own local policy. In other words, the control point does not follow any policies that are defined in this specification. The control point creates synchronization relationship information on a CDS with its interest for the CDS to track some objects. The CDS keeps change log for the objects the control point is interested. Therefore, an embedded control point in the CSS is disabled for this type of synchronization. Subclause 2.5 explains in details how this kind of unidirectional synchronization can be achived.

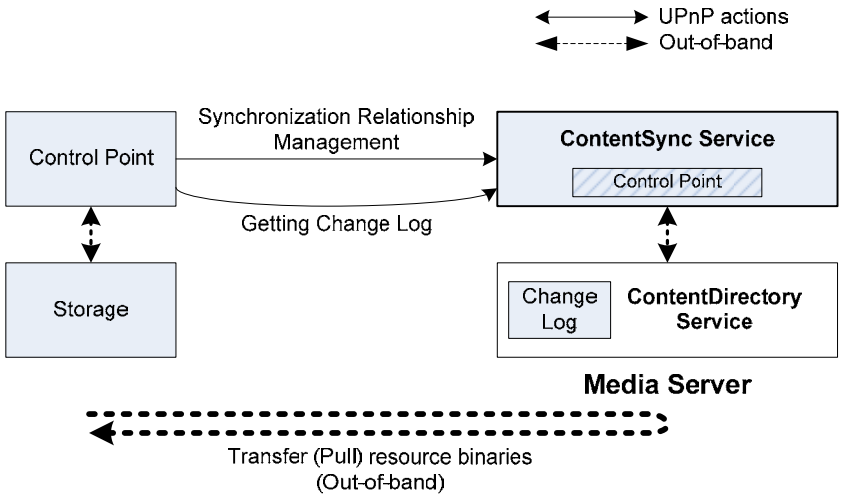

Figure 3 — Unidirectional Contents Synchronization

1.1.1 ContentSync Function

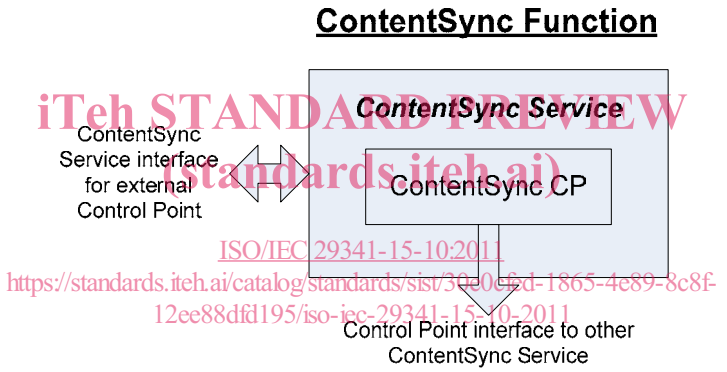

Figure 4 — ContentSync Function

The Content Sync function is an essential part of the Content Synchronization. This function is a combination of a ContentSync service and a Content Sync CP in a CSS as shown in Figure 4.

ContentSync Service:

ContentSync service is responsible for managing synchronization data structure and performing synchronization operation with a partner CSS.

ContentSync CP:

The ContentSync CP provides Control Point functionality that controls other ContentSync service running on the network.

The interface between the ContentSync CP and the ContentSync service is device-dependent and not defined by the UPnP ContentSync Service specifications.

1.1.2 Media Server Device and ContentDirectory Service

Since a ContentSync service provides the functionality to synchronize ContentDirectory service objects, ContentSync service implementation MUST appear together with ContentDirectory service implementation and MUST be also deployed on an UPnP Media Server device [MSD] that supports synchronization. Therefore, a Media Server

implementation MUST expose an XML device description document which contains description of both ContentSync service and ContentDirectory service when the Media Server implementation supports synchronization of CDS objects.

The following device type identifies a Media Server device that is compliant with this specification:

urn:schemas-upnp-org:device:*MediaServer:2*

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

urn:schemas-upnp-org:service:*ContentDirectory:2*

To enable synchronization of CDS objects, this specification imposes additional requirements on ContentDirectory:2 service specification. When supporting synchronization of CDS objects, these additional requirements MUST be implemented on top of ContentDirectory:2 service implementation. **See Annex A for the additional requirements on ContentDirectory:2 service specification (especially CDS properties of ContentDirectory:2 service).**

Additionally, since this specification adds extended properties to CDS, the AVCS XML schema [AVCS-XSD] for those properties is specified in this specification, not in UPnP AV. In other words, a CDS object expressed by original DIDL-Lite XML document MUST also refer to the AVCS XML schema when the new properties are added to the object. (The schema of the DIDL-Lite XML document does not have any reference to the AVCS XML schema). Note that the schema is informative only and hence the XML data types defined in this specification take precedence over all the XML schemas.

1.2 Notation

- In this document, features are described as Required, Recommended, or Optional as follows:

  The key words “MUST,” “MUST NOT,” “REQUIRED,” “SHALL,” “SHALL NOT,” “SHOULD,” “SHOULD NOT,” “RECOMMENDED,” “MAY,” and “OPTIONAL” in this specification are to be interpreted as described in [RFC 2119].

  In addition, the following keywords are used in this specification:

  PROHIBITED – The definition or behavior is an absolute prohibition of this specification. Opposite of REQUIRED.

  CONDITIONALLY REQUIRED – The definition or behavior depends on a condition. If the specified condition is met, then the definition or behavior is REQUIRED, otherwise it is PROHIBITED.

  CONDITIONALLY OPTIONAL – The definition or behavior depends on a condition. If the specified condition is met, then the definition or behavior is OPTIONAL, otherwise it is PROHIBITED.

