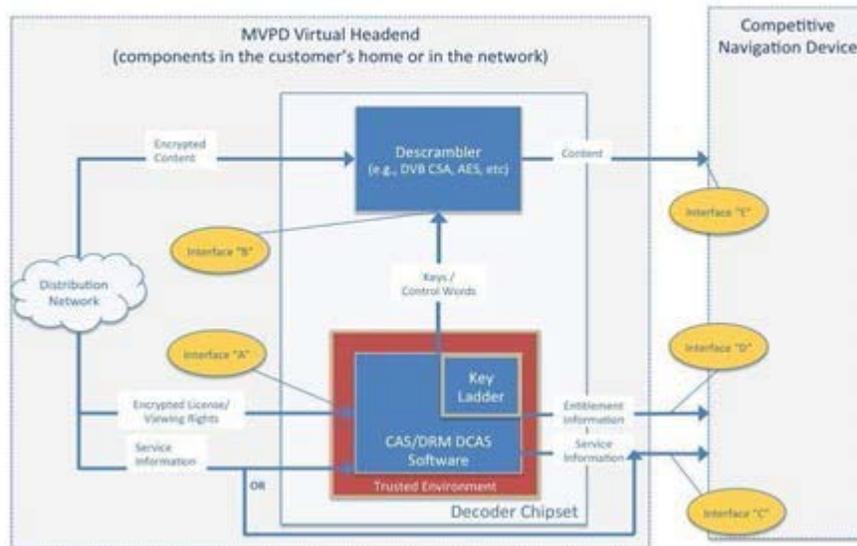# Implementing the Virtual Headend Proposal

The DSTAC's Final Report contained a common outline from two separate working groups relating to a set of interfaces that would need to be satisfied as part of a working solution, described as a "Virtual Headend". Below is a copy of the diagram representing this proposal:

In the WG4 report, the "Competitive Navigation Device" description gives a more detailed explanation of what these interfaces need to do. At a high level, they were described as:

- **Interface "C"** - Service Discovery Interface
- **Interface "D"** - Entitlement Information Interface
- **Interface "E"** - Content Delivery Interface

A Virtual Headend can provide these interfaces through reference to standards and specifications in common use by MVPDs today. It would most resemble VidiPath. It can also be described and referenced in accordance with the tools comprising DLNA CVP-2. In each case it would draw on independent certification tools and bodies already in existence and, unlike other DSTAC proposals, would provide uniformity in access at minimal burden.

Service Discovery Interface

Specifications relating to "Networking and Connectivity" reference the layers at which communications occur overall. "Device Discovery and Control" reference the specific protocols used to broadcast a message and receive a reply about the existence of the Virtual Headend and

its capabilities. Either the CVP-2 server requirement or the UPnP AV Architecture specification satisfies these requirements.

The Service Discovery Interface provides information on the services and relevant metadata for content, including the linear TV channels (including PPV) and VOD (transactional, entitled and free). The content metadata includes program descriptions and availability (air time, cost). Specifics are outlined in (i)(3)(b) below. These are advertised using the "Content Directory Service", which is specified in (i)(3)(a) below.

Parental Control information is included as a required metadata field in the "Content Directory Service", which is outlined in (i)(4) below. EAS is handled as part of the "Content Directory Service", which is outlined in (i)(5) below.

Entitlement Information Interface

The purpose of this interface is to communicate which of the components of available linear TV and VOD services the user is authorized to receive. Again, this is done as part of the "Content Directory Service". In its description of the available services it will indicate which ones the subscriber is authorized to access. The Virtual Headend itself will not output content that the subscriber is not authorized to access. The Entitlement Information Interface in essence is purely informational so as to allow the client device to properly indicate to a user what content is already authorized for access and which is not.

Content Delivery Interface

The purpose of this interface is to deliver the actual content itself (either linear TV or VOD) to the client device from the Virtual Headend. This is addressed in (i)(3) below. Through DTCP-IP or DTCP-2, protection of the content is achieved between the Virtual Headend and the client device. The specifications referenced contain the details about how the transport of the actual media content is done between the devices, which can be done via RTSP, HLS, DASH, HTTP GET, etc.

Requirements relating to closed captioning can be satisfied over this interface as well. The most common technique is simply embedding the CEA-608/708 CC data into the actual media stream itself. There are additional ways to receive the CC data in a side channel using these protocols.

General Summary

Overall, the proposed DSTAC implementation is based on various existing UPnP specifications as well as DTCP, which is similar to the DLNA approach generally. Essentially, the description of technologies below is an extension of DLNA "VidiPath".

