REMOVING COST AND COMPLEXITY FROM THE CONNECTED HOME

DLNA COMMERCIAL VIDEO PROFILE FOR MSOs AND IPTV OPERATORS

STRATEGIC WHITE PAPER

The growing use of connected consumer electronics (CE) devices in the home provides a route for operators to redefine the operating model and cost base for pay TV services. By tapping consumers' willingness to spend on smart or connected devices, pay TV operators can remove the need to provide set-top boxes (STBs) while offering consumers a better and more interactive television experience. To date, however, progress has been inhibited by the lack of a cost-effective and manageable way to handle the proliferating client requirements for each device and operating system.

Digital Living Network Alliance (DLNA) provides a set of standards that allow CE equipment to share media (pictures, music and video) between devices within a single home. Its Commercial Video Profile 2 (CVP2) specification supplies a framework within which operators can deliver their premium video content to retail CE devices purchased by the consumer. This framework simplifies the client build requirements, allowing pay TV operators to reduce the time and complexity involved in deploying multiscreen services.

The move toward CVP2 will be evolutionary. In the short term, some operators, including multiple-system operators (MSOs), will invest in media gateway functionality to terminate the cable (QAM) streams in the home gateway. They will then use DLNA standards to deliver content to end devices over the home IP network. As cable networks move toward all-IP, processing will migrate into the network and away from the media gateway. Content sources will originate in the network. IPTV operators can do this today. This white paper discusses how MSOs and IPTV operators can extend the DLNA standards to deliver on-demand content directly from their networks to CE devices in subscriber homes.

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1. INTRODUCTION

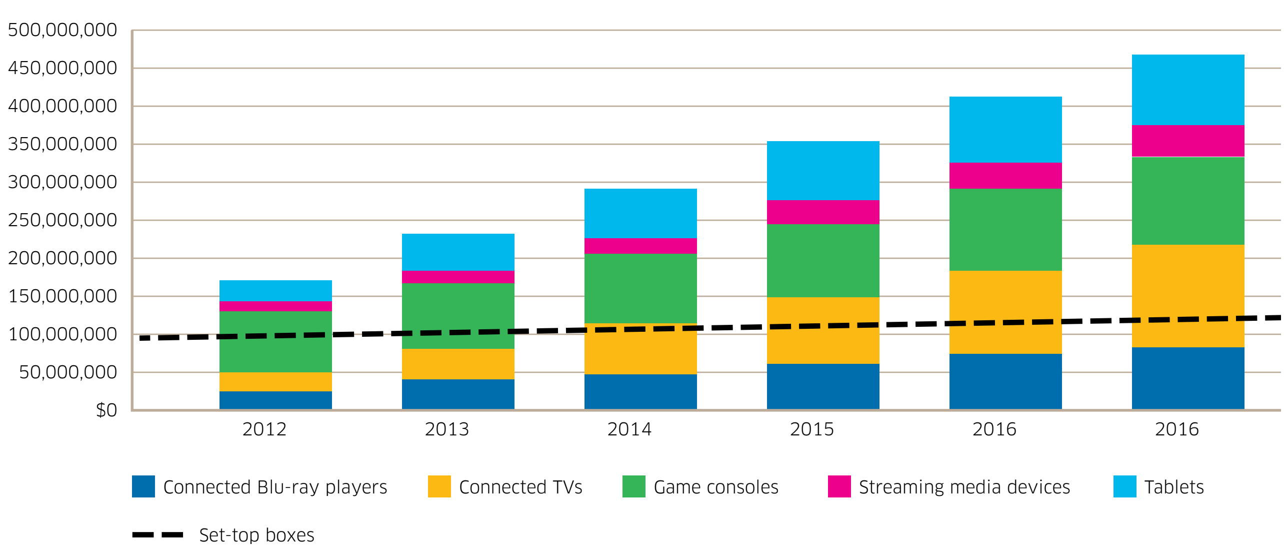
Increasing broadband network speeds have made it feasible to stream video on demand to end users in their homes. Empowered by these higher speeds, a growing number of online video streaming services — including recent entrants such as Apple, Hulu, NetFlix and Amazon/LoveFilm — are seeking to capture a share of the consumer entertainment market. What's more, major broadcasters are expanding their offering beyond the TV screen to PCs, tablets and smartphones. Examples are TV Everywhere in the United States and YouView and SkyGo in the United Kingdom.

At the same time, major pay TV operators, including telcos and MSOs, are experimenting with IP video as the potential future mode of operation for delivering TV services to the home. IP video promises to remove the need for in-home, operator-provided devices, including set-top boxes (STBs) and digital video recorders (DVRs). It will also eliminate the need to operate managed video networks using quadrature amplitude modulation (QAM) schemes and multicast IP. These devices and networks will be replaced with IP video delivered direct to consumer-purchased devices.