  These keywords are thus capitalized when used to unambiguously specify requirements over protocol and application features and behavior that affect the interoperability and security of implementations. When these words are not capitalized, they are meant in their natural-language sense.
- Strings that are to be taken literally are enclosed in “double quotes”.
- Words that are emphasized are printed in *italic*.
- Keywords that are defined by the UPnP ContentSync and AV Working Committee are printed using the *forum* character style.
- Keywords that are defined by the UPnP Device Architecture are printed using the **arch** character style.
- A double colon delimiter, “::”, signifies a hierarchical parent-child (parent::child) relationship between the two objects separated by the double colon. This delimiter is used

in multiple contexts, for example: Service::Action(), Action()::Argument, parentProperty::childProperty.

1.2.1 Data Types

This specification uses data type definitions from two different sources. The UPnP Device Architecture defined data types are used to define state variable and action argument data types.

For UPnP Device Architecture defined Boolean data types, it is strongly RECOMMENDED to use the value "**0**" for false, and the value "**1**" for true. However, when used as input arguments, the values "**false**", "**no**", "**true**", "**yes**" may also be encountered and MUST be accepted. Nevertheless, it is strongly RECOMMENDED that all state variables and output arguments be represented as "**0**" and "**1**".

For XML Schema defined Boolean data types, it is strongly RECOMMENDED to use the value "*0*" for false, and the value "*1*" for true. However, when used as input properties, the values "*false*", "*true*" may also be encountered and MUST be accepted. Nevertheless, it is strongly RECOMMENDED that all properties be represented as "*0*" and "*1*".

1.3 Vendor-defined Extensions

Whenever vendors create additional vendor-defined state variables, actions or properties, their assigned names and XML representation MUST follow the naming conventions and XML rules as specified in [DEVICE].

1.4 Namespace for ContentSync Service

All data types represented by XML document in this specification MUST use the following namespaces and XML schemas. Note that this schema is informative only and hence the XML data types defined in this specification take precedence over the XML schema.

Table 1-1 — Namespace Definitions

Standard Name-space Prefix	Namespace Name	Namespace Description	Normative Definition Document Reference
cs:	urn:schemas-upnp-org:cs Reference: http://www.upnp.org/schemas/cs/cs-v1-2007xxxx.xsd	Common data types for use in ContentSync schema	[CSS-XSD]
avcs:	urn:schemas-upnp-org:cs:avcs Reference: http://www.upnp.org/schemas/cs/avcs-v1-2007xxxx.xsd	Metadata for UPnP AV CDS	[AVCS-XSD]

1.5 References

[RFC 2119] – IETF RFC 2119, Key words for use in RFCs to Indicate Requirement Levels, S. Bradner, 1997.

[RFC 4122] – IETF RFC 4122, A Universally Unique Identifier (UUID) URN Namespace, P. Leach, et. al., 2005.

[CDS] – *ContentDirectory:2*, UPnP Forum, May 31, 2006.

[DIDL-LITE-XSD] – XML Schema for ContentDirectory:2 Structure and Metadata (DIDL-Lite), UPnP Forum, May 31, 2006.

[CSS-XSD] – *XML Schema for ContentSync Service:1*, UPnP Forum, July 26, 2007.

[AVCS-XSD] – XML Schema for additional CDS Object Properties of ContentSync Service:1, UPnP Forum, July 26, 2007.

[DEVICE] – *UPnP Device Architecture, version 1.0*, UPnP Forum, June 13, 2000.

[XML] – *Extensible Markup Language (XML) 1.0 (Third Edition)*, François Yergeau, Tim Bray, Jean Paoli, C. M. Sperberg-McQueen, Eve Maler, eds., W3C Recommendation, February 4, 2004.

[XML SCHEMA-2] – *XML Schema Part 2: Data Types, Second Edition*, Paul V. Biron, Ashok Malhotra, W3C Recommendation, 28 October 2004.

[MSD] – *MediaServer:2*, UPnP Forum, May 31, 2006.

2 Service Modeling Definitions

2.1 ServiceType

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

urn:schemas-upnp-org:service:*ContentSync:1*.

2.2 Terms

2.2.1 Synchronization Object and Pair

A CDS object that is to be synchronized is called a synchronization object.

A synchronization pair represents a binding between a synchronization object in the local device and a synchronization object in the partner device. This binding information is stored in the *avcs:syncInfo* property of the synchronization objects. The *avcs:syncInfo* property for an object also keeps information related to which property or resource has been changed for that object since the object synchronized last with a remote object. This property MUST be updated whenever there is a change to that object. Therefore, any change to *avcs:syncInfo* property MUST not be perceived as object change. **See Annex A and Annex B for details on synchronization object property.** It is possible that an object that is new or yet to be synchronized does not have the corresponding remote object. In that case the remote object gets created in the partner device during the synchronization operation if specified by the policy. When creating a synchronization pair for an object, one of the three possible scenarios as shown in Figure 5 will occur.

- **Scenario 1:** an (local) object is paired with an existing remote object in the partner device.
- **Scenario 2:** the local object does not have a corresponding remote object in the partner device and the remote object gets created under an exsiting container object in the partner device which is designated by the control point. The existing container object here is called as *Remote Parent Object*.
- **Scenario 3:** This is similar to scenario 2, however the remote parent object under which the remote object will be created does not exist either and it gets created along with the remote object during the synchronization operation. In scenario 3, the remote parent object that will be created MUST be paired with the parent object of the local object which is called as *Virtual Remote Parent Object*.