



DLNA Client Implementation Guide

Comcast-SP-DLNA-CIG-I01-130314

Publicly Issued

March 14, 2013

This Client Implementation Guide (CIG) consists of a set of recommended practices and international standards compliances in order for Consumer Electronics (CE) device manufacturers to bring devices to market that can interoperate with Comcast ethernet enabled DTA devices.

Comcast ethernet enabled DTA devices will be made available with IP output ethernet ports supporting DLNA DMS services as outlined in this Implementation Guide, and in compliance with FCC Order 12-126.

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A stable document, which has undergone rigorous review and is suitable for product design and development by Consumer Electronics (CE) manufactureres. It will serve as a basis for testing and product interoperability.

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1 Introduction

1.1 Overview

The Comcast DLNA Client Implementation Guide describes technical requirements, including a collection of US and International Standard Normative References, that a DLNA client should implement to interact and interoperate with a Comcast EHD-uDTA. It also gives an overview of how the overall system will function.

Version 2 of Comcast's HD-uDTA product line provides Comcast subscribers with the ability to stream content to a DLNA capable display or player device over an Ethernet interface and is thus referred to as the Ethernet enabled High Definition universal Digital Transport Adapter, or EHD-uDTA. The EHD-uDTA provides the standard services of an HD DTA with the added ability to stream content out of an Ethernet port. The streaming of the currently tuned channel out of the Ethernet port is done according to DLNA and OCAP HNP specifications. This feature is mutually exclusive from standard decode and display of video out of the RF and HDMI ports.

1.2 Purpose of Document

This document provides guidelines and instruction on what a device should do to properly interoperate with and act as a home network client to a Comcast EHD-uDTA.

1.3 Organization of Document

The document is organized into sections as follows:

Sections 1 – 4 present basic information, including references and acronyms.

Section 5 provides general requirements for UPnP support.

Section 6 provides general requirements for DLNA support.

Section 7 provides general requirements for VPOP support and gives an overview of how the client should interact with the EHD-uDTA.

Section 8 gives an overview of recommended behavior of a client.

Section 9 addresses other system requirements that a client developer should be aware of.

1.4 Scope

This specification provides functional requirements and guidelines for a DLNA home networked client such that it interoperates with a Comcast EHD-uDTA to provide Comcast subscribed and authorized services.

1.5 Typographical Conventions

This specification uses different typefaces to differentiate and emphasize important information.

Table 1 - Typographical Conventions

Typeface	Usage
Boldface	Used to call attention to a piece of information. For example:

Typeface	Usage
	This specification does not include headend diagnostic screens.
Boldface & Uppercase	Used to emphasize information and for readability. For example: ENTER, MUTE, INFO, VOL +/- and other buttons on the remote control.
Italics	Used to emphasize that the information being presented is for informational purposes only and is not a requirement even though it may contain conformance language. For example: Note: In the DTA network, the STT may be delivered more often than the typical once-per-minute called out in [SCTE 65]. Note: The public and private keys for the elliptic curve calculations are required to be at least 1024 bits in length.
UPPERCASE	Used to define and signify a requirement. For example: SHOULD NOT, SHOULD and MAY.

1.6 Requirements (Conformance Notation)

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

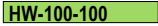
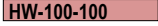
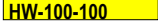
“SHOULD” This word or the adjective “RECOMMENDED” means that the listed requirement is strongly recommended to be adhered to to ensure a properly operating and properly inter-operating system between the DLNA client (DMP) and the Comcast EHD-uDTA.

“SHOULD NOT” This phrase means that the item is strongly recommended to not be performed in order for system components to properly operate or inter-operate.

“MAY” This word or the adjective “OPTIONAL” means that this item is truly optional. One device manufacturer may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another device manufacturer may omit the same item.

1.6.1 Unique Requirements Numbering

All requirements are assigned a unique requirement number and displayed in a color-coded text box in the right margin. The requirements text boxes are color coded as follows:

-  HW-100-100 A SHOULD requirement
-  HW-100-100 A SHOULD NOT requirement
-  HW-100-100 A MAY requirement

1.7 Legal Notices

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2 References

Reasonable effort is made to keep references up to date with respect to versions and release dates, however CE manufacturers are responsible for ensuring they have the most recent version of a reference specification (unless otherwise noted).

Where conflicts exist between requirements contained in this specification and normative references, the specification requirements provide the most accurate requirements related to interoperability guidelines.

2.1 Normative References

In addition to complying with the requirements of this Implementation Guideline, it is necessary to conform to all requirements from each of the standards and other works listed below (Normative References) to ensure product interoperability, unless otherwise specifically indicated by individual requirements listed in this document.

- [ATSC A/52B] ATSC A/52:2010, Digital Audio Compression (AC-3, E-AC-3) Standard, November 2010.
- [ATSC A/53] ATSC Digital Television Standard: Part 4 – MPEG-2 Video System Characteristics, Document A/53, August 7, 2009
- [CEA-708] CEA-708-C, Digital Television (DTV) Closed Captioning, 2006
- [DLNA vol 1] Digital Living Network Alliance Home Networked Device Interoperability Guidelines; expanded: October 2006, Volume 1: Architectures and Protocols.
- [DLNA vol 2] Digital Living Network Alliance Home Networked Device Interoperability Guidelines; expanded: December 2011, Volume 2: Media Format Profiles.
- [DLNA vol 3] Digital Living Network Alliance Home Networked Device Interoperability Guidelines, expanded: October 2006, Volume 3: Link Protection.
- [DLNA vol 5] Digital Living Network Alliance Home Networked Device Interoperability Guidelines, Volume V: Device Profiles.
- [DTCP] DTCP Volume 1 (informational version) Digital Transmission Content Protection Specification (Informational Version) Revision 1.7: December 14, 2011
- [DTCP-IP] DTCP Volume 1 Supplement E Mapping DTCP to IP (Informational Version), version 1.4, December 12, 2011.
- [DTCP-LA] Digital Transmission Protection License Agreement, Exhibit B Audiovisual, Part 1: Compliance Rules for Sink Functions, July 2012
- [ISO 13818-1] ISO/IEC 13818-1, 2007: Information technology - Generic coding of moving pictures and associated audio: Systems

