

OpenCable™ Specification

Home Networking Protocol

OC-SP-HNP-I01-060630

ISSUED

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Contents

1	SCOPE	1
1.1	Introduction and Overview.....	1
1.2	Purpose of document.....	1
1.3	Requirements.....	1
2	REFERENCES	2
2.1	Normative References	2
2.2	Informative References	3
2.3	Reference Acquisition	6
3	TERMS AND DEFINITIONS	8
4	ABBREVIATIONS AND ACRONYMS	9
5	TECHNICAL REQUIREMENTS	10
5.1	UPnP Protocol	10
5.2	Device Discovery and Control	11
5.3	Content Formats	12
5.4	Quality of Service (QoS).....	13
5.5	Content Protection.....	13
5.6	UPnP Interoperability.....	13
6	UPNP MAPPING REQUIREMENTS	15
6.1	Device Registry	15
6.2	Package Org.ocap.hn	15
6.2.1	<i>ContentManagementModule interface</i>	15
6.2.2	<i>RemoteMediaStorage interface</i>	18
6.2.3	<i>RemoteNetModule interface</i>	18
6.2.4	<i>RemoteRecordingManager interface</i>	18
6.2.5	<i>RemoteRecordingResourceUsage interface</i>	18
6.2.6	<i>RemoteResourceUsage interface</i>	18
6.2.7	<i>RemoteTimeShiftManager interface</i>	18
6.2.8	<i>RemoteTimeShiftResourceUsage interface</i>	18
6.2.9	<i>HomeNetPermission class</i>	18
6.2.10	<i>NetActionEvent class</i>	18
6.2.11	<i>NetManager class</i>	18
6.2.12	<i>NetModuleChangeEvent class</i>	18
6.2.13	<i>NetModuleEvent class</i>	18
6.2.14	<i>PropertyFilter class</i>	19
6.3	Package Org.ocap.hn.content	19
6.3.2	<i>ContentContainer class</i>	20
6.3.3	<i>ContentDatabase class</i>	20
6.3.4	<i>ContentItem class</i>	20
6.3.5	<i>ContentListEvent class</i>	20
6.3.6	<i>ContentResource class</i>	21
6.3.7	<i>MetadataNode class</i>	21
6.3.8	<i>RecordingContentItem class</i>	21
6.4	Package Org.ocap.hn.content.navigation	21
6.4.1	<i>ContentDatabaseFilter class</i>	21
6.4.2	<i>ContentList class</i>	21
6.4.3	<i>DatabaseQuery class</i>	21

6.4.4	<i>DeviceFilter class</i>	21
6.5	Package <i>Org.ocap.hn.profile.upnp</i>	21
6.5.1	<i>UPnPConstants interface</i>	21
6.6	Package <i>Org.ocap.hn.service</i>	25
6.6.1	<i>RemoteService interface</i>	25
7	DLNA VERSION 1.0 DEVICE INTEROPERABILITY REQUIREMENTS	26
7.1	Network and Connectivity Requirements	26
7.2	Device Discovery and Control Requirements	26
7.3	Media Management Requirements	28
7.4	Media Interoperability Requirements	30
7.5	Mandatory Audio Media Class Profile Requirements	30
7.6	Image Media Class Requirements	30
7.7	AV Media Class Formatting Requirements	31
7.8	HTTP Media Transport Requirements	32
ANNEX A	XML DOCUMENTS (NORMATIVE)	34
A.1	Device Description	34
APPENDIX I	ACKNOWLEDGEMENTS	36

Figures

Figure 1	– OCAP Home Networking Framework for UPnP	10
Figure 2	– UPnP Device Architecture Protocol Stack	11
Figure 3	– Signal Flow Example	14

Tables

Table 1	– Mandatory Media Formats	13
Table 2	– TransferStatus Return Values	16
Table 3	– Errors Returned by geActionStatus	16

1 SCOPE

1.1 Introduction and Overview

The OpenCable Home Networking Protocol defines a profile based on the Host 2.0 Home Networking Extension [HOSTHN] and the OCAP Home Networking Extension [OCAPHN] specifications. This profile is independent of the physical network implementation, but runs over Internet Protocol (IP). It is designed to provide interoperability between OpenCable devices and a common protocol layer on a home network.

The UPnP protocol layer mapping is defined in Section 5. Alternative protocol layers may be added as sequential sections beginning with a new section following Section 7.

1.2 Purpose of document

This specification defines minimum technical requirements and additional features that must be implemented in order to provide a mapping to a protocol layer service over a home network.

1.3 Requirements

Throughout this document, the words that are used to define the significance of particular requirements are capitalized. These words are:

"SHALL"	This word means that the item is an absolute requirement of this specification.
"SHALL NOT"	This phrase means that the item is an absolute prohibition of this specification.
"SHOULD"	This word means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
"SHOULD NOT"	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
"MAY"	This word means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

2 REFERENCES

2.1 Normative References

In order to claim compliance with this specification, it is necessary to conform to the following standards and other works as indicated, in addition to the other requirements of this specification. Notwithstanding, intellectual property rights may be required to use or implement such normative references.

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- Cable Television Laboratories, Inc., 858 Coal Creek Circle, Louisville, CO 80027; Phone 303-661-9100; Fax 303-661-9199; Internet: <http://www.cablelabs.com/>
- CEA, Consumer Electronics Association, <http://global.ihs.com/>
- Digital Living Networking (DLNA), Internet: <http://www.dlna.org/home>
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- International Organization for Standardization (ISO/IEC) Internet: <http://www.iso.org/iso/en/prods-services/ISOstore/store.html>
- International Telecommunication Union (ITU), Internet: <http://www.itu.int/home/index.html>
- Internet Engineering Task Force (IETF), Internet: <http://www.ietf.org>
- Japanese Electronics and Information Technologies Association (JEITA), Internet: <http://www.jeita.or.jp/english/>
- Society of Cable Telecommunication Engineers (SCTE), Internet: <http://www.scte.org/standards>
- UpnP, Internet: <http://www.upnp.org/>
- Wi-Fi Alliance, Internet: www.wi-fi.org
- World Wide Web Consortium (W3C), Internet: www.w3.org

3 TERMS AND DEFINITIONS

This specification uses the following terms:

HNIMP A device that provides a network interface compliant with the Home Networking Interface Mapping Protocol (this specification)

4 ABBREVIATIONS AND ACRONYMS

This specification uses the following abbreviations and acronyms.

CA	Conditional Access
CCI	Copy Control Information
CCIF	CableCARD Interface
CMS	ConnectionManager Service
DIDL-L	Digital Item Declaration Language – Lite
DMS	Digital Media Server
EDN	Event Detection and Notification
GENA	General Event Notification Architecture
HOSTHN	OpenCable Host 2.0 Home Networking Extension
HN Host	Home Networking Host
HTTP	Hypertext Transfer Protocol
IFO	InFOrmation (file extension format for DVD burning)
JMF	Java Media Framework
JPEG	Joint Photographic Experts Group
LPCM	Linear Pulse Code Modulation
MPEG	Moving Picture Experts Group
OCAP	OpenCable Application Platform
OCAPHN	OCAP Home Networking Extension
PNG	Portable Network Graphics
SOAP	Simple Object Access Protocol
SSDP	Simple Service Discovery Protocol
TSB	Time Shift Buffer
UPnP	Universal Plug-n-Play
URI	Uniform Resource Identifier
UTF-8	Universal Transformation Format - 8
XML	eXtensible Markup Language

5 TECHNICAL REQUIREMENTS

5.1 UPnP Protocol

Figure 1 shows an overview of the various layers that make up the OpenCable Home Networking Architecture. The OCAP HN APIs provide a high level abstraction of functionality that is independent of the underlying transport and network protocols and specific physical layer mechanism. The OpenCable HN Architecture maps the OCAP HN APIs to the UPnP Device Architecture/ UPnP AV Architecture in order to provide device discovery and control, media management and media transport functions. The UPnP Architecture itself is built on the standard TCP/UDP over IPv4 suite of protocols. 10Mbps/100Mbps Ethernet and 802.11a/b/g provide the physical communication layer.