The Internet Protocol ("IP") base layer is already heavily in use today for content distribution. Nearly all the service interfaces described above operate over the HTTP protocol using XML data as the message format. DTCP then adds a widely supported security layer so as to provide, in accordance with STELAR and (hence) DSTAC requirements, a uniform and interoperable Virtual Headend with minimum burden to service operators and owners of competitive devices. The DTCP licenses ensure protection of the content by the client devices and all devices downstream from the client.

Implementation In Reference To Existing Standards and Specifications

Industry standards and specifications sufficient to comprise a Virtual Headend system can be referenced in at least two ways -- in terms of CVP-2 certification requirements associated with VidiPath, with modifications; or in terms of specific standards and technologies, starting with either the DLNA CVP-1 or CVP-2 profiles. The "VidiPath" approach involves the provision by MVPDs of an interface which has been certified to conform to the DLNA CVP-2 server requirements, with certain exceptions that relate mostly to guide data, remote user interface, closed captioning, emergency alerts and v-chip data. The second approach involves more fully-specifying specific standards and technologies, beginning with the set of standards referred to by DLNA CVP-1 or CVP-2, and making additions and exclusions. Note that the current approach by some MVPDs of requiring only the receiving devices to be VidiPath certified and not the MVPD's server product is not sufficient. This doesn't ensure that the MVPDs provide an interface that allow the consumer's device to present its own user interface.

Generally, implementation of either approach would create an environment where:
- Remote User Interface is optional
- Diagnostics service is optional
- Authentication service is optional (pairing of subscribers with receivers may be done using a facility similar to TV Everywhere)
- Certification to CVP-2 of receivers is optional, and MVPDs cannot decline to supply programming to non-CVP-2 certified devices.
- Certification of servers is required (with slight changes), ensuring a common interface to competitive retail devices. This requires servers to implement the Content Directory Service (CDS) and the Digital Media Server (DMS), to support content discovery, metadata delivery, and content streaming.
- DTCP and DTCP-2 are essentially mandatory (for commercial reasons, for both receivers and servers)
- Certain other additions are made as well, including:
  - Requirements for how v-chip data is carried
  - Requirement for a certain minimum set of metadata (EPG data)
  - Requirement for how closed captioning data is carried

Navigation Interface Requirements.

A Virtual Headend Interface as provided by a service operator for support of consumer navigation devices is one that:

    i. Is certified to conform to [the mandatory aspects of] the "CVP-2_Server" Device Profile in [DLNA Guidelines Part 5], Section 8.1, with the following exceptions:

        1. "+RUIHSRC+" is optional

        2. Inter-operates with devices that conform to the "CVP-2_Client" Device Profile in [DLNA Guidelines Part 5], Section 8.1, but does not require clients to be "CVP-2_Client"-certified.

        3. Implements the CVP-2_Server CVP-2_Server required DMS function, by function, by following UPNP guidelines for a MediaServer:4 profile, with the following mandatory expansions/required features:

            a. The embedded upnp:ContentDirectoryService:4 shall contain navigable URI's to all linear, linear PPV, VOD assets, and recordings.

                i. The CVP-2 server shall stream content using one of the following mechanisms: HTTP Adaptive, HTTP, RTSP, DASH, or HLS

            b. There shall be full implementation of upnp:EPG feature and cdsEPG class described in DLNA guidelines Part 1 Section 5.7.15 and Part 1 Section 1.7.4.4.11 and detailed in UPnP CDS:4 specification appendix E and F.1.

                i. EPG data for a minimum of the next fourteen days, or the amount present on the MVPDs own UIs (whichever is smaller), of programming metadata shall be supplied in the upnp:EPG implementation.

                ii. All items in upnp:EPG shall have a URI that reference a specific object in the CDS:4.

                iii. The normative requirements in Table A shall be implemented.

                iv. The optional fields in Table A shall be implemented if corresponding data is present in the MVPD's supplied user interfaces (e.g. leased box user interfaces) unless the upnp:ProgramId property contains an EIDR ID.

                v. Purchasing details for PPV and VOD shall be provided as described in (6), below.

        4. Makes content rating information available for an audioProgram or videoProgram EPG Program Item as exposed using the upnp:rating property, and includes the *upnp:rating@type* property, where—

            a. "type" is <CEA-766-Region-1>, indicating that the rating is a rating in Rating Region 1 as defined in ANSI/CEA-766-C (2008), "U.S. and Canadian Rating Region Tables (RRT) and Content Advisory Descriptors for Transport of Content Advisory Information Using ATSC Program and System Information Protocol (PSIP)" and

b. "rating" is the program rating, in the format of the "rating_description_text()" described in ATSC A/65:2009, "Program and System Information Protocol for Terrestrial Broadcast and Cable" section 6.9.3 and Table 6.27.