All of this promises to bring significant value to end users. The prospect of watching premium content on demand and on any device is very attractive to consumers. Over the past two years, almost a third of all US Internet traffic in peak evening hours has come from one source alone: Netflix.[1] Statistics for BBC iPlayer show a continuous near-linear increase in viewership since 2009. Users of iPlayer now watch more than 170M TV programs per month.[2]

Consumers are enthusiastically embracing video-friendly connected devices. Figure 1 highlights research by Informa, which projects continued growth for connected Blu-ray players, TVs, game consoles, streaming media devices and tablets between 2012 and 2017. The figure also highlights the relatively flat growth projection for STBs, as indicated by the dashed black line.

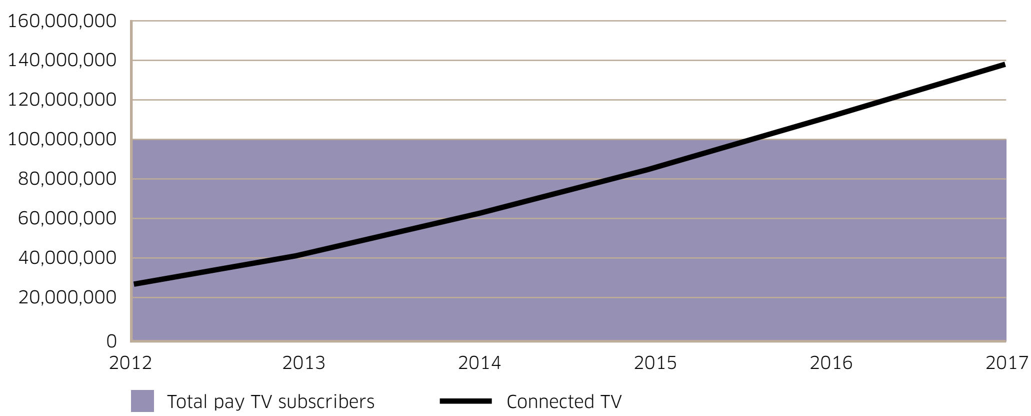
Figure 1. Consumer connected devices in the United States – Informa



1 "2013 Global Internet Phenomena Report: 1H 2013." Sandvine, May 2013.
2 "BBC iPlayer Performance Pack –August 2013." BBC Communications, September 30, 2013.

Informa anticipates particularly strong growth in the US smart TV market between 2012 and 2017. Figure 2 contrasts increasing smart TV penetration with relatively static pay TV subscribership.

Figure 2. Smart TV penetration in the United States – Informa



For operators, the opportunity to leverage consumer-purchased devices has the potential to transform the economics of pay TV. Operators are facing pressure from two key sources:

- Television networks and broadcasters are continually pushing for higher affiliate and retransmission fees.
- Consumers are questioning the value of pay TV services and showing an unwillingness to pay more to cover higher affiliate and retransmission fees.

In addition, operators have to keep investing in their video networks so that they can cope with video traffic growth.

The shift to IP video offers a chance to relieve this pressure. Consumers are buying IP video-enabled devices like tablets, smartphones and game consoles. These devices offer operators a means to deliver video to consumers without having to invest in more STBs. By funding the devices required to reach them, consumers will indirectly help reduce or eliminate the nearly US$10 billion per year currently spent on operator-provided STBs.[3]

2. THE CE DEVICE FRAGMENTATION CHALLENGE

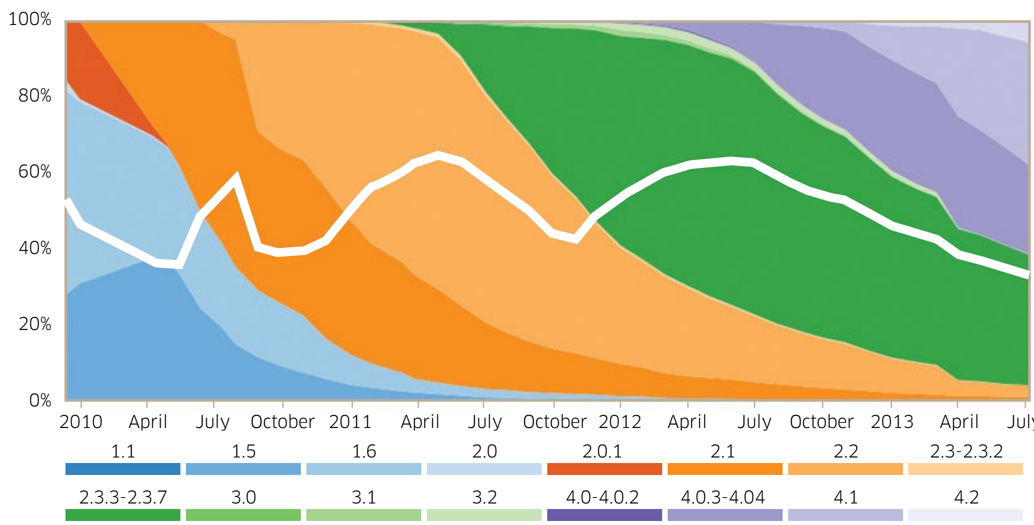
Device fragmentation is the biggest challenge for pay TV operators seeking to capture a multiscreen audience. These operators need to meet the demand for premium content across a fast-growing and increasingly diverse collection of CE devices, including game consoles, PCs, smartphones, tablets and smart TVs.