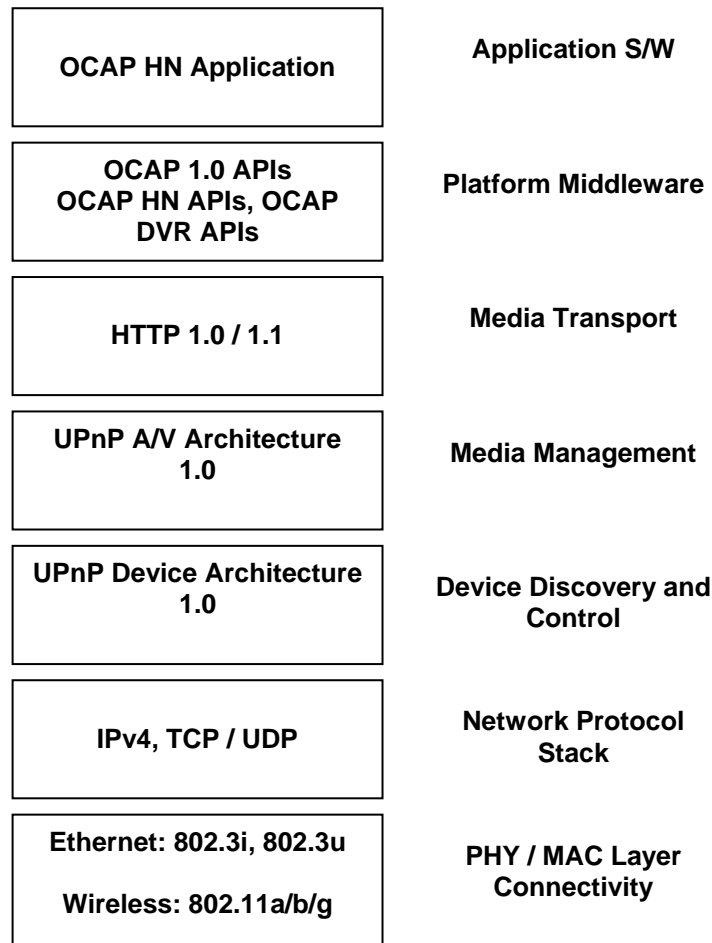


Figure 1 – OCAP Home Networking Framework for UPnP

Figure 2 shows the UPnP Device architecture stack in more detail

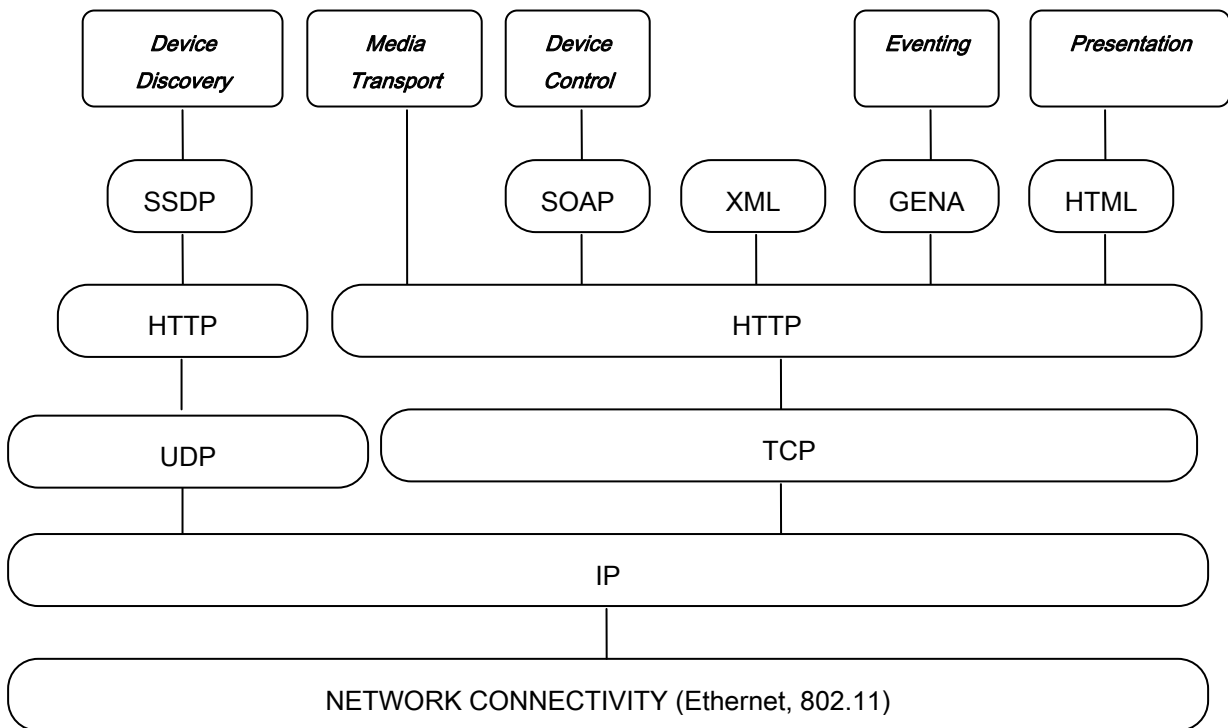


Figure 2 – UPnP Device Architecture Protocol Stack

5.2 Device Discovery and Control

The Home Networking Interface Mapping Protocol (HNIMP) SHALL provide an implementation of the UPnP AV Architecture as defined in [UPNPAVA] for management of content on the LAN.

The HNIMP SHALL provide an implementation of the UPnP Device Architecture as defined in [UPNPDA].

The HNIMP SHALL provide an implementation of a UPnP MediaRenderer Device as defined in [UPNPMR].

The HNIMP SHALL provide an implementation of a UPnP MediaServer Device as defined in [UPNPMS].

The HNIMP SHALL implement the AVTransport:1.0 Service Type along with the required Service Types as defined in [UPNPAVTS].

The HNIMP SHALL provide an implementation of a UPnP Control Point as defined in [UPNPDA] for discovery and control of UPnP devices on the LAN.

The RenderingControl Service of the HNIMP SHALL implement the following State Variables along with the required State Variables defined in [UPNPMR]:

- Mute
- Volume

The RenderingControl Service of the HNIMP SHALL implement the following Actions along with the required Actions defined in [UPNPMR]:

- GetMute
- SetMute
- GetVolume
- SetVolume

The ConnectionManager Service of the HNIMP SHALL implement the following Actions along with the required Actions defined in [UPNPCMS]:

- PrepareForConnection
- ConnectionComplete

The HNIMP SHALL support the http-get protocol as defined and constrained in [DLNA] section 7.8.