5. Provides that for VOD purchasing, the metadata contains the URL for VOD content purchase in UPnP foreign Metadata and has the following properties:
   a. A upnp:foreignMetadata@type property with the string value of "fcc.gov_DSTAC";
   b. A upnp:foreignMetadata:fmId property with an empty string;
   c. A upnp:foreignMetadata:fmProvider property with the string value of "fcc.gov"; and,
   d. A upnp:foreignMetadata:fmBody property embedding the URL for purchasing the VOD content

6. The interface complies with ANSI/CEA-2035 (J-STD-070), "Emergency Alert Metadata for the Home Network," April 2010, as follows:
   a. Such interface shall include the X_DSTAC_EASMessageURL state variable in the Content Directory Service description, and shall implement the state variable defined below for EAS eventing. The X_DSTAC_EASMessageURL shall have the following properties:
      i. Data type: string
      ii. Allowed Value: Empty string (""), or a string representing the location URL of the XML document containing the latest EAS signaling messages defined by CEA-2035.
      iii. Value Update: It shall be changed each time a new EAS signaling message is received.
      iv. Evented: Yes.
      v. Moderated event: No.
   b. The X_DSTAC_EASMessageURL state variable shall be defined in the service description document of Content Directory Service using the following XML fragment:

```
<stateVariable sendEvents="yes">
    <name>X_DSTAC_EASMessageURL</name>
    <dataType>string</dataType>
</stateVariable>
```

7. Closed caption data is supplied via the mechanisms referenced in DLNA Guidelines, Part 2 Media Formats.

ii. Uses DTCP-IP or DTCP-2 for link protection, when required.

Table A: *epgItem:item* **Properties**

Property Name	Mandatory Fields (linear TV)	Mandatory Fields (VOD)	Elements
upnp:programID			Contains the unique ID of a program.
upnp:programID@type			Indicates the type of the ID that is contained in the *upnp:programID* property Value: *<ICANN Name>_<Identifier>* <ICANN Name>: The ICANN name of the organization that defines the format and values of the *matchingID* property. <Identifier>: A unique identifier for the particular ID type, defined by that organization.
upnp:channelName	X		Contains the user-friendly name of the associated broadcast channel.
upnp:channelNr	X		Contains the number of the associated broadcast channel. If there exists a *upnp:channelID* property with its dependent property *upnp:channelID@type* property set to "*DIGITAL*", then the *upnp:channelNr* property shall be set equal to the major channel number from that *upnp:channelID* property. Else, if there exists a *upnp:channelID* property with its dependent *upnp:channelID@type* property set to "*ANALOG*", then the *upnp:channelNr* property shall be set equal to the value of that *upnp:channelID* property.

Property			Description
upnp:programTitle	X	X	Contains the name of the program. This is most likely obtained from a database that contains program-related information, such as an Electronic Program Guide.
upnp:longDescription		X	Provides a summary or synopsis for the EPG Program Item.
upnp:channelID			Indicates the channel that is associated with the content item.
upnp:channelID@type			Determines the format that is used for the *upnp:channelID* property as defined above. The possible formats and allowed values of the upnp:channelID@type property are identical to the possible formats of the srs:scheduledChannelID@type property as described in the ScheduledRecording service specification [SRS].
upnp:channelID@distriNetworkName			Identifies the Distribution Network from which the channel is sourced.
upnp:channelID@distriNetworkID			Identifies the Distribution Network from which the channel is sourced.
upnp:scheduledStartTime	X		Indicates the start time of a scheduled program, intended for use by tuners. The format shall be compliant to ISO 8601. Compliance with RFC 3339 also is recommended.
upnp:scheduledEndTime	X		Indicates the end time of a scheduled program, intended for use by tuners. The format shall be compliant to ISO 8601. Compliance with RFC 3339 also is recommended.
upnp:scheduledStartTime@usage	X	X	Indicates whether the *upnp:scheduledStartTime* and *upnp:scheduledEndTime* properties contain the start and end times of a scheduled program event, or contain the start and end times of the time window within which on-demand content is available for consumption. Allowed values are "SCHEDULED PROGRAM" and "ON DEMAND".

