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Information technology – UPnP device architecture – Part 3-1: Audio Video Device Control Protocol – Audio Video Architecture

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INFORMATION TECHNOLOGY – UPNP DEVICE ARCHITECTURE –

Part 3-1: Audio Video Device Control Protocol – Audio Video Architecture

FOREWORD

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International Standard ISO/IEC 29341-3-1 was prepared by UPnP Forum Steering committee[1], was adopted, under the fast track procedure, by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

This International Standard replaces ISO/IEC 29341-3-1, first edition, published in 2008, and constitutes a technical revision.

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".

1 Overview and Scope

1.1 Introduction

This document describes the overall UPnP AV Architecture, which forms the foundation for the UPnP AV Device and Service templates. The AV Architecture defines the general interaction between UPnP Control Points and UPnP AV devices. It is independent of any particular device type, content format, and transfer protocol. It supports a variety of devices such as TVs, VCRs, CD/DVD players/jukeboxes, settop boxes, stereos systems, MP3 players, still-image cameras, camcorders, electronic picture frames (EPFs), and the PC. The AV Architecture allows devices to support different types of formats for the entertainment content (such as MPEG2, MPEG4, JPEG, MP3, Windows Media Architecture (WMA), bitmaps (BMP), NTSC, PAL, ATSC, etc.) and multiple types of transfer protocols (such as IEC-61883/IEEE-1394, HTTP GET, RTP, HTTP PUT/POST, TCP/IP, etc.). The following clauses describe the AV Architecture and how the various UPnP AV devices and services work together to enable various end-user scenarios.

1.2 Goals

The UPnP AV Architecture was explicitly defined to meet the following goals:

- To support arbitrary transfer protocols and content formats.
- To enable the AV content to flow directly between devices without any intervention from the Control Point.
- To enable Control Points to remain independent of any particular transfer protocol and content format. This allows Control Points to transparently support new protocols and formats.
- Scalability, i.e. support of devices with very low resources, especially memory and processing power as well as full-featured devices.

1.3 Non-Goals

The UPnP AV Architecture does not enable any of the following:

- Two-way Interactive Communication, such as audio and video conferencing, Internet gaming, etc.
- Access Control, Content Protection, and Digital Rights Management
- Synchronized playback to multiple rendering devices

1.4 Notation

Table 1-1 — Default Short Names for the AV Specifications

AV Specification Name	Short Name
AVTransport	AVT
ConnectionManager	CM
ContentDirectory	CDS
MediaRenderer	MR
MediaServer	MS
RenderingControl	RCS
ScheduledRecording	SRS

1.5 References

This clause lists the normative references used in the UPnP AV specifications and includes the tag inside square brackets that is used for each such reference:

[AVT] – *AVTransport:2*, UPnP Forum, September 30, 2008. Available at: http://www.upnp.org/specs/av/UPnP-av-AVTransport-v2-Service-20080930.pdf. Latest version available at: http://www.upnp.org/specs/av/UPnP-av-AVTransport-v2-Service.pdf.

[CDS] – *ContentDirectory:3*, UPnP Forum, September 30, 2008. Available at: http://www.upnp.org/specs/av/UPnP-av-ContentDirectory-v3-Service-20080930.pdf. Latest version available at: http://www.upnp.org/specs/av/UPnP-av-ContentDirectory-v3-Service.pdf.

[CM] – *ConnectionManager:2*, UPnP Forum, September 30, 2008. Available at: http://www.upnp.org/specs/av/UPnP-av-ConnectionManager-v2-Service-20080930.pdf. Latest version available at: http://www.upnp.org/specs/av/UPnP-av-ConnectionManager-v2-Service.pdf.

[MR] – *MediaRenderer:2*, UPnP Forum, September 30, 2008. Available at: http://www.upnp.org/specs/av/UPnP-av-MediaRenderer-v2-Device-20080930.pdf. Latest version available at: http://www.upnp.org/specs/av /UPnP-av-MediaRenderer-v2-Device.pdf.

[MS] – *MediaServer:3*, UPnP Forum, September 30, 2008. Available at: http://www.upnp.org/specs/av/UPnP-av-MediaServer-v3-Device-20080930.pdf. Latest version available at: http://www.upnp.org/specs/av/UPnP-av-MediaServer-v3-Device.pdf.

[RCS] – *RenderingControl:2*, UPnP Forum, September 30, 2008. Available at: http://www.upnp.org/specs/av/UPnP-av-RenderingControl-v2-Service-20080930.pdf. Latest version available at: http://www.upnp.org/specs/av/UPnP-av-RenderingControl-v2-Service.pdf.