OCAP HN devices SHALL employ the <ocap:X_OCAPHN> XML element inside the <device> element of the device description document to indicate adherence to a particular OCAP Home Networking Protocol document version. The value of this element is the DLNA device class, a dash character, followed by the numeric version value of the Interoperability Guidelines document. The <ocap:X_OCAPHN > element indicates compliance for a specific <device>, excluding its embedded devices listed in <deviceList>. An example of <ocap:X_OCAPHN > element is shown as follows:

```
<ocap:X_OCAPHN xmlns:ocap="urn:schemas-cablelabs-com:device-1-0">DMS-1.0</ocap:X_OCAPHN>
```

The "urn:schemas-cablelabs-com:device-1-0" namespace must be specified for the <ocap:X_OCAPHN > element and the namespace prefix must be "ocap:". The namespace prefix declaration may be specified in the <root> element of the device description. The value of the <ocap:X_OCAPHN > element is a string as defined below. Linear white spaces (LWS) are not implied in this definition below.

```
ocaphn-value = ocaphn-dev-class "-" ocaphn-version
ocaphn-dev-class = "DMS" | "DMR" (DMS = Digital Media Server, DMR = Digital Media Renderer)
ocaphn-version = major-version "." minor-version
major-version = DIGIT
minor-version = DIGIT
```

5.3 Content Formats

The HNIMP SHALL support the rendering of content formats as specified in [OCAP]. This includes both broadcast streaming and monomedia-based content formats. Additionally, the HNIMP SHALL support the mandatory DLNA media formats as described in Sections 7.4 through 7.7 of this document. The required formats are described in Table 5.3.

Table 1 – Mandatory Media Formats

Media Type	OCAP	DLNA
Images	JPEG, PNG, GIF	JPEG_SM max resolution 640 x 480
Video	MPEG-2 TS according to SCTE 43	MPEG_PS_NTSC (MPEG-2 PS)
Monomedia Audio	MPEG-1 layer 1, 2 & 3; Dolby AC-3	LPCM
Broadcast Streaming Audio	Dolby AC-3	LPCM

5.4 Quality of Service (QoS)

The current version of [HOSTHN] only supports Quality of Service at a Best Effort level. Later versions of this specification will address higher levels such as prioritized and parameterized QoS as specified by UPnP QoS 1.0 and later versions.

5.5 Content Protection

The current version of [HOSTHN] only allows for discovery and rendering of personal content and prohibits the transport of cable-delivered content, including recorded cable services, on the LAN regardless of the state of copy protection applied to the content. Later versions of the specification will address the issue of cable content on the LAN.

The HNIMP SHALL NOT act as a MediaServer [UPNPMS] with respect to content delivered over the cable plant.

5.6 UPnP Interoperability

The HNIMP SHALL comply with UPnP interoperability guidelines as specified in [UPNPDA].

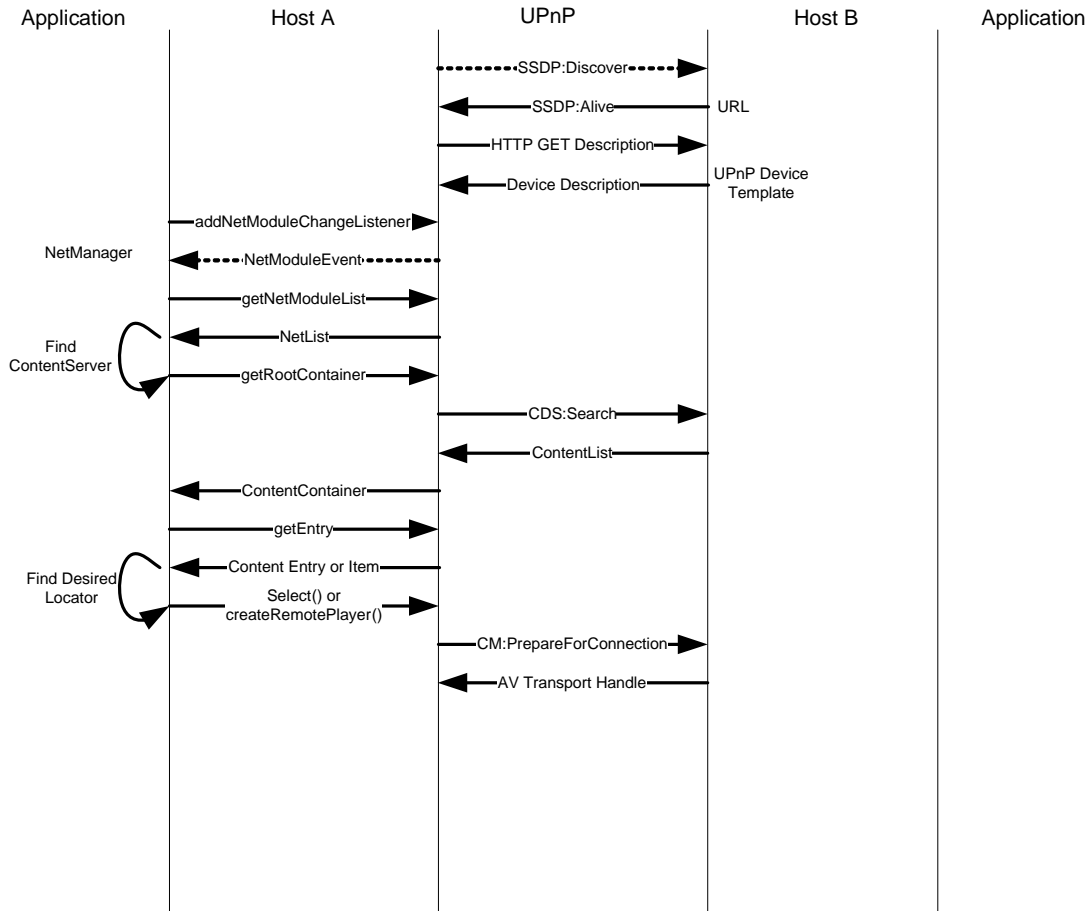


Figure 3 – Signal Flow Example

6 UPNP MAPPING REQUIREMENTS

OCAP Home Networking Extension-compliant devices, [OCAPHN], implementing the UPnP protocol SHALL map OCAP Home Networking API methods to UPnP actions, per this section. Some of the functionality of UPnP that is anticipated to be used in an OpenCable home network is not required in this version: in particular, *RemoteTimeShiftBuffer*, *RemoteRecordingManager*, and *RemoteStorageManager*. These interfaces will remain in the API, but will not be supported in the current version of the Home Networking Protocol Specification. Implementations will not enumerate them in *NetModule*.

6.1 Device Registry

OCAP Home Networking Extension-compliant devices, [OCAPHN], implementing the UPnP protocol SHALL maintain a current list of devices and services based on received UPnP device available and device unavailable messages as specified in [UPNPDA] section 1.

6.2 Package Org.ocap.hn

6.2.1 ContentManagementModule interface

6.2.1.1 *copy method*

There are two cases that affect UPnP action mapping to this method:

- When the device is the destination, this method SHALL use the [UPNPCDS] ImportResource action.
- When the device is the source, this method SHALL use the [UPNPCDS] ExportResource action.

In addition to the throws clauses defined in the javadoc of this method, this method will throw `SecurityException` if any "access denied" or "restricted parent object" UPnP error is incurred, and `IllegalArgumentException` if any other UPnP error is incurred.

In this profile the copy method does not support content transfers where neither the source nor the destination is the device where the method is called.

6.2.1.2 *move method*

This is the same as the copy method, except the content SHALL be deleted from the source once the copy has completed successfully. See the following delete method.

6.2.1.3 *delete method*

First, the `DestroyObject` SHALL be used. If the locator for the content is an entire OCAP service, the service is deleted, using the [UPNPCDS] `DeleteResource`. In this case, all of the content and metadata associated with the OCAP service are deleted.