Smart TVs create the most problems. Pay TV operators can reach the majority of the market by supporting two types of consoles (Xbox 360 and PS3) and two types of PCs (Windows and MacOS). But there is no commonality between smart TV operating systems.

3 " Set-Top Boxes and Pay TV Subscribers – Market Share and Forecasts, 4Q12." Infonetics, April 8, 2013.

Tablets and smartphones present similar problems: Apple devices can be easily covered with iOS but there are many variants of Android, as illustrated in Figure 3. The end result is that operators need to support hundreds of CE device and OS variants. For example, Netflix currently supports over 800 device/OS variants; BBC iPlayer supports more than 600 variants.

Figure 3. Android fragmentation – Opensignal[4]



Device fragmentation will continue to grow, as will demand for high-quality multiscreen TV services. To provide a captivating experience on every device and operating system, pay TV operators need to build applications for these devices that address key requirements relating to content discovery, advanced remote control, content streaming and content protection.

2.1 Content discovery

The content provider needs a user interface (UI) that will allow end users to search for and select content. Traditionally, this need has been served using a grid-based electronic program guide (EPG). Navigation using a 6-button (left, right, up, down, select and back) remote control makes the EPG an adequate way to find programs currently being broadcast. It is suitable for TV screens viewed from 3 meters away.

Beyond the main screen experience, consumers are demanding more advanced UIs. They want UIs that can complement the grid with support for deeper metadata searches and more interactive features. For many, the ideal option is to use a smartphone or tablet as a remote control. These devices offer far superior input capabilities, making it easier to search for programs that are on now, in back catalogs, stored on DVRs or available through catch-up TV. A tactile 6-button remote control can provide quick navigation once the selected program has started.

4 "Android Fragmentation Visualized." Opensignal, July 2013.

2.2 Advanced remote control

A smartphone- or tablet-based remote application needs to understand and interact with other devices in the home. For example, it must enable consumers to move content between devices, pause and resume programs on different screens, browse the EPG and control the main screen. These capabilities require either back-end logic that understands and links clients on a home network, or some form of home-based gateway proxy that can perform this function.

2.3 Content streaming

The CE device needs the ability to receive streamed content. In addition to broadcast content, streamed content may be sent as unicast IP traffic over the Internet or relayed by way of in in-home gateway device.

When content was streamed solely from a source inside the home to devices in the home, bandwidth was not usually a constraint. The choice of resolution was determined by the capabilities of the display device. For example, there is no value in sending an Ultra HD 4K stream to a smartphone. Even if it could process the stream in real time, the smartphone would be unable to display the requisite level of detail.

When content can be streamed across the open Internet, the available bandwidth depends on many factors, including the access network speed and the services that are concurrently operating. Strict admission control can be used across a fully managed network to ensure that there is sufficient bandwidth for each stream before it starts. This approach is used often in IPTV systems. However, it is not practical when there are many sources for streams. It is possible to dynamically adjust the encoder parameters for a single stream, but it is very expensive to have one encoder per stream.

HTTP Adaptive Streaming (HAS) provides a more economical solution that dynamically adapts the encoding bitrate to the available bandwidth. HAS pre-encodes streams in several (typically 6–10) bit rates. The client dynamically senses the available bandwidth and pulls the most suitable bit rate. As content is divided into short chunks (typically 2–10 seconds long), the client can make a new decision every 2–10 seconds and select a different bit rate if the network conditions have changed. Most CE devices purchased today include built-in support for HAS.

2.4 Content protection

Content protection is essential. To start, the content provider or aggregator needs the ability to authenticate subscribers. This may be a matter of knowing that a given subscriber has a registered IP address or valid username and password credentials within the operator's network. Stronger authentication may be needed in cases where authentication credentials involve information from the client device.

The next stage of protection is to scramble the content as it is streamed over the network. This may involve a simple per-session key exchange and AES content scrambling mechanism. Or, it may require a full-blown digital rights management (DRM) scheme.

3. DLNA AND CVP2

Digital Living Network Alliance (DLNA) offers a potential solution to the device fragmentation challenge. Its Commercial Video Profile 2 (CVP2) specification enables cable and IPTV operators to provide whole-home DVR and multi-room services to a large number of device types at a reasonable cost. It also enables operators to use their networks to stream premium content to subscribers on demand. In both cases, the operator determines the user experience and can ensure that it is consistent across devices. What's more, the use of CVP2 ensures that these services can be quickly deployed and updated.

