



**PRODUCT OVERVIEW WHITE PAPER**

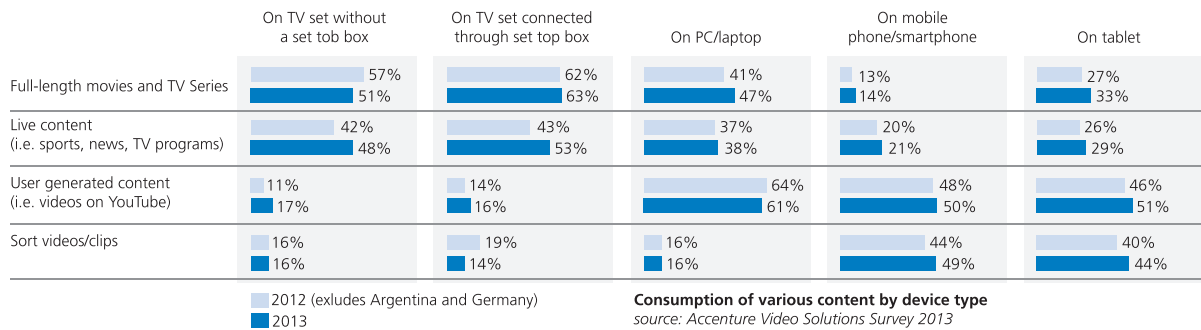
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# 1. Introduction

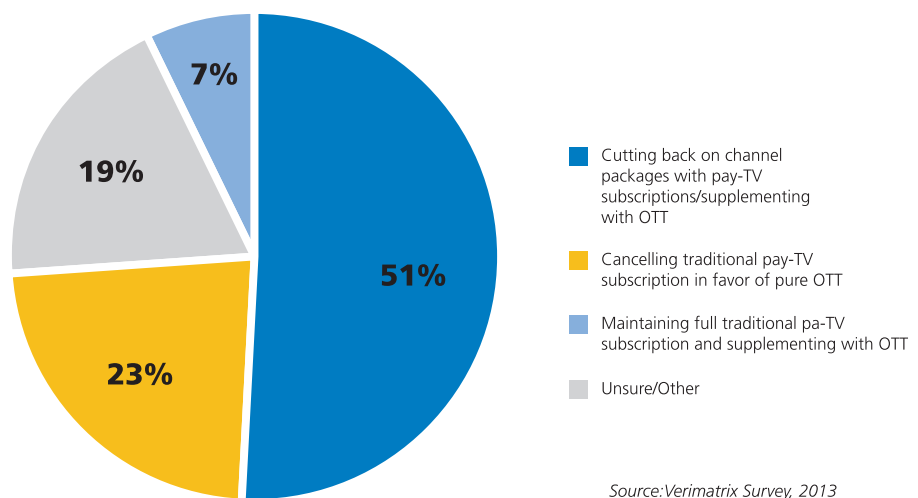
## 1.1 Market challenges

Today's consumers are quickly becoming accustomed to accessing media anywhere, anytime, and on any device. The shift to over-the-top content (OTT), the delivery of media over the Internet without using multiple-system operators, is accelerating as more and more devices support OTT-delivered video. The problem for subscription-based operators and broadcasters is competing with the rise of OTT content.



According to a recent survey conducted by Verimatrix, a leader in video servicing, only 19% of respondents would maintain full traditional pay-TV subscriptions and still use OTT content. An astounding 51% of respondents, on the other hand, would cut back on full traditional pay-TV subscriptions and still use OTT content. Clearly, consumers will progressively rely on OTT content as opposed to traditional subscription models, and pay-TV operators and broadcasters will need OTT video services to maintain and increase their subscriber base, profitability and competitiveness.

## Predictions on how consumers will respond to pure OTT video



The challenge for operators, however, is how to deliver unified content anywhere, anytime, and to any device. A solution is needed, a solution that reaches its users across multiple devices, and RealNetworks' latest innovation is that solution: RealHome Media Portal.

A multi-format cross-platform streaming media solution, RealHome Media Portal allows the delivery of OTT content to a variety of platforms such as Smart TVs, network-attached storage devices and across multiple devices without impacting existing broadcast systems. The result, then, is increased profitability and competitiveness through enhanced services and a larger user base.