2 Architectural Overview

In most (non-AV) UPnP scenarios, a Control Point controls the operation of one or more UPnP devices in order to accomplish the desired behavior. Although the Control Point is managing multiple devices, all interactions occur in isolation between the Control Point and each device. The Control Point coordinates the operation of each device to achieve an overall, synchronized, end-user effect. The individual devices do not interact directly with each another. All of the coordination between the devices is performed by the Control Point and not the devices themselves.

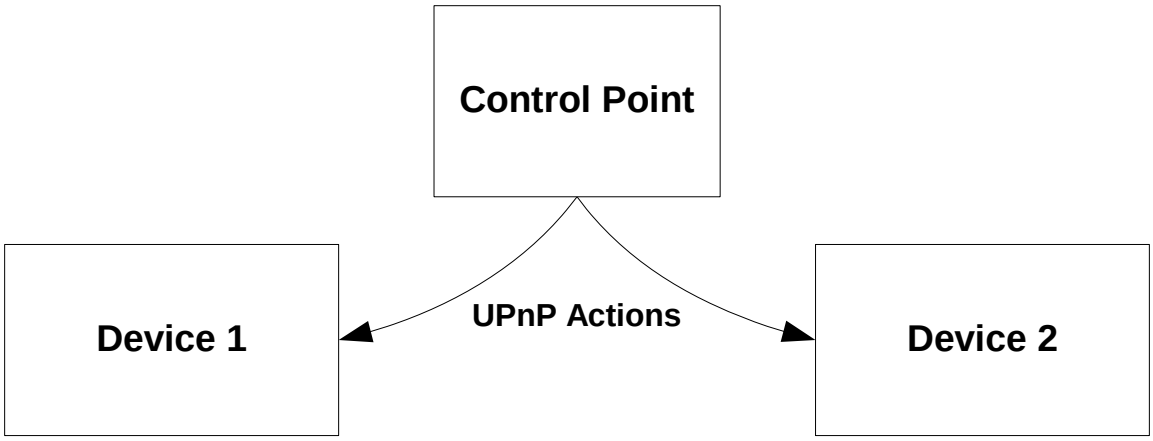

Figure 1 — Typical UPnP Device Interaction Model

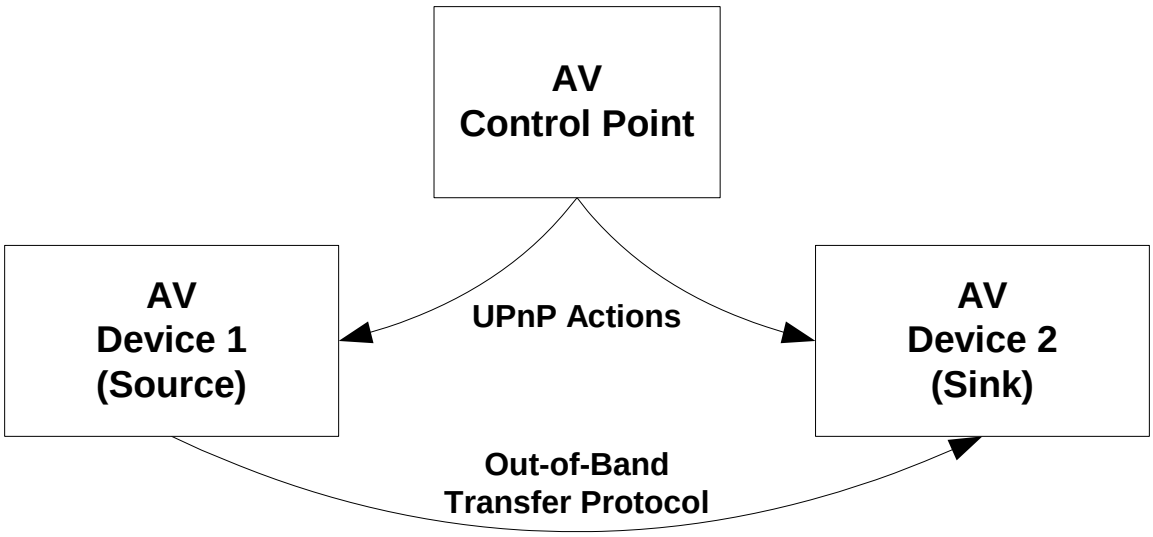

Figure 2 — UPnP AV Device Interaction Model

Most AV scenarios involve the flow of (entertainment) content (i.e. a movie, song, picture, etc.) from one device to another. As shown in Figure 2, an AV Control Point interacts with two or more UPnP devices acting as source and sink, respectively. Although the Control Point coordinates and synchronizes the behavior of both devices, the devices themselves interact with each other using a non-UPnP ("out-of-band") communication protocol. The Control Point uses UPnP to initialize and configure both devices so that the desired content is transferred from one device to the other. However, since the content is transferred using an "out-of-band" transfer protocol, the Control Point is not directly involved in the actual transfer of the content. The Control Point configures the devices as needed, triggers the flow of content, then gets out of the way. Thus, after the transfer has begun, the Control Point can be disconnected without disrupting the flow of content. In other words, the core task (i.e. transferring the content) continues to function even without the Control Point present.