Many operators have begun to explore DLNA as a means to simplify the development of clients for the home. A standards-based solution, DLNA removes the need for operators to develop specific clients to support capabilities such as device interoperability and control. The CVP2 initiative adds enhanced HTML5 UI, client security and content encryption capabilities. These capabilities can help operators reduce the time and complexity involved in deploying pay TV services across a range of connected devices.

3.1 DLNA

Digital Living Network Alliance (DLNA) was founded in 2003 by a collection of global companies that shared a vision to easily connect and enjoy photos, music and video amongst networked CE, PC and mobile devices. This vision includes the streaming of video content.

DLNA has developed a set of specifications to allow interworking between certified wired and wireless devices. These specifications combine plug-and-play capabilities with automatic discovery. The combination makes it easy for consumers to add devices to their home DLNA networks and begin sharing and streaming content.

Over 250 companies around the world are committed to developing DLNA specifications and manufacturing DLNA Certified® products. More than 20,000 products have already been certified including smart TVs, storage devices, mobile phones, software, cameras, printers, game consoles, PCs, photo frames, media adapters, STBs, audiovisual (AV) receivers, Blu-ray disc players and tablet computers. DLNA Certified devices take the guesswork out of selecting products that work together and facilitate better, easier sharing of digital video, photos and music throughout the home.

Recent improvements in CE device processing power have made the execution of browser-based solutions viable. In addition, there is increased desire for delivery of commercial video to CE devices such as smart TVs. In response to these developments, DLNA is developing a new set of recommendations known as Commercial Video Profile 2 (CVP2). These recommendations will allow premium video providers to deliver their content directly to retail devices.

CVP2 is being developed to use the latest technologies. For example, its Remote UI uses HTML5, which allows for embedding of video into web pages while supporting a more powerful UI. It encodes video media using Advanced Video Coding (AVC) or High Efficiency Video Coding (HEVC), and supports different video resolutions. There are slight variations in the US and European requirements because the media is largely dependent on the underlying TV standards. Of more importance is the plan to support adaptive streaming with Dynamic Streaming over HTTP (MPEG-DASH) technology.

The CVP2 specification also includes support for authentication, diagnostics and low power consumption.

3.2 DLNA architecture summary

DLNA defines several classes of devices. A device class specifies the functional capabilities of a device regardless of its physical attributes. In fact, a single physical device can, and frequently does, incorporate multiple device classes.

- Digital Media Server (DMS) is used to store content and make it available to other devices on the network. Content can be uploaded, downloaded or streamed as needed. The DMS provides a simple directory structure to better catalogue the content. Examples of DMS devices include PCs, network attached storage (NAS) and portable media players such as smartphones and tablets.
- Digital Media Player (DMP) products find content offered by a DMS or M-DMS and provide playback and rendering capabilities. DMPs are not visible to other devices on the network, such as Digital Media Controllers (DMC or M-DMC). Examples of DMP devices include TVs, home theater systems, game consoles and handheld mobile devices like smartphones.
- Digital Media Renderer (DMR) products are similar to DMPs in that they render or play content received from a DMS or M-DMS. However, DMRs are unable to find content on the network, and must be set up by a Digital Media Controller (DMC or M-DMC). A combination DMP/DMR device can either find a DMS on its own or be controlled by an external DMC or M-DMC. Examples of DMRs include TVs, AV receivers and remote speakers.
- Digital Media Controller (DMC) products find content offered by a DMS or M-DMS and match it to the rendering capabilities of a DMR. This process sets up the connections between the DMS and DMR. An example of a DMC device is an intelligent remote control such as a tablet or smartphone.
- Digital Media Printer (DMPr) products provide printing services to the DLNA home network. Although photo printing is the primary usage of the DMPr, more traditional printing applications also support a DMPr. Networked photo printers and networked all-in-one printers are examples of DMPr devices.

An ‘M-‘ prefix is used to denote mobile variants of DMS, DMP, DMR, DMC and DMPr — for example, M-DMS and M-DMC. The main difference between the fixed and mobile variants is the media formats they support. For instance, an M-DMP does not need to support HD video.

Figure 4 shows the DLNA stack from the network upwards. DLNA has not aimed to create standards but rather to profile pre-existing standards. In particular, it uses the Universal Plug and Play (UPnP) standards for device and content discovery. This allows devices on the home network to seamlessly find each other, discover their capabilities and provide basic control functions.

DLNA defines two modes of working: 2-box and 3-box. In 2-box mode, there are two devices interacting. This can be a DMP (for example, a TV or game console) interrogating a DMS (for example, a NAS or PC with photos, audio or video content), selecting content and streaming it for local display. The 3-box mode caters to devices with more limited capabilities. The third device acts as a controller, or DMC. It can read content on a DMS and send it to a DMR.