6.2.1.4 *ContentServer*

6.2.1.5 *getRootContainer*

The `getRootContainer` method SHALL use the `ContentDirectory` service `Browse` action with the following argument settings:

- ObjectID set to 0,
- BrowseFlag set to BrowseMetadata,
- StartingIndex set to 0,
- RequestedCount set to 0,
- SortCriteria set to ""

6.2.1.6 *NetActionEvent*

6.2.1.6.1 *getActionStatus method*

The *getActionStatus* method SHALL use the [UPNPCDS] *GetTransferProgress* action. Values of the action argument *TransferStatus* SHALL be mapped to values returned by this method according to the following table:

Table 2 - TransferStatus Return Values

TransferStatus value	Value returned by <i>getActionStatus</i>
IN_PROGRESS	ACTION_NEEDS_MORE_TIME
STOPPED	ACTION_CANCELLED
ERROR	ACTION_FAILED
COMPLETED	ACTION_COMPLETED

6.2.1.6.2 *getError*

When the *getActionStatus* method returns ACTION_FAILED, the *getActionStatus* method returns an error value that is mapped to UPnP error codes indicated by the following table:

Table 3 – Errors Returned by *geActionStatus*

Error code values returned in UPnP message	Value returned by <i>getResponse</i>
402, 701, 710, 714, 718	ERROR_INVALID_PARAMETER
501, 716, 720	ERROR_TIMED_OUT
711, 713, 715, 719	ERROR_UNAUTHORIZED
708, 709	ERROR_INVALID_CRITERIA

6.2.1.7 *NetActionRequest*

6.2.1.7.1 *cancel method*

The *cancel* method SHALL use the [UPNPCDS] *StopTransferResource* action. If any UPnP errors are encountered, this method SHALL return false.

6.2.1.7.2 *getActionStatus method*

The *getActionStatus* method SHALL use the [UPNPCDS] *GetTransferProgress* action as defined by Section 6.2.1.6.1 for *NetActionEvent*.

6.2.1.7.3 *getProgress method*

The `getProgress` method SHALL use the [UPNPCDS] `GetTransferProgress` action as defined by Section 6.2.1.6.1 for `NetActionEvent`. In addition, the value returned SHALL be determined by the following statement:

```

If the GetTransferProgress action TransferTotal or TransferLength
arguments are indeterminate, or if any UPnP errors are encountered
    Return -1.0
Else If (TransferTotal - TransferLength) > 0
    Return ((TransferTotal - TransferLength) / TransferTotal) rounded to one
    decimal place
Else
    Return 1.0

```

6.2.1.8 *RemoteMediaRendererModule interface*

6.2.1.8.1 *createRemotePlayer method*

Content rendering using the UPnP AV service allows a UPnP Control Point to control the streaming playback of content from a Server to a content Renderer. The `createRemotePlayer` method establishes a means of accessing a UPnP Control Point (associated with the local device), which in turn establishes communications with a local or networked server (as determined by the locator passed to the method) and a local or networked Renderer (implicitly associated with the object associated with the method). Prior to returning a JMF player, the UPnP Control Point must perform the necessary UPnP Connection Manager functions:

- a) Server - Renderer Negotiations (`ConnectionManager::GetProtocolInfo()`)
 - Get capabilities
 - Negotiation of delivery protocol
 - Negotiation of content format / options
- b) Prepare for Connection (`ConnectionManager::Prepare for Connection()`)
 - Instantiate resources
 - Register QoS (if available)
 - Verify access permissions
 - Get AV Transport handle from server (push) or renderer (pull)

Once the connection has been established, the JMF player will provide an interface to connection manager functions (for connection status), AV Transport playback control (e.g., fast forward, rewind) and rendering control (e.g., mute, volume). When the player is released, the control point implementation is responsible for closing the connection (`ConnectionManager::ConnectionComplete()`).

Supported JMF player controls will vary widely from renderer to renderer. A simple audio device, for example, may only support the `GainControl` object and associated methods. More sophisticated AV renderers may support trick-play (`setRate()`). A complete list of supported JMF controls supported by a given module are provided player's `getControls()` method.

6.2.1.8.2 *getSupportedMimeTypes method*

This method provides an interface for determining what mime types the renderer supports. The mime types supported will be determined using the UPnP Media Renderer's `ConnectionManager::GetProtocolInfo()` action.

6.2.1.8.3 *isSupportedMimeType* method

The *isSupportedMimeTypes* method provides an interface for determining if the associated renderer supports a given mime type. The mime type passed will be compared against supported format types obtained using the UPnP Media Renderer's `ConnectionManager::GetProtocolInfo()` action.

6.2.2 **RemoteMediaStorage** interface

No UPnP mapping defined.

6.2.3 **RemoteNetModule** interface

No UPnP mapping defined.

6.2.4 **RemoteRecordingManager** interface

No UPnP mapping defined.

6.2.5 **RemoteRecordingResourceUsage** interface

No UPnP mapping defined.

6.2.6 **RemoteResourceUsage** interface

No UPnP mapping defined.

6.2.7 **RemoteTimeShiftManager** interface

No UPnP mapping defined.

6.2.8 **RemoteTimeShiftResourceUsage** interface

No UPnP mapping defined.

6.2.9 **HomeNetPermission** class

No UPnP mapping defined.

6.2.10 **NetActionEvent** class

No UPnP mapping defined.

6.2.11 **NetManager** class

No UPnP mapping defined.

6.2.12 **NetModuleChangeEvent** class

No UPnP mapping defined.

6.2.13 **NetModuleEvent** class

No UPnP mapping defined.

6.2.14 PropertyFilter class

No UPnP mapping defined.

6.3 Package Org.ocap.hn.content

6.3.1.1 AudioResource Interface

6.3.1.1.1 getSampleFrequency method

This method maps to the [DIDL-L] property res@sampleFrequency, which is referenced in [UPNPCDS]. This is the sample frequency in Hertz (Hz).

6.3.1.1.2 getNumberOfChannels method

This method maps to the [DIDL-L] property res@nrAudioChannels, which is referenced in [UPNPCDS]. This integer refers to the number of audio channels within the resource, such as 1 for monaural, 2 for stereo, or 6 for Dolby surround sound.

6.3.1.1.3 getBitsPerSample method

This method maps to the [DIDL-L] property res@bitsPerSample, which is referenced in [UPNPCDS]. This integer refers to the number of bits per sample within the resource.

6.3.1.2 ContentContainer

6.3.1.2.1 requestNewEntry

The requestNewEntry method SHALL use the [UPNPCDS] CreateObject action. The control point SHALL NOT set the value of the <res> element. The ContentManagementModule can be used to import resources to the item.

6.3.1.3 ContentDatabase

6.3.1.3.1 requestEntries

The requestEntries method SHALL use the [UPNPCDS] Browse action when all entries are requested. The Filter argument SHALL use the "*" wildcard. If a subset of the entries is requested, the [UPNPCDS] Search action SHALL be used. The SearchCriteria argument SHALL be created from the requested metadata key identifier and value pairs. Both actions setup some of the arguments identically as follows:

- ObjectID set to 0,
- BrowseFlag set to BrowseDirectChildren,
- StartingIndex set to 0,
- RequestedCount set to 0,
- SortCriteria derived from the sortOrder parameter if not null. If null, empty string is used.

6.3.1.4 ContentEntry Interface

6.3.1.4.1 getName method

[UPNPCDS] does not export the file name of a resource. The UPnP ID SHALL be returned by this method. This is the name of the content entry, and is not the title of a piece of content, but rather an identifier of a physical piece of content.

6.3.1.4.2 getContentSize method

This method maps to the [DIDL-L] property res@size, which is referenced in [UPNPCDS]. This unsigned long value is the size in bytes of the resource.

6.3.1.4.3 getExtendedFileAccessPermissions method

File permissions are defined in [UPNPCDS] using the [DIDL-L] property object@restricted and the upnp:writeStatus property.