## 1.2 RealHome Media Portal benefits

RealHome Media Portal delivers these benefits:

### Enhanced Services

- Users enjoy a unified hub with an intuitive interface to easily categorize, search and access personal media, operator-provided premium content and OTT content on all of their devices, at home or on the road.
- Premium content is protected with a multi-dimensional security structure including conditional access (CA) and digital rights management (DRM) integration with third-party security solutions.
- Advertising impact is broadened with joint TV and multi-screen advertising.

### Streamlined Operations

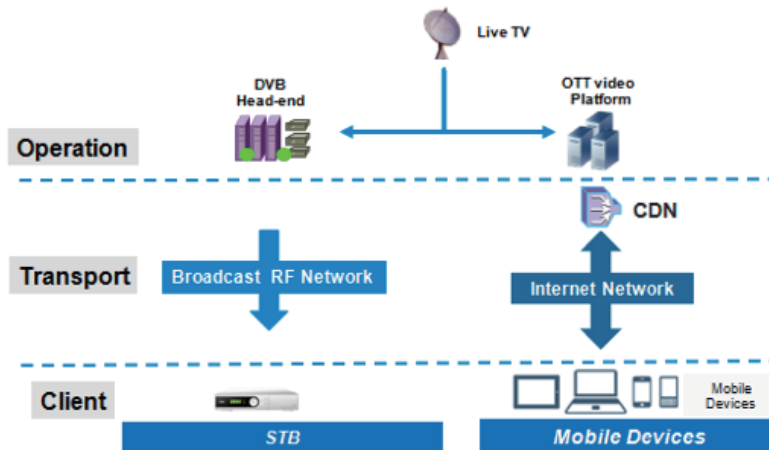
- Innovative DVB+OTT architecture provides both DVB and OTT services using existing CRM, BSS or OSS systems.
- Multi-format support for numerous protocols, video formats and file containers, as well as a self-adaptive ability to identify devices, capabilities and protocols, extends content to all users.
- Centralized control with an HTML5-based web app client on the set top box or Smart TV simplifies operations.
- Harmonized revenue security approach optimizes content monetization for different business objectives, delivery networks and consumer devices, within a single platform.

### Low Cost and Risk

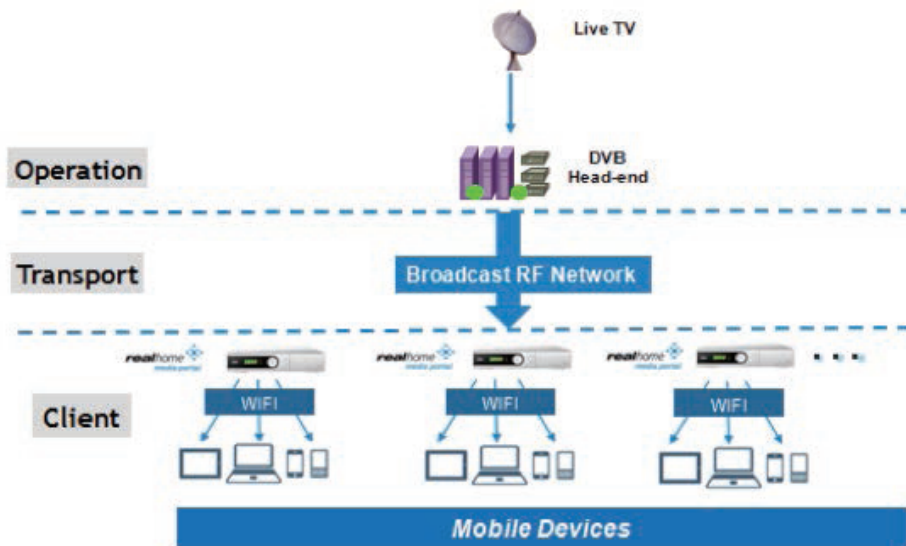
- Embedding within the STB or Smart TV allows manufacturers to substantially reduce the high costs of hardware and operational support.
- Development and delivery of RealHome Media Portal is based on an independent app model, which doesn't impact existing broadcasting systems or require new hardware.
- No certification is required and easy development for HTML5-based web clients means services are more quickly deployed and there is no need to hire expensive programmers.
- Standards-based security architecture that enables smooth network enhancements as standards evolve.

### 1.3 What is the difference?

Digital TV operators who deployed centralized OTT video head-ends usually face challenges of potentially huge investment in data traffic as subscriber base grows. As data traffic generated by mobile access increases, operators will have to deploy additional CDN systems to reduce traffic surges and to improve user viewing experience.