- [OC HNP]** OpenCable Home Networking Protocol 2.0; OC-SP-HNP2.0-I08-120531.
- [UPNP AVA]** UPnP AV Architecture 1.1; September 30th, 2008.
- [UPNP DA]** UPnP Device Architecture 1.0; October 15th, 2008.

2.2 Informative References

The following references are intended to provide additional information that may be informative in understanding this specification.

- [UPNP CDS]** UPnP ContentDirectory v3, ContentDirectory:3 Service Template Version 1.01, UPnP Forum, September 30, 2008.
- [UPNP CMS]** UPnP ConnectionManager v2, ConnectionManager:2 Service TemplateVersion 1.01, UPnP Forum, May 31, 2006.
- [UPNP MS]** UPnP MediaServer v2, MediaServer:2 Device Template Version 1.01, UPnP Forum, May 31.
- [SCTE 18]** Emergency Alert Message for Cable, ANSI/SCTE 18, 2007.

3 Terms and Definitions

This document uses the following terms and definitions.

Table 2 - Terms and Definitions

Auto-IP	Automatic assignment of an IP address in a well-known range if a DHCP server is not available.
Digital Media Player	A device that finds content on digital media servers (DMS) and provides playback and rendering capabilities.
Digital Media Renderer	A device that renders content it receives from a digital media server (DMS), after being setup by a digital media controller (DMC).
Digital Media Server	A device that stores content and makes it available to networked digital media players (DMP) and digital media renderers (DMR).
Home Network	Local Ethernet network in user's home.
Services Available on channel	The channel has content and can be forwarded out of the Ethernet port.
Services Not Available on channel	The channel either does not have content or is not authorized to be forwarded out of the Ethernet port.
Services Not Available on EHD-uDTA	The EHD-uDTA has no available channels that can be forwarded out of the Ethernet port. An example of this is when the EHD-uDTA has no signal.

4 Abbreviations and Acronyms

This document uses the following abbreviations and acronyms.

Table 3 - Abbreviations and Acronyms

BCM	Basic Connection Management
CC	Closed Captioning
CDS	Content Directory Service
CE	Consumer Electronics
CMS	Connection Manager Service
CVP	Commercial Video Profile
DHCP	Dynamic Host Control Protocol
DLNA	Digital Living Network Alliance
DMP	Digital Media Player
DMR	Digital Media Renderer
DMS	Digital Media Server
DTA	Digital Transport Adapter
EAS	Emergency Alert System
EHD-uDTA	Ethernet enabled High Definition universal Digital Transport Adapter
OTT	Over-the-top
PAT	Program Association Table
PMT	Program Map Table
PSI	Program Specific Information
SPTS	Single Program Transport Stream
UPNP	Universal Plug and Play
URI	Uniform Resource Identifier
VCN	Virtual Channel Number
VPOP	View Primary Output Port

5 Recommended Operation

The EHD-uDTA functions as a DLNA Digital Media Server (DMS) as described in [DLNA vol 1]. The DMS functionality of the EHD-uDTA is extended by the View Primary Output Port (VPOP) functionality specified in Section 5.13 of [OC HNP]. It is expected that a developer of a Digital Media Player (DMP) (which is referred to as a “client” in this document) is intimately familiar with these standards and guidelines before reading this specification.

The EHD-uDTA may not always be available to provide DMS services. The EHD-uDTA will provide services as a DMS when the Ethernet port has been enabled by Comcast and **Networking Status** is set to “Enabled” in the Settings Menu of the EHD-uDTA. The Settings Menu is accessed by pressing the XFINITY key on the Comcast remote control. The EHD-uDTA is required to be “powered on” in a Comcast network and fully configured for Comcast subscribed services prior to providing services over the Ethernet port.

This document introduces the concepts of the EHD-uDTA and the recommended operation of a client in order to develop a robust, meaningful experience for a user and then details the requirements necessary to fully and correctly interact with the EHD-uDTA.

At its core, the EHD-uDTA can operate as a DMS that provides one content item. This content item references the VPOP MPEG TS, and DTCP-IP link protection is required to access it. Once a session is established, it will persist through channel changes and other video disruptions – such as a lost signal – by streaming NULL packets to keep the connection open until content is available to stream.

The majority of the technologies needed to implement this functionality are captured in the normative references to this document; this document calls out exactly how those technologies should be leveraged in a streaming client of the EHD-uDTA

This document assumes the EHD-uDTA is available to provide services as a DLNA DMS according to the Comcast EHD-uDTA specifications for a compliant client.

5.1 Startup Procedure

The EHD-uDTA does not provide a method for a client to retrieve the current channel number; it is therefore recommended that the client cache the current channel number between sessions. When a client begins a new session, it will not know what channel number is tuned on the EHD-uDTA and should tune a known channel number immediately in order to present a consistent experience to the user. With this in mind, the steps below are recommended at startup. Please see Table 6 for a full description of HTTP status codes mentioned here.