6.3.1.4.4 getLocation method

[UPNPCDS] does not offer file location, so this string can be created using the identifiers of the content and its parent.

6.3.1.5 VideoResource Interface

6.3.1.5.1 getColorDepth method

This method maps to the [DIDL-L] property res@colorDepth, which is referenced in [UPNPCDS]. This unsigned integer value is the encoding characteristic of the resource.

6.3.1.5.2 getResolution method

This method maps to the [DIDL-L] property res@resolution, which is referenced in [UPNPCDS]. This pattern string identifies the XxY resolution of the resource in pixels (typically an image item or video item). String pattern is of the form: [0-9] + x[0-9] + (one or more digits, 'x', followed by one or more digits).

6.3.2 ContentContainer class

No UPnP mapping defined.

6.3.3 ContentDatabase class

No UPnP mapping defined.

6.3.4 ContentItem class

No UPnP mapping defined.

6.3.5 ContentListEvent class

No UPnP mapping defined.

6.3.6 ContentResource class

No UPnP mapping defined.

6.3.7 MetadataNode class

No UPnP mapping defined.

6.3.8 RecordingContentItem class

No UPnP mapping defined.

6.4 Package Org.ocap.hn.content.navigation**6.4.1 ContentDatabaseFilter class**

No UPnP mapping defined.

6.4.2 ContentList class

No UPnP mapping defined.

6.4.3 DatabaseQuery class

No UPnP mapping defined.

6.4.4 DeviceFilter class

No UPnP mapping defined.

6.5 Package Org.ocap.hn.profile.upnp**6.5.1 UPnPConstants interface****6.5.1.1 actor field**

This field maps to the UPnP property upnp:actor, which is defined in the UPnP Content Directory Service [UPNPCDS]. This string value is the name of an actor appearing in a video item.

6.5.1.2 actor_at_role field

This field maps to the UPnP property actor@role, which is defined in the UPnP Content Directory Service. This string value is the role of the actor in the video item.

6.5.1.3 album field

This field maps to the UPnP property upnp:album, which is defined in the UPnP Content Directory Service. This string value is the title of the album to which the item belongs.

6.5.1.4 *album_art field*

This field maps to the UPnP property `upnp:albumArtURI`, which is defined in the UPnP Content Directory Service. This URI value is a reference to album art. Values SHALL be properly escaped URIs, as described in [RFC3986].

6.5.1.5 *artist field*

This field maps to the UPnP property `upnp:artist`, which is defined in the UPnP Content Directory Service. This string value is the name of the artist.

6.5.1.6 *artist_at_role field*

This field maps to the UPnP property `upnp:artist@role`, which is defined in the UPnP Content Directory Service. This string value is the role of an artist in a work.

6.5.1.7 *artist_discography field*

This field maps to the UPnP property `upnp:artistDiscographyURI`, which is defined in the UPnP Content Directory Service. This URI value is a reference to the artist's discography. Values SHALL be properly escaped URIs, as described in [RFC3986].

6.5.1.8 *author field*

This field maps to the UPnP property `upnp:author`, which is defined in the UPnP Content Directory Service. This string value is the name of an author of a text item.

6.5.1.9 *author_at_role field*

This field maps to the UPnP property `upnp:author@role`, which is defined in the UPnP Content Directory Service. This string value is the role of an author in the work, such as lyrics.

6.5.1.10 *channel_name field*

This field maps to the UPnP property `upnp:channelName`, which is defined in the UPnP Content Directory Service. This string value is used for identification of channels themselves, or information associated with a piece of recorded content.

6.5.1.11 *channel_number field*

This field maps to the UPnP property `upnp:channelNr`, which is defined in the UPnP Content Directory Service. This integer value is used for identification of tuner channels themselves, or information associated with a piece of recorded content.

6.5.1.12 *comments field*

This field maps to the UPnP property `upnp:userAnnotation`, which is defined in the UPnP Content Directory Service. This string value is a general-purpose tag where a user can annotate an object with some userspecific information.

6.5.1.13 *contributor field*

This field maps to the Dublin Core [DC] property `dc:contributor`, which is referenced in the UPnP Content Directory Service. It is recommended in the UPnP Content Directory Service specification, that the

contributor property include the name of the primary content creator or owner (DublinCore 'creator' property).

6.5.1.14 creation_date field

This field maps to the Dublin Core property dc:date, which is referenced in the UPnP Content Directory Service. This string identifies the creation date of a piece of content.

6.5.1.15 creator field

This field maps to the Dublin Core property dc:creator, which is referenced in the UPnP Content Directory Service. The value of this string is the primary content creator or owner of the object. .

6.5.1.16 description field

This field maps to the Dublin Core property dc:description, which is referenced in the UPnP Content Directory Service. This string contains a brief description of the content item.

6.5.1.17 director field

This field maps to the UPnP property upnp:director, which is defined in the UPnP Content Directory Service. This string identifies the name of the director of the video content item.

6.5.1.18 dvd_region_code field

This field maps to the UPnP property upnp:DVDRegionCode, which is defined in the UPnP Content Directory Service. The value of this integer is the region code of the DVD.

6.5.1.19 genre field

This field maps to the UPnP property upnp:genre, which is defined in the UPnP Content Directory Service [8]. This string identifies the name of the genre to which an object belongs.

6.5.1.20 id field

This field maps to the DIDL-Lite property didl-lite:(object)@id, which is referenced in the UPnP Content Directory Service. This string contains an identifier for the object. The value of each object ID property SHALL be unique, with respect to the UPnP Content Directory, and the server hosting this content.

6.5.1.21 language field

This field maps to the Dublin Core property dc:language, which is referenced in the UPnP Content Directory Service. This string identifies the language as defined by [RFC3066].

6.5.1.22 long_description field

This field maps to the UPnP property upnp:longDescription, which is defined in the UPnP Content Directory Service. This string contains a few lines of description of the content item, and is longer than the Dublin Core *description* field.

6.5.1.23 lyrics_ref field

This field maps to the UPnP property `upnp:lyricsURI`, which is defined in the UPnP Content Directory Service. This URI refers to the lyrics of the song, or the whole album. Values SHALL be properly escaped URIs, as described in [RFC3986].

6.5.1.24 media_id field

This field maps to the UPnP property `upnp:toc`, which is defined in the UPnP Content Directory Service. The value of this string is the identifier of an audio CD.

6.5.1.25 playlist field

This field maps to the UPnP property `upnp:playlist`, which is defined in the UPnP Content Directory Service. The value of this string is the name of the playlist to which the item belongs.

6.5.1.26 producer field

This field maps to the UPnP property `upnp:producer`, which is defined in the UPnP Content Directory Service. The value of this string is the name of the producer, such as the producer of a video or of a CD.

6.5.1.27 publisher field

This field maps to the Dublin Core property `dc:publisher`, which is referenced in the UPnP Content Directory Service. This string identifies the publisher of the content.

6.5.1.28 radio_band field

This field maps to the UPnP property `upnp:radioBand`, which is defined in the UPnP Content Directory Service. The value of this string is the radio station frequency band. Recommended values are "AM", "FM", "Shortwave", "Internet", or "Satellite".

6.5.1.29 radio_call_sign field

This field maps to the UPnP property `upnp:radioCallSign`, which is defined in the UPnP Content Directory Service. The value of this string is a radio station call sign, such as "KIFM".

6.5.1.30 radio_station_id field

This field maps to the UPnP property `upnp:radioStationID`, which is defined in the UPnP Content Directory Service. The value of this string is some identification of the broadcast frequency of the radio station, such as "107.7".