As described in the above scenario, three distinct entities are involved: the Control Point, the source of the media content (called the "MediaServer"), and the sink for the content (called the "MediaRenderer"). Throughout the remainder of the document, all three entities are described as if they were independent devices on the network. Although this configuration may be common (i.e. a remote control, a VCR, and a TV), the AV Architecture supports arbitrary combinations of these entities within a single physical device. For example, a TV can be treated as a rendering device (e.g. a display). However, since most TVs contain a built-in tuner, the TV can also act as a server device because it could tune to a particular channel and send that content to a MediaRenderer [MR] (e.g. its local display or some remote device such as a tuner-less display). Similarly, many MediaServers and/or MediaRenderers may also include Control Point functionality. For example, an MP3 Renderer will likely have some UI controls (e.g. a small display and some buttons) that allow the user to control the playback of music.

3 Playback Architecture

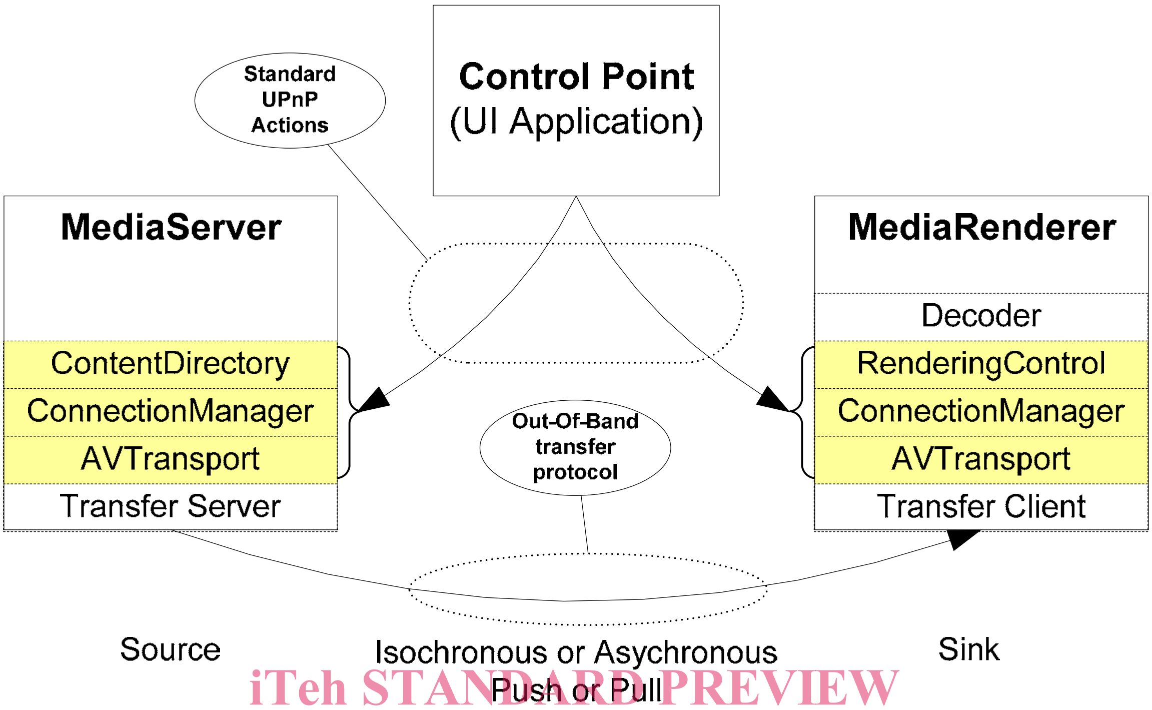

Figure 3 — General Device Architecture aka the 3-Box model

The most common task that end-users want to perform is to render (i.e. play) individual items of content on a specific rendering device. As shown in Figure 3, the content playback scenario involves three distinct UPnP components: a MediaServer [MS], a MediaRenderer, and a UPnP Control Point. These three components (each with a well-defined role) work together to accomplish the task. In this scenario, the MediaServer contains (entertainment) content that the user wants to render (e.g. display or listen to) on the MediaRenderer. The user interacts with the Control Point's UI to locate and select the desired content on the MediaServer and to select the target MediaRenderer.