1. Use UPnP discovery to locate the EHD-uDTA.
2. Send a CDS Browse or Search action to the EHD-uDTA to look for the VPOP content item.
3. If the client hasn't already run DTCP-IP AKE with the EHD-uDTA, it should do so at this point.

4. Initiate VPOP streaming session by calling HTTP GET on the VPOP streaming URI.

Note: HTTP status code 200 means the EHD-uDTA is tuned to a channel with Service Available and HTTP status code 201 means the EHD-uDTA is tuned to a channel with Services Not Available. Since the client doesn't have any way of knowing the channel number when connecting, these are not treated differently in this use case. The client is encouraged to immediately tune a known good channel so as to provide a consistent user experience.

- a. If the HTTP GET succeeds with an HTTP status code of 203, then it has no Services Available and cannot provide channel content. It will open a connection and stream NULL packets. The client should:
 1. Wait 10 seconds
 2. Call the Tune action with an arbitrary channel number
 3. Follow steps in 5.2 for calling the Tune action.
- b. If the HTTP GET returns an HTTP status code of 204, then an EAS session is in progress.
 1. Start decoding the received audio and video PESs
 2. The EHD-uDTA does not process a Tune action while an EAS event is in progress so the client must wait until the EAS event is over to call the Tune action with a desired channel number. The EHD-uDTA will tune back to the channel it was on before the EAS event was started. The client should determine when the channel change occurs to know when it can control the EHD-uDTA again. Section 5.2 describes how this can be done.
- c. If the HTTP GET returns an HTTP status code of 500, a general error has occurred and a streaming session will not be initiated. This indicates a general problem with the EHD-uDTA and the only programmatic recourse of a client is to display an error message to the user and wait some time and then try again.
- d. If the HTTP GET returns an HTTP status code of 503, (as described in [OC HNP] Section 5.13), this indicates another client is accessing the VPOP content item. The client should display an appropriate error message to the user.

5.2 Tuning a Channel

CE device manufacturers should obtain metadata, including channel lists from independent providers of such cable television metadata information. However, not all channels in the channel list will always have Services Available. It is also possible that the channel list could change at any given time. The following steps are recommended when tuning channels on the EHD-uDTA:

1. Attempt to tune the desired channel via the Tune action (as described in [OC HNP] and this document).

- a. If the Tune Action returns an HTTP status code of 200, the EHD-uDTA is tuned to a channel with Services Available. The client should store the new channel number as the “current channel”. The desired channel will begin streaming. The client should decode and render the audio and video from the stream.
- b. If the Tune Action returns an HTTP status code of 201, the EHD-uDTA is tuned to a channel with Services Not Available. The EHD-uDTA will not forward content; instead, it will stream NULL packets to keep the connection open. The client should gracefully handle the NULL packet stream and attempt to tune another channel. The client should also consider flagging this channel as one with Services Not Available. However, if an altered channel list is received from the metadata provider to the client device, this flag should be reset.
- c. If the Tune Action returns an HTTP status code of 601, the EHD-uDTA was given a channel number via the Tune action that does not exist in the channel list. The EHD-uDTA will automatically tune to the next highest available channel in the channel list. If the channel number is higher than the highest number in the channel list, the EHD-uDTA will automatically tune the lowest channel in the channel list. The following steps should be taken:
 - i. The client device should ensure it is using an accurate and up to date channel list from its metadata provider, and determine what channel was tuned by analyzing the channel list – it should be the next highest channel from the number inputted. The number inputted should not be in the list. If it is, the client should call Tune again with the same channel number.
 - ii. The client can then display the correct channel number tuned to the user.
- d. If the Tune action returns an HTTP status code of 203, then it has no Services Available and cannot provide channel content. It will begin streaming NULL packets. The client should:
 - i. Wait 10 seconds.
 - ii. Call the Tune action with an arbitrary channel number to determine if services have been restored.
- e. If the Tune action returns an HTTP status code of 500, a general error has occurred and the specified channel number will not be tuned. This indicates a general problem with the EHD-uDTA and the only programmatic recourse of a client is to display an error message to the user and try to call the Tune action again.
- f. If the Tune action returns an HTTP status code of 503, it indicates the EHD-uDTA is currently in an EAS event. The client cannot change the channel until the EAS event is complete. The client should wait until the EAS event is over and has tuned back to the original channel and then

reattempt the Tune action. A client can determine when the EHD-uDTA finishes the EAS event and tunes back to the previous channel in the following ways:

- i. The client can poll every X seconds with the Tune action, with X being an arbitrary value chosen by the client. At some point, the EAS event will end and the Tune action will successfully tune the desired channel.
- ii. The client can monitor for when the PAT versions changes as described in Section 9. A PAT version change will indicate a channel change and it can be assumed that this was the tune back to the original channel from the EAS event. Once this channel change has been detected, the client should call the Tune action again.

5.3 NULL Packet Streaming

The EHD-uDTA keeps the HTTP connection open while a client has a valid streaming session active – even on channels with Services Not Available or if the EHD-uDTA is in a Services Not Available state. It does this by streaming NULL packets at a rate of approximately 1 NULL MPEG packet per second. NULL packets are described in [13818-1] and are streamed on PID 0x1FFF.

5.4 Channel Change

When a client calls the Tune action to change the channel, the EHD-uDTA will execute the following steps:

1. Stop streaming current channel content.
2. Begin streaming new channel content.

Note: If it takes longer than 1 second for the EHD-uDTA to acquire the new channel and begin streaming, it will stream NULL packets as described above to ensure the HTTP connection doesn't close. The client should be prepared for this.