6.5.1.31 rating field

This field maps to the UPnP property `upnp:rating`, which is defined in the UPnP Content Directory Service. The value of this string is the rating of the object's resource, for "parental control" filtering purposes, such as "R", "PG-13", and "X".

6.5.1.32 region field

This field maps to the UPnP property `upnp:region`, which is defined in the UPnP Content Directory Service. The value of this string is some identification of the region associated with the source of the object, such as "U.S.", "Latin America", or "Seattle".

6.5.1.33 relation field

This field maps to the Dublin Core property `dc:relation`, which is referenced in the UPnP Content Directory Service. This URI property is a reference to related resources. Values SHALL be properly escaped URIs as described in [RFC3986].

6.5.1.34 rights field

This field maps to the Dublin Core property `dc:rights`, which is referenced in the UPnP Content Directory Service. The value of this string is information about rights held in and over the resource.

6.5.1.35 scheduled_end_time field

This field maps to the UPnP property `upnp:scheduledEndTime`, which is defined in the UPnP Content Directory Service. The value of this string is date and time, in the "yyyy-mm-ddThh:mm:ss" format defined by ISO 8601, used to indicate the end time of a scheduled program, intended for use by timers.

6.5.1.36 scheduled_start_time field

This field maps to the UPnP property `upnp:scheduledStartTime`, which is defined in the UPnP Content Directory Service. The value of this string is date and time, in the "yyyy-mm-ddThh:mm:ss" format defined by ISO 8601, used to indicate the start time of a scheduled program, intended for use by timers.

6.5.1.37 storage_medium field

This field maps to the UPnP property `upnp:storageMedium`, which is defined in the UPnP Content Directory Service. The value of this string indicates the type of storage medium used for the content.

6.5.1.38 title field

This field maps to the Dublin Core property `dc:title`, which is referenced in the UPnP Content Directory Service. The value of this string is the name of the object, such as the title of a song, recording, photograph, or book.

6.5.1.39 track field

This field maps to the UPnP property `upnp:originalTrackNumber`, which is defined in the UPnP Content Directory Service. This integer value indicates the original track number on an audio CD or other medium.

6.6 Package Org.ocap.hn.service**6.6.1 RemoteService interface**

No UPnP mapping defined.

7 DLNA VERSION 1.0 DEVICE INTEROPERABILITY REQUIREMENTS

Devices compliant with this specification SHALL implement the following requirements described in Digital Living Network Alliance Home Networked Device Interoperability Guidelines Version: 1.0 [DLNA] as modified by DLNA Home Networked Device Interoperability Guidelines Version: 1.0 Errata, Errata Volume 2.0 and Errata Volume 3.0 [DLNA-E] [DLNA-E2] [DLNA-E3]. It is recommended that devices compliant with this specification also implement the guidelines denoted in [DLNA] as "SHOULD".

7.1 Network and Connectivity Requirements

DLNA Reference	Guideline Name
7.1.1.1	NC Ethernet: Base
7.1.4.1	NC Ethernet: QoS Tolerance
7.1.5.1	NC 802.11: Base
7.1.5.2	NC 802.11: Base
7.1.6.1	NC 802.11: Wi-Fi Conformance
7.1.9.1	NC Devices: IP Stack
7.1.10.1	NC Devices: IP Address Acquisition

7.2 Device Discovery and Control Requirements

DLNA Reference	Guideline Name
7.2.1.1	DDC UPnP Device Architecture
7.2.1.2	DDC UPnP Device Architecture
7.2.1.3	DDC UPnP Device Architecture
7.2.2.1	DDC UPnP Auto IP Support
7.2.2.2	DDC UPnP Auto IP Support
7.2.2.3	DDC UPnP Auto IP Support
7.2.3.1	DDC UPnP SSDP Default Port
7.2.3.2	DDC UPnP SSDP Default Port
7.2.3.3	DDC UPnP SSDP Default Port
7.2.3.4	DDC UPnP SSDP Default Port
7.2.4.2	DDC UPnP Discovery Robustness
7.2.4.3	DDC UPnP Discovery Robustness
7.2.4.4	DDC UPnP Discovery Robustness
7.2.4.5	DDC UPnP Discovery Robustness
7.2.5.1	DDC UPnP HTTP Support and General Rules

DLNA Reference	Guideline Name
7.2.5.2	DDC UPnP HTTP Support and General Rules
7.2.5.3	DDC UPnP HTTP Support and General Rules
7.2.5.5	DDC UPnP HTTP Support and General Rules
7.2.5.7	DDC UPnP HTTP Support and General Rules
7.2.5.8	DDC UPnP HTTP Support and General Rules
7.2.5.9	DDC UPnP HTTP Support and General Rules
7.2.6.1	DDC UPnP HTTP/1.0 Rules
7.2.6.2	DDC UPnP HTTP/1.0 Rules
7.2.6.3	DDC UPnP HTTP/1.0 Rules
7.2.7.1	DDC UPnP HTTP/1.1 Transaction Rules
7.2.7.2	DDC UPnP HTTP/1.1 Transaction Rules
7.2.7.3	DDC UPnP HTTP/1.1 Transaction Rules
7.2.7.4	DDC UPnP HTTP/1.1 Transaction Rules
7.2.8.1	DDC UPnP HTTP Persistent Connections
7.2.8.4	DDC UPnP HTTP Persistent Connections
7.2.8.5	DDC UPnP HTTP Persistent Connections
7.2.8.6	DDC UPnP HTTP Persistent Connections
7.2.8.7	DDC UPnP HTTP Persistent Connections
7.2.9.1	DDC UPnP Device Responsiveness
7.2.10.1	DDC UPnP Device Description Rules
7.2.10.2	DDC UPnP Device Description Rules
7.2.10.3	DDC UPnP Device Description Rules
7.2.11.1	DDC UPnP Embedded Device Support
7.2.11.2	DDC UPnP Embedded Device Support
7.2.11.3	DDC UPnP Embedded Device Support
7.2.11.4	DDC UPnP Embedded Device Support
7.2.11.7	DDC UPnP Embedded Device Support
7.2.12.1	DDC UPnP Service Description Rules
7.2.12.2	DDC UPnP Service Description Rules
7.2.12.4	DDC UPnP Service Description Rules
7.2.12.5	DDC UPnP Service Description Rules
7.2.12.6	DDC UPnP Service Description Rules
7.2.13.1	DDC UPnP XML Namespace
7.2.14.1	DDC UPnP Action Argument Encoding
7.2.15.1	DDC UPnP SOAP Packet Size
7.2.15.2	DDC UPnP SOAP Packet Size
7.2.17.1	DDC UPnP GENA Packet Size
7.2.18.1	DDC UPnP Subscription Handling

DLNA Reference	Guideline Name
7.2.18.2	DDC UPnP Subscription Handling
7.2.20.1	DDC UPnP Event Subscription Renewals
7.2.21.1	DDC UPnP Event Notification Handling
7.2.22.1	DDC UPnP Unknown Header/Tag/Field Robustness Rules
7.2.23.1	DDC URI Rules
7.2.23.2	DDC URI Rules
7.2.23.3	DDC URI Rules
7.2.23.4	DDC URI Rules
7.2.23.5	DDC URI Rules
7.2.23.8	DDC URI Rules
7.2.23.9	DDC URI Rules
7.2.24.1	DDC UPnP Device Description Usage
7.2.24.2	DDC UPnP Device Description Usage
7.2.25.2	DDC UPnP UDN Usage
7.2.25.3	DDC UPnP UDN Usage
7.2.25.4	DDC UPnP UDN Usage
7.2.25.5	DDC UPnP UDN Usage
7.2.26.2	DDC UPnP Multi Homing Rules
7.2.27.1	DDC UPnP Device Icons
7.2.27.3	DDC UPnP Device Icons
7.2.28.1	DDC UPnP UTF-8 Support
7.2.29.1	DDC UPnP XML Comments
7.2.30.1	DDC UPnP Boolean Types