Figure 4. DLNA stack

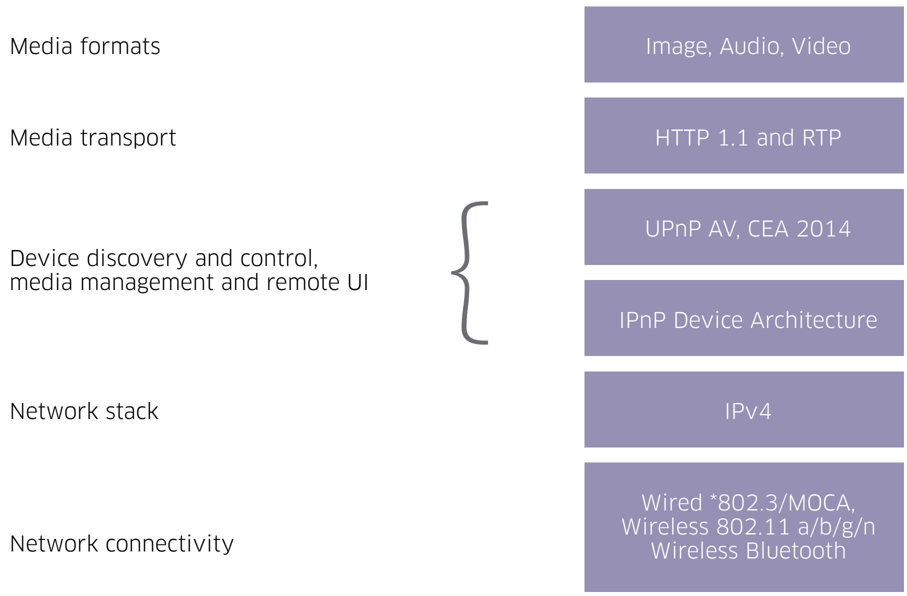
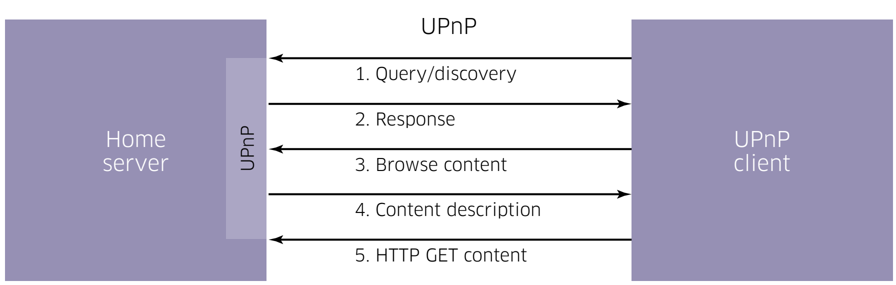


Figure 5 shows a typical 2-box DLNA/UPnP client accessing a home server. In steps 1 and 2, the client (for example, a TV) uses UPnP to discover the home server (for example, a PC or media sever). In steps 3 and 4, the client requests the content available for viewing through the local UPnP UI on the TV. Finally, the client issues a request to stream or download the media for local rendering and display.

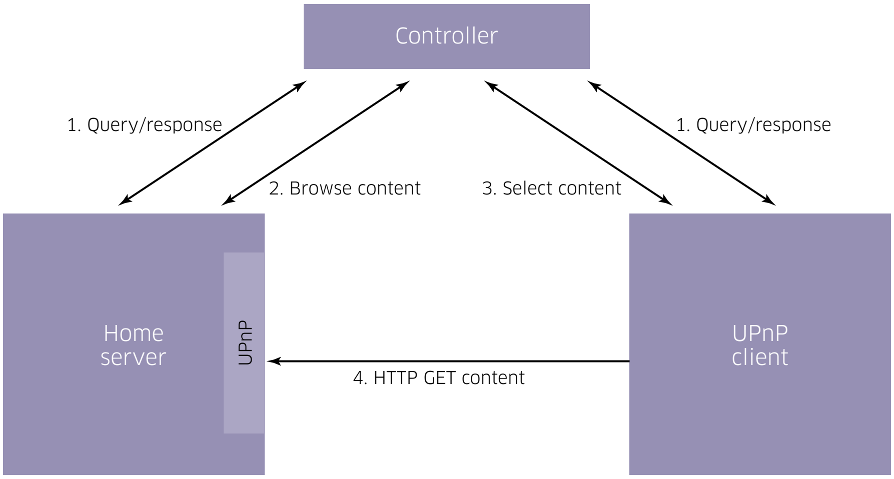
Figure 5. 2-Box UPnP client



In the 3-box solution, the client and home server a joined by a controller device (DMC), as shown in Figure 6. Through UPnP, the client, server and DMC discover each other. Using the controller device, the end user browses and selects the content on the home server and then directs it to the client. The content can either be pushed to the client for rendering or pulled by the client.

In the DLNA 2-box model, the DMP client is responsible for the UI. While often similar, the exact look and feel of the UI differs between devices. To overcome this issue, DLNA supports the concept of remote UIs. The definition of the UI is defined on a shared device and downloaded to the device (DMP or DMC).