5.5 Channel Up/Down

The VPOP service specified in [OC HNP] Section 5.13 provides no action to channel up or down. The client can build the necessary information to implement this behavior through use of a 3rd party metadata provider or through a process of channel scanning before making channels available to the client device's user interface.

If a user is watching a channel on the client and the user presses channel up/down through some mechanism provided by the client (remote control, UI, etc.), the client should look for the next channel number up/down in information built by the client, and then call the Tune action with that channel number as the argument. Normal methods described above for handling a Tune action will apply to the result.

5.6 EHD-uDTA Use Cases

Table 4 gives a detailed overview of the possible use cases of the EHD-uDTA. It will give the client developer an understanding of what behavior can be expected on the Ethernet port in the various operating modes of the EHD-uDTA.

Table 4 - EHD-uDTA Use Cases

Use Case	DTA Mode	Use Case	LED	E-DTA Behavior over RF & HDMI	E-DTA Behavior over Ethernet
1	Hunt Mode	DTA is searching for a valid TOQ	Continuous Long blink	1. Hunt Mode Message 2. Service Interrupt Message 3. Diagnostics	Use Prohibited
2	Pending Init Mode	DTA is not fully configured for service.	Two blinks	1. Activation Support Message 2. Service Interrupt Message 3. Diagnostics	Use Prohibited
3	Code Download Mode	DTA is downloading updated code	Three blinks	1. Code Download Message 2. Diagnostics	Use Prohibited
4	Normal Operations Mode, DLNA Output Mode	Streaming connection present. Currently tuned to a channel with Services Available.	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	Audio & Video
5	Normal Operations Mode, DLNA Output Mode	Streaming connection present. Tune action causes channel change to channel with Services Available	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 200 returned in HTTP response. If channel change time exceeds 1 second, NULL packets streamed until audio and video is available. Audio and video is streamed when acquired.
6	Normal Operations Mode, DLNA Output Mode	Streaming connection NOT present. HTTP GET streaming request while E-DTA is tuned to channel with Services Available.	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 200 returned in HTTP response. Audio and video is streamed when acquired.

7	Normal Operations Mode, DLNA Output Mode	Streaming connection present. Tune action causes channel change to channel with Services Not Available ¹	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 201 returned in HTTP response. Stream NULL packets.
8	Normal Operations Mode, DLNA Output Mode	Streaming connection NOT present. HTTP GET streaming request while E-DTA is tuned to channel with Services Not Available ¹	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 201 returned in HTTP response. Stream NULL packets.
9	Normal Operations Mode, DLNA Output Mode	Streaming connection present. Tune action causes channel change to a channel that is not in the channel map - so E-DTA tunes to the next higher channel	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 202 returned in HTTP response. If channel change time exceeds 1 second, NULL packets streamed until audio and video is available. Audio and video is streamed when acquired.
10	Normal Operations Mode, DLNA Output Mode	Streaming connection present. EAS Event in Progress upon receipt of a Tune action. E-DTA fails request.	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 503 returned in HTTP response. EAS audio and video streamed.
11	Normal Operations Mode, DLNA Output Mode	Streaming connection NOT present. HTTP GET streaming request while EAS Event in Progress.	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 210 returned in HTTP response. EAS audio and video streamed.
12	Normal Operations Mode, DLNA Output Mode	Streaming connection present. Tune action received when no signal is available ²	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 203 returned in HTTP response. Stream NULL packets.

13	Normal Operations Mode, DLNA Output Mode	Streaming connection NOT present. HTTP GET streaming request while E-DTA has no signal ²	LED On Solid, Amber	1. Ethernet Port Active Message 2. Diagnostics	HTTP 203 returned in HTTP response. Stream NULL packets.
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1. Includes both the Not Authorized, Content is encrypted but the E-DTA can't decrypt it and Missing SCTE-65 Flags use cases.
2. QAM is down, RF is disconnected, fiber cut, no visible virtual channels available in currently loaded channel map, etc.

6 UPnP Support

UPnP defines an architecture for device identification and discovery as well as identifying what content is available on a given device. Detailed information about UPnP can be found in [UPNP DA]. The EHD-uDTA, via the DLNA specifications, builds on the UPnP Audio/Video architecture device control protocols as described in [UPNP AVA], [UPNP CDS], and [UPNP CM].

An EHD-uDTA client SHOULD observe all requirements related to advertising and discovering services for a control point as required by the DLNA specifications. The EHD-uDTA functions as a Device as defined in [UPNP DA].

CIG-10-10

An EHD-uDTA client SHOULD function as a UPnP MediaRenderer as defined in [UPNP AVA].

CIG-10-20

An EHD-uDTA client SHOULD function as a Control Point as defined in [UPNP AVA].

CIG-10-30

6.1 Architecture

The EHD-uDTA UPnP architecture consists of a root device that contains one embedded device, called “DMS”. The “DMS” embedded device has 3 services:

1. Content Directory Service as described in [UPNP CDS]
2. Connection Manager Service as described in [UPNP CMS].
3. View Primary Output Port Service (VPOP) as described in [OC HNP] and this document.

The UPnP root device of the EHD-uDTA will be named “XFINITY Video Device (xfinity_#####)” where ##### is the last 4 digits of the Network MAC Address as defined in [E-DTA ID].

6.2 Advertising/Discovery

A client SHOULD perform a search for EHD-uDTAs when joining the network as described in [UPNP DA].

CIG-10-40

If an EHD-uDTA is not found, then the client SHOULD listen for EHD-uDTAs joining the network as described in [UPNP DA].