7.3 Media Management Requirements

DLNA Reference	Guideline Name
7.3.1.1	MM UPnP AV 1.0 Compliance
7.3.2.1	MM DMP UPnP AV MediaServer Control Point Definition
7.3.3.1	MM DMS UPnP AV MediaServer Device Definition
7.3.4.1	MM DMS ContentDirectory Rules
7.3.5.1	MM DMS ConnectionManager Rules
7.3.5.2	MM DMS ConnectionManager Rules
7.3.6.1	MM UPnP AV MediaServer Control Point Tolerance of Unknown Properties
7.3.7.1	MM CMS:GetProtocolInfo Rules
7.3.7.2	MM CMS:GetProtocolInfo Rules
7.3.7.3	MM CMS:GetProtocolInfo Rules

DLNA Reference	Guideline Name
7.3.8.1	MM CDS Browse/Search Action: Filter Argument
7.3.8.2	MM CDS Browse/Search Action: Filter Argument
7.3.8.4	MM CDS Browse/Search Action: Filter Argument
7.3.9.2	MM CDS Browse/Search Action: Reduced Response Behavior
7.3.9.3	MM CDS Browse/Search Action: Reduced Response Behavior
7.3.9.4	MM CDS Browse/Search Action: Reduced Response Behavior
7.3.9.5	MM CDS Browse/Search Action: Reduced Response Behavior
7.3.9.6	MM CDS Browse/Search Action: Reduced Response Behavior
7.3.10.1	MM DIDL-Lite protocolInfo values
7.3.10.2	MM DIDL-Lite protocolInfo values
7.3.10.3	MM DIDL-Lite protocolInfo values
7.3.10.4	MM DIDL-Lite protocolInfo values
7.3.11.1	MM DIDL-Lite protocolInfo values: 4 th Field
7.3.11.3	MM DIDL-Lite protocolInfo values: 4 th Field
7.3.11.4	MM DIDL-Lite protocolInfo values: 4 th Field
7.3.11.6	MM DIDL-Lite protocolInfo values: 4 th Field
7.3.11.8	MM DIDL-Lite protocolInfo values: 4 th Field
7.3.12.1	MM DIDL-Lite Non-empty Metadata Values
7.3.12.2	MM DIDL-Lite Non-empty Metadata Values
7.3.12.3	MM DIDL-Lite Non-empty Metadata Values
7.3.13.1	MM DIDL-Lite Recommended Metadata Properties
7.3.13.2	MM DIDL-Lite Recommended Metadata Properties (Note: typo in Chart 7-2)
7.3.14.1	MM DIDL-Lite dc:date Format
7.3.15.1	MM DIDL-Lite Multiple Res: Formats
7.3.16.1	MM DIDL-Lite Multiple Res: Transports
7.3.17.3	MM DIDL-Lite Multiple Res: Thumbnails
7.3.18.3	MM DIDL-Lite AudioItem Album Art
7.3.19.1	MM DIDL-Lite Content: Multiple Points of Accessibility
7.3.19.2	MM DIDL-Lite Content: Multiple Points of Accessibility
7.3.20.2	MM DIDL-Lite Objects for Multipage Images
7.3.20.3	MM DIDL-Lite Objects for Multipage Images
7.3.21.1	MM DIDL-Lite Boolean Values
7.3.22.1	MM DIDL-Lite Desc Element Use
7.3.23.1	MM DIDL-Lite Restrictions
7.3.24.1	MM DIDL-Lite Max Metadata Length
7.3.24.2	MM DIDL-Lite Max Metadata Length
7.3.24.4	MM DIDL-Lite Max Metadata Length
7.3.25.1	MM ObjectID Usage

DLNA Reference	Guideline Name
7.3.25.2	MM ObjectID Usage
7.3.26.1	MM URI Rules
7.3.26.2	MM URI Rules
7.3.26.3	MM URI Rules
7.3.26.4	MM URI Rules
7.3.27.1	MM upnp:class Values
7.3.27.2	MM upnp:class Values
7.3.28.2	MM Search Capabilities
7.3.28.3	MM Search Capabilities
7.3.28.4	MM Search Capabilities
7.3.30.2	MM Tuner Container
7.3.30.3	MM Tuner Container
7.3.34.2	MM Tuner Properties: Channel Number
7.3.36.1	MM Tuner Content URI
7.3.38.2	MM IFO File URI
7.3.39.1	MM IFO File

7.4 Media Interoperability Requirements

DLNA Reference	Guideline Name
7.4.1.1	MF Mandatory Media Formats: Support Requirements
7.4.1.2	MF Mandatory Media Formats: Support Requirements
7.4.4.1	MF Optional Media Formats: User Indications
7.4.4.2	MF Optional Media Formats: User Indications

7.5 Mandatory Audio Media Class Profile Requirements

DLNA Reference	Guideline Name
7.5.1.1	MF Baseline LPCM Audio Format: DLNA Profile LPCM
7.5.2.1	MF Baseline LPCM Audio Format DLNA Profile LPCM HTTP encapsulation requirement

7.6 Image Media Class Requirements

DLNA Reference	Guideline Name
7.6.1.1	MF Baseline JPEG_SM Image Format Profile: Profile JPEG_SM

DLNA Reference	Guideline Name
7.6.3.1	MF Optional JPEG_MED Image Format Profile: Profile JPEG_MED
7.6.4.1	MF Optional JPEG_LRG Image Format Profile: Profile JPEG_LRG
7.6.5.1	MF Optional JPEG_TN Image Format Profile: Profile JPEG_TN
7.6.6.1	MF Optional PNG_TN Image Format Profile: Profile PNG_TN
7.6.7.1	MF Optional JPEG_SM_ICO Image Format Profile: Profile JPEG_SM_ICO
7.6.8.1	MF Optional JPEG_LRG_ICO Image Format Profile: Profile JPEG_LRG_ICO
7.6.9.1	MF Optional PNG_SM_ICO Image Format profile: Profile PNG_SM_ICO
7.6.10.1	MF Optional PNG_LRG_ICO Image Format Profile: Profile PNG_LRG_ICO

7.7 AV Media Class Formatting Requirements

DLNA Reference	Guideline Name
7.7.1.1	MF Baseline AV MPEG-2 Format Profile: System Stream
7.7.2.1	MF Baseline AV MPEG-2 Format Profile: Program Stream Profiling
7.7.2.2	MF Baseline AV MPEG-2 Format Profile: Program Stream Profiling
7.7.3.1	MF Baseline AV MPEG-2 Format Profile: Program Bit Stream Profiling
7.7.4.1	MF Baseline AV MPEG-2 Format Profile: Program Bit Stream Structure: Stream and Substream IDs
7.7.5.1	MF Baseline AV MPEG-2 Format Profile: Program Bit Stream Structure: Data Packs
7.7.6.1	MF Baseline AV MPEG-2 Format Profile: Program Bit Stream Structure: Private Packs
7.7.7.1	MF Baseline AV MPEG-2 Format Profile: Program Stream Encapsulation
7.7.9.1	MF Baseline AV MPEG-2 Format Program Stream: Best Effort Source Streams
7.7.10.1	MF Baseline AV MPEG-2 Format Profile: Program Stream: Best Effort Destination Streams
7.7.11.1	MF Baseline AV MPEG-2 Format Profile: MIME Type Definition
7.7.12.1	MF Baseline AV MPEG-2 Format Profile: Profiles MPEG_PS_NTSC and MPEG_PS_PAL
7.7.13.1	MF Baseline AV MPEG-2 Format Profile: System Stream Specification
7.7.14.1	MF Baseline AV MPEG-2 Format Profile: Video Elementary Stream Specification Profiles MPEG_PS_NTSC and MPEG_PS_PAL
7.7.15.1	MF Baseline AV MPEG-2 Format Profile: Audio Portion Profiling: LPCM Profiles MPEG_PS_NTSC and MPEG_PS_PAL
7.7.16.1	MF Baseline AV MPEG-2 Format Profile: Audio Portion Profiling: AC-3 Profiles MPEG_PS_NTSC and MPEG_PS_PAL
7.7.17.1	MF Baseline AV MPEG-2 Format Profile: Audio portion profiling: MPEG-1 L2, MPEG-2 L2 AV Audio Profile 3 Profiles MPEG_PS_NTSC and MPEG_PS_PAL
7.7.18.1	MF Baseline AV MPEG2 Format Profile: IFO File Format
7.7.19.1	MF Baseline AV MPEG2 Format Profile: Invalid Field in IFO File
7.7.19.2	MF Baseline AV MPEG2 Format Profile: Invalid Field in IFO File