Figure 6. 3-box UPnP solution



DLNA uses HTML/JavaScript and RVU technologies to support remote UIs. It first created a profile based on HTML4 as defined by the Consumer Electronics Association's CEA-2014 standard. More recently, the introduction of HTML5 has opened up new opportunities to create much more modern-looking and compelling UIs. In addition, DMPs offer much more processing power.

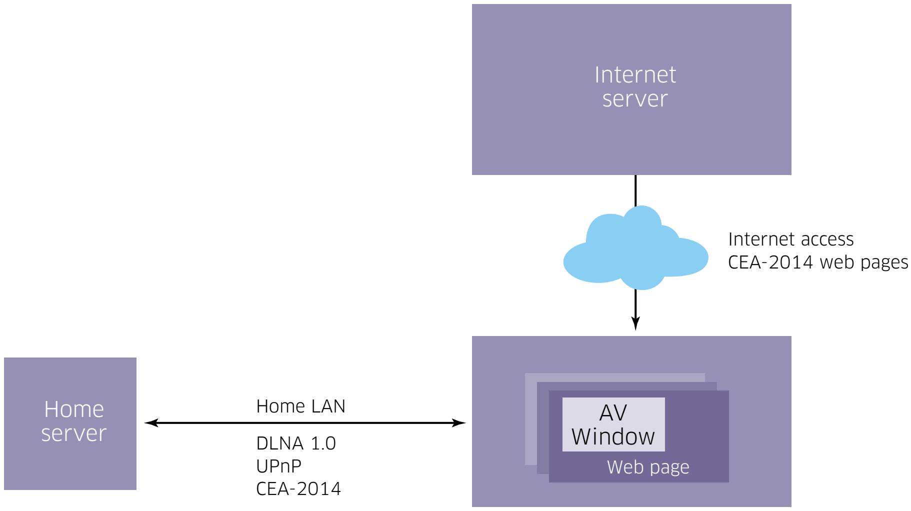
To capitalize on these new device capabilities, DLNA is working to build HTML5 support into its new CVP2 standard. In the interim, DLNA has defined the use of RVU for remote UIs as a means to overcome the shortcomings of CEA-2014 as well as the earlier processing power limitations. RVU is technically similar to the Microsoft® Remote Desktop Protocol (RDP). It provides pixel-accurate UIs but requires high bandwidth when the UI changes.

3.3 Improved UIs and CEA-2014

When the first DLNA devices were certified, many CE devices had very limited processing power and input capabilities. User interfaces had to be very basic, and the look and feel of a given UI depended on the CE vendor. As processing improved and Internet connectivity became widespread, the idea of connecting TVs to the web became a reality. These connected TVs had browsers. To support web browsing, the CEA defined a profile of HTML known as CE-HTML and made it part of CEA-2014. This profile uses a constrained set of the HTML4, JavaScript, Cascading Style Sheets level 1 (CSS TV 1.0) and Document Object Model Level 2 (DOM 2.0) specifications, along with some CE device extensions. As long as a web page conforms to CEA-2014, it can be displayed on a connected TV or other CE device.

With a CEA-2014-enabled DMP, a home server such as a NAS acting as a DLNA DMS can hold a user's music and movie collection and provide a rich UI common to all clients that access the NAS. This configuration is shown in Figure 7.

Figure 7. With CEA-2014, a home server can store content and provide a common UI to all clients



3.4 RVU protocol

Initially, there were two issues with CEA-2014-enabled devices: inconsistent and poor performance meant that the UIs often clunky, and the exact layout varied from browser to browser. To overcome the problems with web-based CEA-2014 remote UIs, DLNA has ratified an alternative way to generate a remote UI, known as RVU (pronounced "R-View"). Clients are thin, and the UI is generated and executed on another server in the home. RVU creates pixel-accurate UIs using a remote bitmap approach similar to Microsoft RDP. There is no processing on the client — only rendering of the remote bitmap information.

RVU allows operators to introduce whole-home DVRs and multi-room viewing at minimal cost. For example, DirectTV has introduced a six-tuner DVR/home gateway that also acts as a RVU server. TVs and other clients can get the UI and stream content from the DVR. Some TV manufacturers have begun to build RVU support directly into their products.

3.5 Remote UI through HTML5

Today, users expect a compelling UI. Fortunately, the increased processing power and memory capacity generally available in retail devices can deliver powerful UIs. There is no longer a need to create the UI on a separate server and stream the bitmaps to the display device. Applications stored on these devices already have most of the information required to deliver a superior user experience, including all application graphics and page display instructions. Scalability improves if the display device runs as an application and only needs to request EPG and program data from the server.

Web-based UIs enable operators to provide a consistent user experience across a range of devices. They also make it easy to update this experience. TVs with web browsers have been available for some time. With HTML5, the user experience is downloaded to the client device when a user points a TV or other player to the operator's website. The operator can quickly update the look and feel of the site and make it available to all devices. With constructs such as canvases, animations and video tags, HTML5 is well suited to providing flexible and compelling UIs. Moreover, its use of WebSockets and JavaScript allows for efficient updating of EPG values.