CIG-10-50

It is possible that multiple EHD-uDTAs can exist on the home network. If a client device encounters multiple EHD-uDTAs, it SHOULD provide a mechanism for resolving which EHD-uDTA to connect with.

CIG-10-60

Note: This would typically come in the form of a UI interaction with the user.

6.3 EHD-uDTA Connection Manager Service (CMS)

The CMS for the DMS embedded device does not implement the ConnectionManager::PrepareForConnection action described in [UPNP CMS].

6.4 EHD-uDTA Content Directory Service

The CDS for the DMS embedded device contains one content item – the VPOP content item as described in Section 5.13 of [OC HNP] and Section 11 of this document.

7 DLNA Support

The EHD-uDTA provides the ability for a client to communicate with the EHD-uDTA via the mechanisms described in this document over a home network. The EHD-uDTA functions as a DMS as defined in [DLNA vol 1].

The client SHOULD function as a DMP in a 2-box pull system as described in Section 5.7.1 of [DLNA vol 1].

CIG-20-10

The client SHOULD support all IP addressing requirements as specified in Section 7.2.5 of [DLNA vol 1]. This includes both Auto-IP and DHCP support.

CIG-20-20

The client SHOULD support receiving a ConnectionID via the scid.dlna.org header defined in the Basic Connection Management (BCM) guidelines listed in Section 7.5.4.3.2.38 of [DLNA vol 1].

CIG-20-30

7.1 Certification

The client SHOULD pass DLNA certification for both the DMP and DMR Device Classes with the following requirements:

CIG-20-35

- In the certification registration tool, the client developer SHOULD declare support for media formats that are mandatory as defined by CVP-NA-1 guideline 2.2.1.
- In the certification registration tool, the client developer SHOULD declare support for QoS as made mandatory as defined by CVP-NA-1 guideline 2.3.5.
- In the certification registration tool, the client developer SHOULD declare support for Link Protection.

CIG-20-35.01

CIG-20-35.02

CIG-20-35.03

7.2 CVP-NA-1 Support

The client SHOULD follow the CVP-NA-1 guidelines as described in Section 2 of [DLNA vol 5] with the following exceptions:

CIG-20-40

- All trickmode guidelines in Section 2.3.3.

Note: The EHD-uDTA cannot timeshift content, thus no trickmode support is available.

The client SHOULD support the CVP-NA-1 media format MPEG_TS_NA_ISO as specified in [DLNA vol 5] and defined in [DLNA vol 2].

CIG-20-50

The client SHOULD support decoding MPEG-2 video.

CIG-20-60

The client SHOULD support all video formats specified in Table 60 of [DLNA vol 2].

CIG-20-70

The client SHOULD support decoding MPEG-4 AVC video.

CIG-20-80

The client SHOULD support decoding AC-3 audio 5.1-channel audio as defined in [ATSC A/52B].

CIG-20-90

The client SHOULD support decoding E-AC-3 7.1-channel audio as defined in [ATSC A/52B].

CIG-20-100

Note: The EHD-uDTA will stream primarily MPEG-2 video and AC-3 audio content to client devices.

The SPTS delivered by the EHD-uDTA has one program that contains one video stream but can have multiple audio streams. All streams are delineated in the PMT.

7.3 DIDL-Lite Metadata Length

The client SHOULD be able to support DLNA element values and attribute values, appearing in DIDL-Lite documents or fragments, that are a maximum size of 8192 bytes each, in their XML-escaped form, encoded in UTF-8.

CIG-20-110

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8 DTCP Support

8.1 General

The VPOP content item listed in the CDS by the EHD-uDTA is prefixed with DTCP_ as described in Section 8.9.1.3 of [DLNA vol 3] to indicate that a DTCP session must be established to stream content from the EHD-uDTA.

The client SHOULD support link protection as defined in [DLNA vol 5], [DLNA vol 3] and [OC HNP].

CIG-30-10

The client SHOULD function as a format-cognizant sink device as defined in [DTCP] and adhere to all embedded copy control and rights management information as defined in [DTCP-LA].

CIG-30-15

If a client's key expires while content is being encapsulated by the EHD-uDTA in DTCP packets, but not encrypted, the client SHOULD perform AKE in the background without interrupting video decode and display.

CIG-30-30

8.2 Certificates

The client SHOULD support DTCP Device Certificates Format 0 and Format 1 as defined in [DTCP].

CIG-30-40

The client SHOULD support the Additional Localization (AL) flag in all DTCP device certificates as defined in [DTCP IP] if available.

CIG-30-50

8.3 DTCP_descriptor

The EHD-uDTA supports a DTCP_descriptor in the PMT as required in [DTCP]. The client SHOULD support values in the DTCP_descriptor defined in Table 5.

CIG-30-60

Table 5 - DTCP_descriptor values

Field	Value
DTCP_CCI	Value defined by the CA system to coincide with the CCI/EMI of the content
Retention_Move_Mode	0x1b
Retention_State	0x000b
EPN	Defined by [CCAD]
DOT	0x1b
AST	0x1b
ICT	0x1b
APS	0x00b

CIG-30-60.01

CIG-30-60.02

CIG-30-60.03

CIG-30-60.04

CIG-30-60.05

CIG-30-60.06

CIG-30-60.07

8.4 Authentication and Key Exchange

The client SHOULD support AKE (Authentication and Key Exchange) with an EHD-uDTA prior to beginning streaming content (with an HTTP GET call to the VPOP content item).