The MediaServer contains or has access to a variety of entertainment content, either stored locally or stored on an external device that is accessible via the MediaServer. The MediaServer is able to access its content and transmit it to another device via the network using some type of transfer protocol. The content exposed by the MediaServer may include arbitrary types of content including video, audio, and/or still images. The content is transmitted over the network using a transfer protocol and data format that is that is understood by the MediaServer and MediaRenderer. MediaServers may support one or multiple transfer protocols and data formats for each content item or be able to convert the format of a given content item into another formats on the fly. Examples of a MediaServer include a VCR, CD/DVD player/jukebox, camera, camcorder, PC, set-top box, satellite receiver, audio tape player, etc.

The MediaRenderer obtains content from a MediaServer via network. Examples of a MediaRenderer include TV, stereo, network-enabled speakers, MP3 players, Electronic Picture Frame (EPF), a music-controlled water fountain, etc.. The type of content that a MediaRenderer can receive depends on the transfer protocols and data formats that it supports. Some MediaRenderers may only support one type of content (e.g. audio or still images), where as other MediaRenderers may support a wide variety of content including video, audio, still images.

The Control Point coordinates and manages the operation of the MediaServer and MediaRenderer as directed by the user (e.g. play, stop, pause) in order to accomplish the desired task (e.g. play “MyFavorite” music). Additionally, the Control Point provides the UI (if any) for the user to interact with in order to control the operation of the device(s) (e.g. to select the desired content). The layout of the Control Point’s UI and the functionality that it exposes is implementation dependent and determined solely by the Control Point’s manufacturer. Some examples of a Control Point might include a TV with a traditional remote control or a wireless PDA-like device with a small display.

Note: The above descriptions talk about devices “sending/receiving content to/from the home network.” In the context of the AV Architecture, this includes point-to-point connections such as an RCA cable that is used to connect a VCR to a TV. The AV Architecture treats this type of connection as a small part (e.g. segment) of the home network. Refer to the ConnectionManager Service [CM] for more details.

As described above, the AV Architecture consists of three distinct components that perform well-defined roles. In some cases, these components will exist as separate, individual UPnP devices. However, this need not be the case. Device manufacturers are free to combine any of these logical entities into a single physical device. In such cases, the individual components of these combo devices may interact with each other using either the standard UPnP control protocols (e.g. SOAP over HTTP) or using some private communication mechanism. In either case, the function of each logical entity remains unchanged. However, in the later case, since the communication between the logical entities is private, the individual components will not be able to communicate with other UPnP AV devices that do not implement the private protocol.

As shown in Figure 3, the Control Point is the only component that initiates UPnP actions. The Control Point requests to configure the MediaServer and MediaRenderer so that the desired content flows from the MediaServer to the MediaRenderer (using one of the transfer protocols and data formats that are supported by both the MediaServer and MediaRenderer). The MediaServer and MediaRenderer do invoke any UPnP actions to the Control Point. However, if needed, the MediaServer and/or MediaRenderer may send event notifications to the Control Point in order to inform the Control Point of a change in the MediaServer’s/MediaRenderer’s internal state.

The MediaServer and MediaRenderer do not control each other via UPnP actions. However, in order to transfer the content, the MediaServer and MediaRenderer use an “out-of-band” (e.g. a non-UPnP) transfer protocol to directly transmit the content. The Control Point is not involved in the actual transfer of the content. It simply configures the MediaServer and MediaRenderer as needed and initiates the transfer of the content. Once the transfer begins, the Control Point “gets out of the way” and is no longer needed to complete the transfer.

However, if desired by the user, the Control Point is capable of controlling the flow of the content by invoking various AVTransport actions such as Stop, Pause, FF, REW, Skip, Scan, etc. Additionally, the Control Point is also able to control the various rendering characteristics on the Renderer device such as Brightness, Contrast, Volume, Balance, etc.

3.1 Media Server

The MediaServer is used to locate content that is available via the home network. MediaServers include a wide variety of devices including VCRs, DVD players, satellite/cable receivers, TV tuners, radio tuners, CD players, audio tape players, MP3 players, PCs, etc. A MediaServer’s primary purpose is to allow Control Points to enumerate (i.e. browse or search for) content items that are available for the user to render. The MediaServer contains a ContentDirectory Service [CDS], a ConnectionManager Service [CM], and an optional AVTransport Service [AVT] (depending on the supported transfer protocols).

Some MediaServers are capable of transferring multiple content items at the same time, e.g. a hard-disk-based audio jukebox may be able to simultaneously stream multiple audio files to the network. In order to support this type of MediaServer, the ConnectionManager assigns a