HTML5 allows web pages consisting of HTML5/JavaScript and CSS files to be stored on the client device. The version must always be checked, and the data (such as the current EPG) will need to be downloaded on a regular basis. But there is no need to download the entire web application each time the pages are used.

HTML5 is the standard for CVP2 UIs. Many connected devices already have web browsing capabilities. Using HTML5, an operator can create a consistent UI across a range of devices. The home gateway can act as a web server and deliver compelling UIs to devices throughout the home. Alternatively, the client device can access the operator's website. The DLNA 3-box model supports the use of a smartphone or tablet as a remote control. These devices provide excellent support for content discovery. Once content is found, it can be played from the DVR in the home or the operator's TV Everywhere service.

3.6 Content delivery through MPEG-DASH

DLNA uses multiple profiles for media codecs and streaming to address different protocols, video formats, device capabilities and expectations relative to quality of experience.

DLNA supports HTTP progressive download for streaming content from inside the home network. This works in most cases because there is usually sufficient bandwidth in the home.

DLNA also supports HAS for streaming content across the open Internet to dynamically adapt the encoding bitrate to the available bandwidth. MPEG-DASH is the standardized form of HAS supported by DLNA.

3.7 Content protection through DTCP-IP

DLNA specifies that Digital Content Protection over IP (DTCP-IP) be used for moving content between devices. DTCP-IP is a link-protection system. It allows any pair of devices to establish a secure link without the overhead of a DRM system. One requirement is for DLNA Certified devices to be able to exchange audiovisual (AV) data without the need for pre-configuration. This is done by exchanging X.500 certificates to verify that the communicating party is a DLNA Certified device and using these certificates to establish a session key. DTCP-IP also imposes strict limitation on the relative distance between client and server (see section 4.2). The aim is to ensure that DTCP-IP is only used to protect content exchanged within the home.

4. EXTENDING DTCP-IP

4.1 Migrating content sourcing in the network

Current implementations of DLNA within operator networks are dominated by reliance on a home gateway acting as an origin server, or DMS, to devices in the home. The home gateway receives content from the operator's network and delivers it, possibly after transcoding or repackaging, to other devices in the home.

This is a logical choice for MSOs that continue to run television over QAM networks, and require QAM tuning by way of a device in the home.

For telcos running pure IP networks, or for MSOs migrating to all-IP networks, deploying this additional processing in the home makes little sense. These operators can achieve greater economic efficiencies by migrating the following processing functions to the network:

- Content preparation – Encode content in a DLNA-defined codec or profile.
- Transcoding – Use head end- or network-based transcoding where necessary.
- Device specific packaging – Use head end- or network-based content repackaging.
- DVR – Deploy a network DVR.
- UI rendering – Serve an HTML5 UI from the network.

This leaves only security or encryption as a gap. The gap can be covered using standard DRM mechanisms such as Microsoft PlayReady® and Adobe® Access. However, each of these mechanisms requires specific client software or plugins. These requirements push complexity onto the operator.

As an alternative, the extension of existing CVP2 Link Level encryption (that is, DTCP-IP) allows content to be encrypted at the network level. It enables operators to keep their CVP2-based client implementations simple and migrate DMS content sources from the home or home gateway into the network.

Migration may be a gradual process for cable operators, with clients rendering unified UIs from DMS sources both in the home (high usage linear QAM-based video channels) and from the network. Over time, sources would migrate from the home to the network and eventually negate the requirement for a home gateway or STB.

4.2 Content protection through extended DTCP-IP

DTCP-IP technology is designed to secure media, including video, over IP networks within the home. Existing DTCP authentication procedures focus on several goals:

- Prove that the source is a genuine DTCP-IP implementation.
- Provide a secure way to exchange keys.
- Propagate rules for possible further content dissemination.
- Avoid unauthorized distribution by applying localization rules.

To confine content sharing to the home, DTCP imposes some localization constraints. These include a time to live (TTL) of less than 3 hops, a round trip time (RTT) of less than 7 msec and a DTCP source restriction of 34 concurrent streams.

These restrictions exist because DTCP-IP security is weaker than most DRM schemes. It is adequate for in-home sharing of media between DLNA-compliant devices. MSOs and IPTV operators already know that they are delivering to a subscriber on their network. It is therefore logical to consider a DLNA source in the operator's network as an extension of the home network and relax these localization rules. This would allow an MSO or IPTV operator to stream directly from its network to CE devices in subscribers' homes.

5. DEALING WITH LEGACY DEVICES

Several companies are marketing reasonably priced HDMI or USB dongles that can convert a basic TV into a smart TV. The dongle is a small but powerful device capable of running many TV-related apps and over-the-top (OTT) video services.

Dongles often have a dual-core or even quad-core CPU running at 1 GHz or more with 1 GB or more memory. Many have built-in Wi-Fi® or Ethernet for connectivity to the home network. Many dongles also run Android OS, which means they can access the entire Google Android Play application marketplace.