CIG-30-70

9 MPEG-TS

The EHD-uDTA supplies a full SPTS conforming to MPEG_TS_NA_ISO in [DLNA vol 2]. The SPTS has a PAT that contains one program when content is actively streaming. The PMT for this program (pointed to by the PAT) is on an arbitrary PID - meaning the client can't assume the PMT PID is always the same. When the EHD-uDTA doesn't have content to stream out, such as during a channel change or when a channel with Services Not Available is tuned, the SPTS has a PAT with no PMT and the MPEG stream is padded with NULL packets.

9.1 General

The client SHOULD process PSI tables in the incoming SPTS as described in [13818-1].

CIG-40-10

If the PAT version changes, the client device SHOULD assume the PMT is invalid and reparse the new PAT for the PMT PID.

CIG-40-20

9.2 NULL Packet Streaming

The EHD-uDTA will stream NULL packets at a rate of 1 per second, or faster, if content is not available to stream in order to keep the connection open. This normally happens on a channel change or when an unauthorized channel is tuned.

The client SHOULD be able to handle a NULL packet stream of 1 MPEG packet per second or faster.

CIG-40-30

The EHD-uDTA may forward either encrypted or non-encrypted NULL packets depending on its current state when it begins forwarding NULL packets. In all cases, the NULL packets will be DTCP encapsulated.

The client SHOULD be able to handle DTCP encapsulated and encrypted NULL packets.

CIG-40-40

The client SHOULD be able to handle DTCP encapsulated NULL packets.

CIG-40-50

10 HTTP Requirements

10.1 General

The client SHOULD function as an HTTP 1.1 client. CIG-50-10

The client SHOULD support persistent connections if it is an HTTP 1.1 client. CIG-50-20

The client SHOULD NOT close an HTTP connection due to lack of received streaming data until it has not received data for at least 2 seconds. CIG-50-25

If the EHD-uDTA closes an HTTP connection unexpectedly, the client SHOULD immediately reopen the connection with no user interaction. CIG-50-27

10.2 Streaming

The EHD-uDTA supports using chunked encoding as defined in [HTTP 1.1].

The client SHOULD support streaming from an HTTP 1.1 server using chunked encoding as defined in Section 3.6.1 of [HTTP 1.1]. CIG-50-30

10.3 Status Codes

This section details the HTTP status codes for both the HTTP GET call to initiate streaming and the Tune action to change the channel. Though they capture similar scenarios on the EHD-uDTA, status codes for each are different and should be understood in their own context. Status codes are detailed in Table 6 and Table 7.

The HTTP status codes specified below supersede status codes specified in normative specifications if there is a conflict.

10.3.1 HTTP GET on VPOP Streaming URI

If a client performs an HTTP GET request on the VPOP streaming URI, the client SHOULD interpret the returned status code to deduce the EHD-uDTA's state as listed in Table 6, [OC HNP], or any other relevant specification. CIG-50-50

Table 6 - HTTP GET Streaming Status Codes

State	Status Code	Message	EHD-uDTA Behavior	Client Behavior
The EHD-uDTA is tuned to a channel with Services Available.	HTTP 200	"XFINITY streaming connection complete. Services available on this channel."	EHD-uDTA streams content from tuned channel.	The client SHOULD begin decoding the incoming audio and video streams. CIG-50-50.01
The EHD-uDTA is tuned to a channel with Services Not Available	HTTP 201	"XFINITY video connection complete. Services not available on current channel."	EHD-uDTA streams NULL packets.	The client SHOULD gracefully handle the NULL packet stream, display the provided message to the user and provide a mechanism to input a new channel. CIG-50-50.02

The EHD-uDTA does not have any Services Available. This could include no channels in the channel map or no input signal.	HTTP 203	"XFINITY streaming connection complete. Services not available."	EHD-uDTA streams NULL packets.	The client SHOULD gracefully handle the NULL packet stream and display the provided message to the user. The client SHOULD periodically check to see if services have been restored.	CIG-50-50.03 CIG-50-50.04
The EHD-uDTA is displaying an EAS event.	HTTP 210	"XFINITY streaming connection complete. Emergency Alert in progress."	The EHD-uDTA streams the EAS channel.	The client SHOULD begin decoding the incoming audio and video streams. When EAS ends, the EHD-uDTA will revert back to the channel it was tuned to before the event started. When this tune back occurs, the client may then tune another channel.	CIG-50-50.05
Streaming request failed for unknown reason.	HTTP 500	"XFINITY streaming connection failed."	The EHD-uDTA does not open a streaming connection.	The client SHOULD display the provided message to the user.	CIG-50-50.06

10.3.2 VPOP Tune Action

If a client performs a Tune action request on the VPOP service, the client SHOULD interpret the returned status code to deduce the EHD-uDTA's state as listed in Table 7.

Table 7 - Tune Action Status Codes

State	Status Code	Message	EHD-uDTA Behavior	Client Behavior	
Tuned to a channel with Services Available.	HTTP 200	"XFINITY channel tune complete."	EHD-uDTA streams content from new channel.	The client SHOULD begin decoding the incoming audio and video streams.	CIG-50-60.01
Tuned to a channel with Services Not Available.	HTTP 201	"XFINITY channel tune complete. Services Not Available on requested channel."	EHD-uDTA streams NULL packets.	The client SHOULD gracefully handle the NULL packet stream and display the provided message to the user.	CIG-50-60.02
The EHD-uDTA does not have any Services Available.	HTTP 203	"XFINITY channel tune complete. Services not available."	EHD-uDTA streams NULL packets.	The client SHOULD gracefully handle the NULL packet	CIG-50-60.03