DLNA Reference	Guideline Name
7.7.20.1	MF Baseline AV MPEG2 Format Profile: IFO File MIME Type

7.8 HTTP Media Transport Requirements

DLNA Reference	Guideline Name
7.8.1.1	MT Baseline Transport: HTTP
7.8.2.1	MT HTTP Play Operation
7.8.9.1	MT Valid HTTP Response
7.8.9.4	MT Valid HTTP Response
7.8.10.1	MT HTTP Header Tolerance
7.8.10.2	MT HTTP Header Tolerance
7.8.10.3	MT HTTP Header Tolerance
7.8.11.1	MT HTTP Header Case-Sensitivity
7.8.12.1	MT Baseline Transport: HTTP Server
7.8.12.3	MT Baseline Transport: HTTP Server
7.8.12.4	MT Baseline Transport: HTTP Server
7.8.12.5	MT Baseline Transport: HTTP Server
7.8.14.1	MT HTTP Header: CONTENT-TYPE
7.8.14.2	MT HTTP Header: CONTENT-TYPE
7.8.15.1	MT HTTP Header: contentFeatures.dlna.org
7.8.15.3	MT HTTP Header: contentFeatures.dlna.org
7.8.15.4	MT HTTP Header: contentFeatures.dlna.org
7.8.16.1	MT HTTP Header: dlna pragma-directive (ifoFileURI.dlna.org)
7.8.16.3	MT HTTP Header: dlna pragma-directive (ifoFileURI.dlna.org)
7.8.16.4	MT HTTP Header: dlna pragma-directive (ifoFileURI.dlna.org)
7.8.17.1	MT HTTP HEAD Requests
7.8.17.2	MT HTTP HEAD Requests
7.8.17.3	MT HTTP HEAD Requests
7.8.17.4	MT HTTP HEAD Requests
7.8.17.6	MT HTTP HEAD Requests
7.8.18.1	MT HTTP Header Parsing (Server)
7.8.19.1	MT HTTP Header: CONTENT-LENGTH
7.8.19.2	MT HTTP Header: CONTENT-LENGTH
7.8.19.3	MT HTTP Header: CONTENT-LENGTH
7.8.19.5	MT HTTP Header: CONTENT-LENGTH
7.8.19.6	MT HTTP Header: CONTENT-LENGTH
7.8.19.7	MT HTTP Header: CONTENT-LENGTH

DLNA Reference	Guideline Name
7.8.20.1	MT Maximum Byte Size Transfers
7.8.20.2	MT Maximum Byte Size Transfers
7.8.21.1	MT HTTP/1.0 Persistent Connections (Server)
7.8.22.1	MT HTTP Header: RANGE (Server)
7.8.22.3	MT HTTP Header: RANGE (Server)
7.8.22.4	MT HTTP Header: RANGE (Server)
7.8.22.5	MT HTTP Header: RANGE (Server)
7.8.22.6	MT HTTP Header: RANGE (Server)
7.8.22.7	MT HTTP Header: RANGE (Server)
7.8.23.2	MT HTTP Chunked Transfer Coding
7.8.25.2	MT Seek Behavior for Stored Content
7.8.25.4	MT Seek Behavior for Stored Content
7.8.28.1	MT Baseline Transport: HTTP Client
7.8.28.2	MT Baseline Transport: HTTP Client
7.8.28.3	MT Baseline Transport: HTTP Client
7.8.28.4	MT Baseline Transport: HTTP Client
7.8.29.1	MT HTTP Header: RANGE (Client)
7.8.30.2	MT HTTP Persistent Connection Usage for Clients
7.8.32.1	MT HTTP Header Parsing (Client)

Annex A XML Documents (Normative)

A.1 Device Description

```

<?xml version="1.0" ?>
<root xmlns="urn:schemas-upnp-org:device-1-0">
<specVersion>
  <major>1</major>
  <minor>0</minor>
</specVersion>
<device>
  <deviceType> urn:schemas-opencable-com:device: :1</deviceType>
  < ocap:X_OCAPHN xmlns:ocap="urn:schemas-cablelabs-com:device-1-0">DMS-1.0</ ocap:X_OCAPHN>
  < ocap:X_OCAPHN xmlns:ocap="urn:schemas-cablelabs-com:device-1-0">DMR-1.0</ ocap:X_OCAPHN>
  <UDN>uuid:UUID</UDN>
  <friendlyName>friendlyName</friendlyName>
  <manufacturer>manufacturer</manufacturer>
  <manufacturerURL>manufactureURL</manufacturerURL>
  <modelName>modelName</modelName>
  <modelNumber>modelNumber</modelNumber>
  <modelDescription>modelDescription</modelDescription>
  <serialNumber> serialNumber<serialNumber />
  <presentationURL>URL for Presentation</presentationURL>
<serviceList>
<service>
  <serviceType>urn:schemas-upnp-
    org:service:ConnectionManager:1</serviceType>
  <serviceId>urn:upnp-org:serviceId:ConnectionManager</serviceId>
  <SCPDURL>ConnectionManager.xml</SCPDURL>
  <eventSubURL>ConnectionManager/Event</eventSubURL>
  <controlURL>ConnectionManager/Control</controlURL>
  </service>
<service>
  <serviceType>urn:schemas-upnp-
    org:service:ContentDirectory:1</serviceType>
  <serviceId>urn:upnp-org:serviceId:ContentDirectory</serviceId>
  <SCPDURL>ContentDirectory.xml</SCPDURL>
  <eventSubURL>ContentDirectory/Event</eventSubURL>
  <controlURL>ContentDirectory/Control</controlURL> </service>
<service>
  <serviceType>urn:schemas-upnp-org:service:AVTransport:1</serviceType>
  <serviceId>urn:upnp-org:serviceId:AVTransport</serviceId>
  <SCPDURL>ContentDirectory.xml</SCPDURL>
  <eventSubURL>ContentDirectory/Event</eventSubURL>
  <controlURL>ContentDirectory/Control</controlURL>
</service>
</serviceList>
</device>

```

```
<serviceType>urn:schemas-upnp-  
  org:service:RenderingControl:1</serviceType>  
<serviceId>urn:upnp-org:serviceId: RenderingControl </serviceId>  
<SCPDURL> RenderingControl.xml</SCPDURL>  
<eventSubURL> RenderingControl /Event</eventSubURL>  
<controlURL> RenderingControl /Control</controlURL>  
</service>  
</serviceList>  
</device>  
</root>
```

Appendix I Acknowledgements

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