What all of this means is that dongles have the processing power to run compelling UIs and be updated from the application store as necessary. In addition, they provide a common video player with potential for hardware hooks for supporting secure DRM schemes.

Dongles are likely to support Google Chrome or other HTML5 browsers, and a video player capable of running MPEG-DASH with AVC or HEVC video decoding. They are an attractive target for OTT TV app developers, and will become even more attractive when their current rough edges are smoothed. For companies like Amazon, Apple and Google, dongles offer a way into the TV market. Google has already begun addressing this market with its Chromecast streaming media adapter.

Dongles are also suitable devices for running DLNA CVP2-based clients. This means that IPTV and cable operators can use dongles to offer their services on TVs that do not support DLNA CVP2.

6. SUMMARY

Pay TV operators are being challenged to deliver their content to customers on many different connected devices. Customers also want to use these devices to view content already stored on DVRs, just as they do with personal content stored on their PCs. DLNA has defined a set of standards to support in-home streaming of pictures, music and video. With the CVP2 standard, DLNA is now extending its specifications to include streaming of professional content.

With CVP2, a pay TV operator can deliver video to multiple devices in the home. By specifying the use of HTML5, CVP2 ensures that operators can extend a consistent and compelling UI across device types and avoid creating hundreds of applications to overcome the fragmentation caused by smart TVs. The improved processing power in smart TVs will enable operators to offer compelling HTML5-based user experiences. Where this is not possible, operators can incorporate a smartphone- or tablet-based remote control application.

Dongles can be used for TVs that are not connected or that do not have the ability to run CVP2. Many dongles run the Android OS, which means that they support HTML5 and MPEG-DASH for content delivery. If a dongle can support DTCP-IP and decode AVC and HEVC (future requirement), it can be used to extend the operator's offer and enhance the customer experience.

CVP2 can enable an operator to provide a home gateway that is also a whole-home DVR. The DVR supplies the remote user interface (RUI) to the other devices in the home. It provides an operator-branded and consistent look and feel without the need to create device specific applications. The operator can stream content from this DVR to CVP2-compliant devices over the home network. Further, CVP2 with extended DTCP-IP enables the operator to migrate the DLNA server function into the network so that client devices can stream content from sources within the network. Initially, operators will support a blend of content sources, including home gateways/STBs and the network. Over time, a move to deliver all content directly from the network will free up the US$10 billion per year currently spent on operator-provided STBs.

DTCP-IP provides adequate protection for delivery from the home gateway to other devices in the home. This eliminates the need to support DRM clients on all target devices. By extending DTCP-IP, MSOs and IPTV operators can provide protection when they stream from the network to subscribers' homes.

Looking ahead, DLNA CVP2 offers an excellent set of specifications for cable or IPTV operators seeking to quickly provide on-demand services (both time-shifted TV and TV Everywhere) to multiple devices in subscribers' homes. HTML5 and MPEG-DASH will become widely used on smart TVs, PCs, smartphones and tablets, which will reduce the cost of supporting them. Modifying the DTCP-IP localization rules allows operators to protect content delivered into the home. Before the full DLNA CVP2 specifications are finalized and deployed in the field, dongles will be used on non-networked TVs and remote control applications on smartphones and tablets.

7. ABBREVIATIONS

AES	Advanced Encryption Standard
A/V	Audiovisual
AVC	Advanced Video Coding
CE	Consumer electronics
CEA	Consumer Electronics Association
CPE	Customer-premises equipment
CPU	Central processing unit
CSS	Cascading Style Sheets
CVP2	Commercial Video Profile 2
DASH	Dynamic Adaptive Streaming over HTTP
DLNA	Digital Living Network Alliance
DMC	Digital Media Controller
DMP	Digital Media Player
DMPr	Digital Media Printer
DMR	Digital Media Recorder
DMS	Digital Media Server
DOM2.0	Document Object Model Level 2
DRM	Digital rights management
DTCP	Digital Transmission Content Protection
DVB-C	Digital Video Broadcasting - Cable
DVR	Digital video recorder
EPG	Electronic program guide
HD	High definition
HDMI	High-Definition Multimedia Interface
HEVC	High Efficiency Video Coding
HTML	HyperText Markup Language
IP	Internet Protocol
IPTV	Internet Protocol television
MOCA	Multimedia over Coax Alliance®
MPEG	Moving Picture Experts Group
MSO	Multiple-system operator
M-DMC	Mobile Digital Media Controller
M-DMS	Mobile Digital Media Server
NAS	Network-attached storage
OS	Operating system
QAM	Quadrature amplitude modulation
RDP	Remote Desktop Protocol
RUI	Remote user interface
RVU	RVU protocol, pronounced “R-view”
RTP	Real-time Transport Protocol
RTT	Round-trip time
STB	Set-top box
TTL	Time to live
UI	User interface
Ultra HD	Ultra high definition
USB	Universal Serial Bus

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