With RealHome Media Portal, set-top boxes become mini OTT head-ends so as to offload data traffic from mobile devices by leveraging set-top boxes' hardware capability. Therefore, operational costs are easily transferred to subscribers. Existing DVB billing systems can be used to charge on both DVB (digital video broadcasting) and OTT video services.



Instead of replacing the existing OTT solutions, RealHome Media Portal aims at providing the best viewership experience by offering features and benefits which are complementary to the existing solutions.

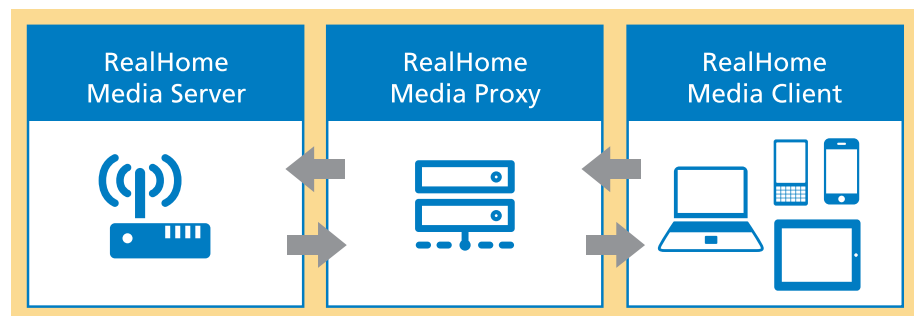
	Channel Switch	Video Quality	Video Latency
<b>OTT Head-end</b>	Quick channel switch 2~3s	Lower bit rate stream video due to limited bandwidth Video playback jitter due to instable internet connection	Longer latency: ~20s
<b>RealHome Media Portal</b>	Longer channel switch: ~10s	Higher bit rate video: >8mbps H.264 HD video Smooth and stable video playback	Shorter latency: ~7s

## 2. System Components

RealHome Media Portal from RealNetworks enables unified viewing of OTT content and digital video broadcast across a wide range of connected devices including set top boxes (STB), Smart TV, PCs, tablets and mobile. The solution allows manufacturers and pay TV operators to increase profitability and competitiveness by delivering OTT video to any connected device without impact to existing broadcast systems.

The system includes three key software components: RealHome Media Server, RealHome Media Client and RealHome Media Proxy.

### How it works



#### RealHome Media Server

- Supports Android and Linux
- Runs on embedded devices, such as Smart TVs and set-top boxes
- Enables STB/TV to directly provide streaming services to other devices
- Acts as a home hub for content aggregation of both premium live TV content and personal user content
- Delivers OTT video services to a broad range of connected devices by supporting multiple streaming protocols, video formats and file containers. It also provides the ability to identify and adapt to specific devices, capabilities and supported protocols

### RealHome Media Client

- Runs on mobile client devices, such as smart phones, tablets and more
- Supports an HTML5-based Web client, accessible with standard Web browsers, and light-hybrid Web apps, installed from app stores or the RealHome Media Server
- Calls on the native player or third party player to play video; there is no embedded player in the RealHome Media Client