This could include no channels in the channel map or no input signal.				stream, display the provided message to the user and SHOULD check to see if services have been restored every 10 seconds.	CIG-50-60.04
Tune failed for undefined reason.	HTTP 500	"XFINITY video channel tune failed."	The EHD-uDTA ignores the request and continues to stream the currently tuned channel.	The client SHOULD ensure its UI reflects the channel did not change.	CIG-50-60.05
Tune Failed due to EAS being active.	HTTP 503	"Emergency Alert in progress. Tune temporarily disabled."	The EHD-uDTA ignores the request and continues to stream the EAS channel.	The client SHOULD display the EAS event until it is complete and then allow the user to tune a channel again.	CIG-50-60.06
Tuned to channel that is not in channel map.	HTTP 601	"XFINITY channel tune complete. Requested channel did not exist. Tuned next available channel."	EHD-uDTA tunes to the next highest available channel in the channel map. If a channel with Services Available is tuned, it streams content. If a channel with Services Not Available is tuned, it streams NULL packets.	The client SHOULD determine the correct channel as described in Section 12.2 and inform the user of the correct channel.	CIG-50-60.07

11 View Primary Output Port (VPOP)

The EHD-uDTA supports the VPOP service, as specified in [OC HNP] Section 5.13, and advertises the VPOP content item dc:title property as “XFINITY Video Service (xfinity_#####)” where “#####” is the last 4 digits of the Network MAC address of the EHD-uDTA.

The client SHOULD interact with this service and the associated content item to stream video and interact with the EHD-uDTA.

CIG-60-10

11.1 Initiating a Session

The EHD-uDTA acts as a DLNA DMS and advertises itself when it joins the network. The VPOP service has the service type:

“urn:cablelabs-com:service:ViewPrimaryOutputPort:1”.

When a client discovers an EHD-uDTA, it SHOULD retrieve information about the VPOP content item from the CDS to obtain the streaming URI.

CIG-60-20

A client can retrieve the VPOP content item using a CDS search or Browse action. When using a Browse action the client may not know the @id of the VPOP content item, but it can use the return all “*” value to acquire all of the EHD-uDTA content items, considering there is only one. When using a Search action the client can use the return all value of if a more specific search is desired the client can discover the VPOP content item using any one of a number of techniques:

1. Look for a upnp:class property with a value of object.item.videoItem.vpop.
2. Look for presence of the res@ocap:channelList property.
3. Look for dc:title property starting with “XFINITY”.

The client SHOULD subscribe to EHD-uDTA CDS LastChange events.

CIG-60-22

If the client receives an event indicating that the VPOP content item has changed, then it SHOULD reacquire the content item.

CIG-60-24

The VPOP content item is the only item listed in the Content Directory Service (CDS). The media format profile ID of the VPOP content binary is DTCP_MPEG_TS_NA_ISO.

Once a client has retrieved information about the VPOP CDS entry, through either the browse or search CDS action, it SHOULD open a connection to the streaming URI to retrieve video.

CIG-60-40

A client does this by performing an HTTP GET on the streaming URI found in the <res> element of the VPOP content item. A response is given that conveys two things:

1. Status code indicating the status of the EHD-uDTA.
2. scid.dlna.org header containing the ConnectionID.

A client SHOULD use the ConnectionID returned in the scid.dlna.org header in the HTTP response in subsequent calls to the Tune action over the same connection.

CIG-60-50

If the HTTP status code is contained in Table 6, above, the client SHOULD behave as the table indicates for that status code.

CIG-60-60

If a client receives an HTTP 200 status code in response to an HTTP GET call to the VPOP streaming URI, it SHOULD begin decoding and display the content provided.

CIG-60-70

If a client receives an HTTP 201 status code in response to an HTTP GET call to the VPOP streaming URI, it SHOULD display the string provided in the HTTP response to the user.

CIG-60-80

If a client receives an HTTP 203 status code in response to an HTTP GET call to the VPOP streaming URI, it SHOULD display the string provided in the HTTP response to the user.

CIG-60-90

If a client receives an HTTP 210 status code to an HTTP GET call to the VPOP streaming URI, the client SHOULD interpret the state as having begun streaming during an EAS event.

CIG-60-100

If a client receives an HTTP 210 status code to an HTTP GET call to the VPOP streaming URI, indicating an EAS event is streaming, the client SHOULD wait until the EHD-uDTA tunes back to the previous channel to issue a Tune action or close the connection.

CIG-60-110

Note: Methods for determining this are provided in Section 5.1.

If a client receives an HTTP 500 status code in response to an HTTP GET call to the VPOP streaming URI, it SHOULD display the string provided in the HTTP response to the user.

CIG-60-120

If an HTTP status code indicating an error is received (5XX), then the scid.dlna.org header will not contain a valid ConnectionID. If an HTTP status code indicating success is received (2XX), then the scid.dlna.org header will contain a valid ConnectionID.

11.2 Active Session

The client can send a Tune action with the ConnectionID received after the HTTP GET request and a virtual channel number. The Tune action can indicate several possible conditions with its return value:

1. Tuned to a channel with Services Available. The channel exists and was available. Valid content from the currently tuned channel will be streamed out of the Ethernet port.
2. Tuned to a channel with Services Not Available. NULL packets will be streamed.
3. The virtual channel number specified did not exist and the EHD-uDTA tuned to the next highest available channel and this channel was authorized. Valid content from the tuned channel will be streamed out of the Ethernet port.
4. The EHD-uDTA does not have Services Available. NULL packets will be streamed. Tune failure due to active EAS.
5. General Tune error.