Property			Description
upnp:scheduledDuration	X	X	Indicates the scheduled duration of a scheduled program. The durat i on format syntax of the *upnp:scheduledDuration* property is defined in Appendix D, "EBNF Syntax Definitions".
upnp:scheduledStartTime@daylightSaving			Indicates whether the time value used in the *upnp:scheduledStartTime* property is expressed using as a reference either Daylight Saving Time or Standard Time. This property is only applicable when the time value in the *upnp:scheduledStartTime* property is expressed in local time. Whenever the time value in the *upnp:scheduledStartTime* property is expressed in absolute time, the *upnp:scheduledStartTime@daylightSaving* property shall not be present on output and shall be ignored on input.
upnp:scheduledEndTime@daylightSaving			Indicates whether the time value used in the *upnp:scheduledEndTime* property is expressed using as a reference either Daylight Saving Time or Standard Time. This property is only applicable when the time value in the *upnp:scheduledEndTime* property is expressed in local time. Whenever the time value in the *upnp:scheduledEndTime* property is expressed in absolute time, the *upnp:scheduledEndTime@daylightSaving* property shall not be present on output and shall be ignored on input.
upnp:rating	X	X	Contains the viewer rating value of the content of this item expressed in the rating system indicated by the *upnp:rating@type* property.
upnp:rating@type	X	X	Indicates the rating system used in the *upnp:rating* property, and shall be <CEA-766-Region-1> as defined in CEA-766, "U.S. and Canadian Rating Region Tables (RRT) and Content Advisory Descriptors for Transport of Content Advisory

Property			Description
			Information Using ATSC Program and System Information Protocol (PSIP)".
upnp:seriesTitle	X	X	Contains the name of the series.
upnp:episodeType			Indicates the broadcast novelty (for example, "FIRST-RUN" or "REPEAT") of this content item.
upnp:episodeNumber			Contains the episode number of this recorded content within the series to which this content belongs.
upnp:episodeCount			Contains the total number of episodes in the series to which this content belongs.
upnp:episodeSeason			Indicates the season of the episode
dc::date	X	X	Indicates the 'original airing date' of the content; for movies this should correspond to the theatrical (or corresponding such as DVD/BluRay/OnDemand) release of the content.
upnp:genre	X	X	Indicates the genre to which an item belongs.
upnp:genre@extended			A CSV list of genre names, which are individually displayable strings, representing increasingly precise (sub)genre names. The first entry must be equal to the value of the upnp:genre property.
upnp:actor			Indicates the name of an actor performing in (part of) the content.
upnp:actor@role			Indicates the role of the actor in the work (such as Guest Star, Narrator, Host, etc.)
upnp:director			Indicates the name of a director of the content (for example, a movie)
upnp:producer			Indicates the name of a producer of the content (for example, a movie)

Property		Description
PPV and/or VOD Related		
upnp:payPerView	X	Indicates whether the object represents pay-per-view content. When set to "1", the object is a pay-per-view object. When set to "0", the object is not a pay-per-view object.
upnp:price	X	Contains the price for a broadcast, series, program, movie, etc.
upnp:price@currency	X	Indicates the unit of currency used for the upnp:price property. The allowed values for this property shall be as specified in ISO 4217, "Type Currency Code List".
upnp:foreignMetadata::fmBody	X	Provides access to the foreign metadata for this object. Access to the foreign metadata is achieved directly. For example, the sub-element contains a URI.
res@validityStart		Defines the beginning date&time when the corresponding uses described in the res@allowedUse property become valid. The format of the res@validityStart property MUST comply with the date-time syntax as defined in Appendix D, "EBNF Syntax Definitions". When the res@validityStart property is not present, the beginning of the validity interval is assumed to have already started.
res@validityEnd		Defines the ending date&time when the corresponding uses described in the res@allowedUse property become invalid. The format of the res@validityEnd property MUST comply with the date-time syntax as defined in Appendix D, "EBNF Syntax Definitions". When the res@validityEnd property is not present, there correspondingly is no end to the validity interval.
res@allowedUse	X	Composed of a comma-separated list of value pairs. In each pair, the first value corresponds to an allowed use for the resource referenced by the associated res property. RECOMMENDED enumerated values are: "PLAY", "COPY",

		"MOVE" and "UNKNOWN". Vendors may extend this list. A value of "UNKNOWN" indicates that allowed uses for this resource may exist, but have not been reflected in the ContentDirectory service.
res@useageInfo	X	Contains a user-friendly string with additional information about the allowed use of the resource, as in the example: "Playing of the movie is allowed in high-definition mode. One copy is allowed to be made, but only the standard definition version may be copied".
res@rightsInfoURI		References an html page and a web site associated with the rights vendor for the resource. The referenced page SHOULD assist the user interface in documenting the rights and the renewal of the allowed use of the resource.