The client SHOULD call the Tune action on the VPOP service to tune a channel.

CIG-60-140

The client SHOULD call the Tune action with a valid ConnectionID to tune a channel.

CIG-60-150

If the HTTP status code sent in response to its Tune action is in Table 7 above, the client SHOULD behave as the table indicates for that status code. CIG-60-170

If a client receives an HTTP 200 status code in response to a Tune action request, it SHOULD begin decoding and displaying the content provided. CIG-60-180

If a client receives an HTTP 201 status code in response to a Tune action request, it SHOULD display the string provided in the HTTP response to the user. CIG-60-190

If a client receives an HTTP 601 status code in response to a Tune action request, it SHOULD begin decoding and displaying the content provided. CIG-60-200

If a client receives a HTTP 601 status code in reply to a Tune action request to the VPOP service, it SHOULD interpret the response as if a non-existent channel was specified and the EHD-uDTA tuned to the next highest channel. CIG-60-210

If a client receives an HTTP 203 status code in response to a Tune action request, it SHOULD display the string provided in the HTTP response to the user. CIG-60-220

If a client receives an HTTP 503 status code in reply to a Tune action request to the VPOP service, it SHOULD interpret the response as if the EHD-uDTA is in an EAS event and the Tune action failed as a result. CIG-60-230

If a client receives an HTTP 606 status code (defined in [OC HNP]) in reply to a Tune action request to the VPOP service, it SHOULD interpret the response as that the value of the ConnectionID parameter passed in does not match the ConnectionID of the in-progress VPOP content item streaming session as defined in [OC HNP]. CIG-60-240

11.3 Terminating a Session

If a client desires to terminate streaming session, it SHOULD terminate the session by closing the HTTP connection. CIG-60-250

11.4 Tune Action

The client SHOULD use an argument name of <TuneParameters> (instead of <Parameters>) in the SOAP control message sent to the EHD-uDTA used to invoke the Tune action on the EHD-uDTA as defined in Section 5.13.2.2.6.1 of [OC HNP]. CIG-60-260

12 User Interface Recommendations

The recommendations detailed in this section outline features that will facilitate a client taking advantage of available data and states of the EHD-uDTA as well as provide services that are normally expected in a cable system

12.1 Metadata

The EHD-uDTA cannot supply Metadata to the client device – the client is responsible for receiving information about each channel and content contained on that channel from some over-the-top (OTT) source of cable service provider Metadata for the US market.

12.2 Secondary Audio Program (SAP)

A program being forwarded in the SPTS will contain one video stream and one or more audio streams. Typically, the multiple audio programs contain different languages for the program. Language information about an audio stream is described in [13818-1].

The client SHOULD provide a UI mechanism to allow the user to select what audio stream is decoded. CIG-70-10

The client SHOULD provide a UI mechanism to allow a user to select a preferred audio language. CIG-70-20

If no preference is selected by the user, then the client SHOULD present the first audio PES listed in the PMT. CIG-70-25

12.3 Emergency Alert System (EAS)

EHD-uDTAs support Emergency Alert capabilities as defined in [SCTE 18]. An EHD-uDTA may, at any given time, receive a message from the headend indicating it must tune to a special channel so the user may receive the EAS message on that channel. When this happens, and the EHD-uDTA is currently streaming video out of the Ethernet port to a client, the EHD-uDTA will tune to the new channel and stream the EAS channel out of the Ethernet port to the client.

At the end of the EAS event, the EHD-uDTA will automatically retune to the previously tuned channel.

If a client sees a channel change happen that it did not initiate, then an EAS event is happening. The client SHOULD make every reasonable effort to decode and display the incoming MPEG content during this period. CIG-70-30

During an EAS event, the client SHOULD not display graphics over the video to block the EAS content. CIG-70-40

When a client sees a second channel change after an EAS channel change, it can assume the EHD-uDTA is terminating the EAS event and returning to the previously tuned channel.

12.4 Closed Captioning (CC)

Closed captioning data will be forwarded in the MPEG picture data as described in [CEA-708]. The client will be responsible for extracting and rendering this data.

The client SHOULD provide a UI mechanism to allow a user to turn CC on and off.

CIG-70-50

The client SHOULD provide a UI mechanism to allow a user to configure CC according to [CEA-708].

CIG-70-60

The client SHOULD extract and decode [ATSC A/53] Part 4 [CEA-708] DTVCC Closed Caption commands and data from MPEG-2 bitstreams when available and the client is rendering audio and video and the user has set closed captioning to on.

CIG-70-70

The client SHOULD extract and decode [ATSC A/53] Part 4 [CEA-708] DTVCC Closed Caption commands and data from MPEG-4 AVC bitstreams when available and the client is rendering audio and video and the user has set closed captioning to on.

CIG-70-80

The client SHOULD graphically render [ATSC A/53] Part 4 / [CEA-708] DTVCC cc_type '10' and '11' Closed Captions.

CIG-70-90

In the event that DTVCC cc_type '10' and '11' are not present, the client SHOULD default to use the [CEA-608] data cc_type '00' or '01' for rendering if they are present.

CIG-70-100

During an EAS event, the client SHOULD not display Closed Captions.

CIG-70-110

The client SHOULD NOT introduce any delay when rendering closed captioning.

CIG-70-120

12.5 Parental Controls

The EHD-uDTA does not observe any parental controls in content forwarded out of the Ethernet port. The client device is responsible for obtaining rating information for channels/content and exposing mechanisms to the user to control access to it.

The client SHOULD provide a parental control mechanism for users to block specific channels and/or content.

CIG-70-130