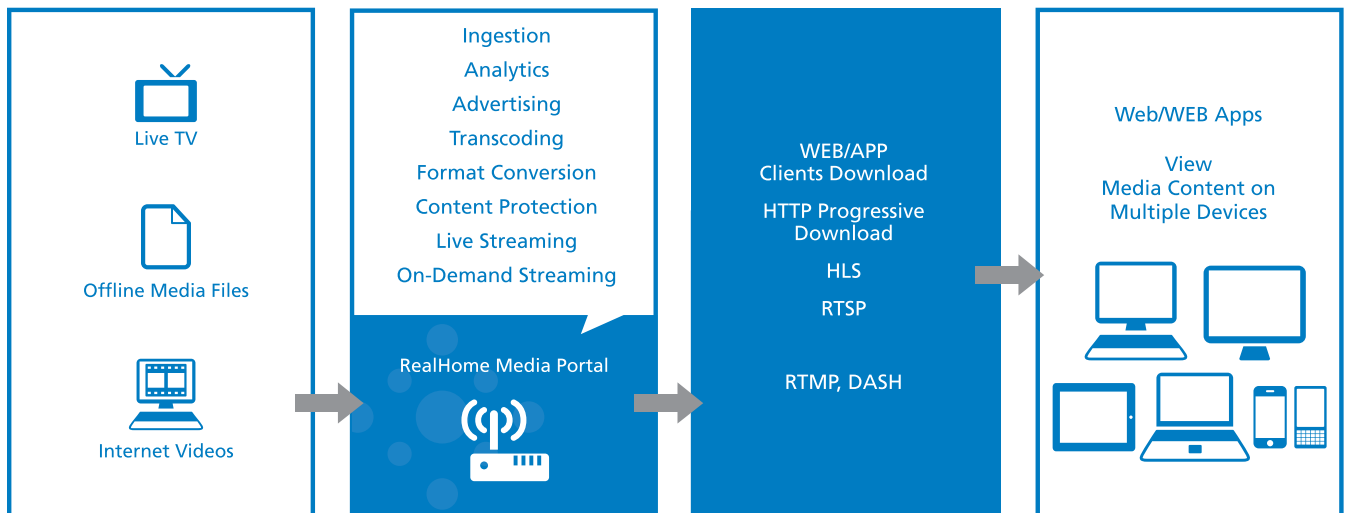
### RealHome Media Proxy

- Provides server with addressing and network address translation (NAT) traversal functions to support out-of-home access
- Deployed in Internet data center

## 2.1 RealHome Media Server

RealHome Media Server can aggregate content from pay TV, local media files and Internet video and provide unified streaming to all connected mobile devices.

One of the most significant innovations of RealHome Media technology is multi-protocol streaming on embedded devices with high efficiency. The server implements Web APIs for broad services interoperability.



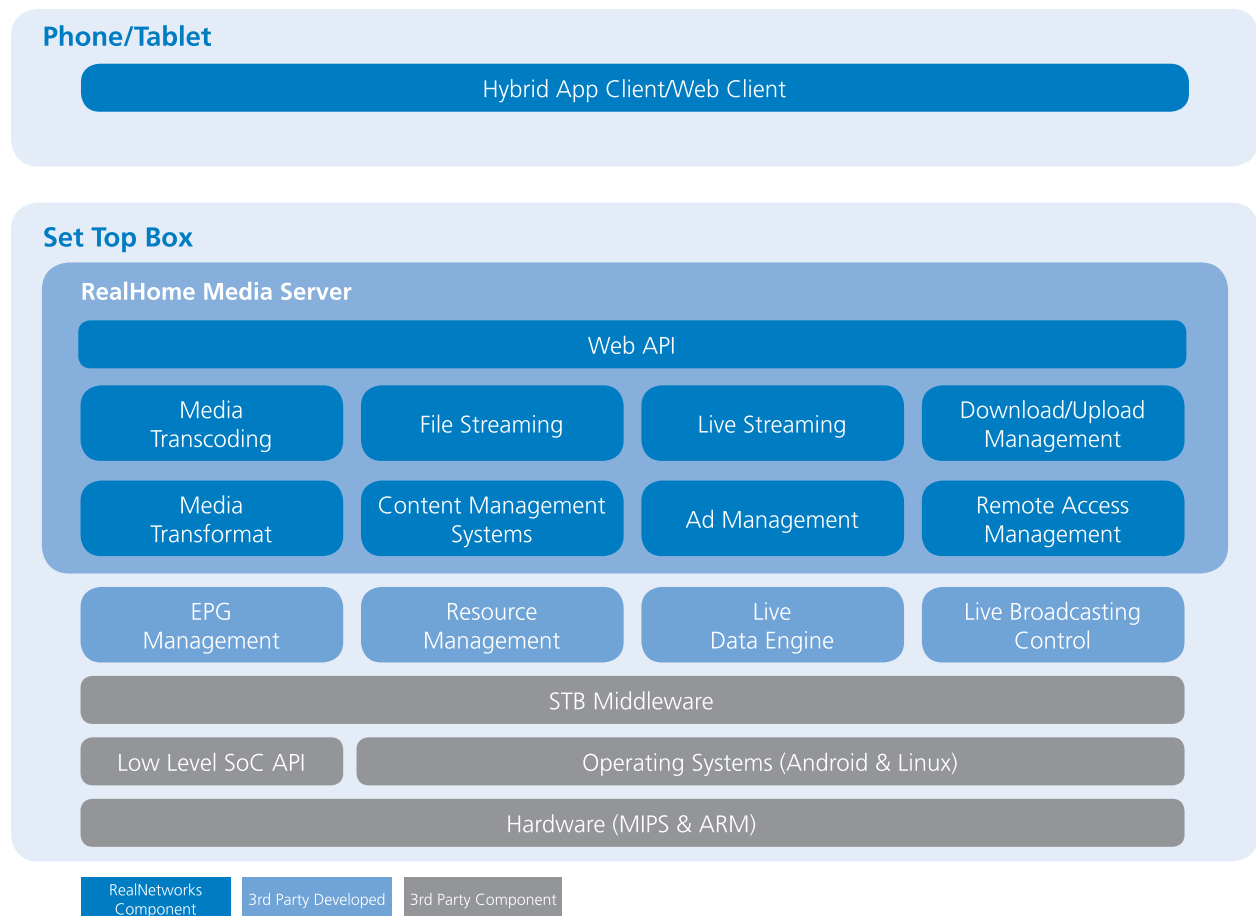
Similar to traditional OTT head-end software deployed in an Internet data center or back-end office, RealHome Media Portal offers these key capabilities:

- **Content ingestion.** The system adapts to different content sources and media formats to ingest transport streams for live TV, catch-up video and video on demand. It also automatically scans all local media files in attached storage devices.
- **Analysis.** A smart module based on content management system (CMS) technology analyzes and recognizes meta-data and EPG data from media content and saves it into the database. The system analyzes the capabilities of connected client devices including supported streaming protocols, media formats and file containers.
- **Advertising.** RealHome Media Portal automatically captures ad content from the live TV stream and distributes it to connected multi-screen devices with identical ad formats and playback rules. The OTT advertising is identical to the DVB advertising.

- **Trans-format and transcode.** The system converts video containers, audio codecs and video codecs for connected devices under control of the CMS.
- **Streaming server:**
  - Using a single architecture, RealHome Media Portal offers a host of streaming server features, including an HLS server, HTTP progressive download server, RTSP server, RTMP server as well as a DASH server to support file streaming and live video streaming to client devices
  - As a powerful Web server, RealHome Media Portal dynamically generates HTML5-based Web pages using the CMS while receiving access requirements from client devices
  - Client apps are part of the streaming server as well. Client devices directly download and install apps from the RealHome Media Server (only available for Android client devices). For iOS devices, users must connect to the Apple app store to install apps
  - To achieve higher quality of service on low reliability hardware and reduce dependency on the operating system and hardware platform, RealHome Media Server takes on certain operating system core features, such as procedure dispatch, internal memory management and more.

These modular software components allow users to easily add or remove them as needed. The RealNetworks engineering team can customize the system to best suit the requirements of the hardware platform.

## RealHome Media Portal software architecture





Key components include:

- Content Management System
- Remote Access Management
- File Streaming
- Live TV Steaming
- User Access Control
- Advertising
- Device Discovery
- Digital Rights Management

### 2.1.1 Content management

- Scans all content in local storage
- Saves media metadata and thumbnails for later query
- Groups and sorts content
- Organizes contents automatically
- Dynamically generates UI to adapt to devices

### 2.1.2 Remote access management

Remote access allows access to the RealHome Media Server outside of the local area network.

User scenarios include:

- Remote access with UPnP requires that the home router enable UPnP
- Remote access with a relay service adapts to the home router which does not support or enable UPnP

### 2.1.3 File streaming

The RealHome Media Server streams the video file to client device with support for:

- Progressive download, HLS and RTSP protocols
- File transcoding
- File trans-formatting

HLS Streaming		
Input	Container	AVI, MP4, MKV, FLV ,MOV
	Audio Codec*	MP3, AAC
	Video Codec*	H.264, MPEG-2, MPEG-4
Output	Container	MPEG-TS
	Audio Codec*	AAC
	Video Codec*	H.264

Progressive Download		
Input	Container	AVI, MP4, MKV, FLV ,MOV
	Audio Codec*	MP3, AAC
	Video Codec*	H.264
Output	Container	AVI, MP4, MKV, FLV
	Audio Codec*	AAC
	Video Codec*	H.264

\*RealHome Media Portal implements the native media Codec of docked devices. Final media capability is decided by hardware.

#### 2.1.4 Live video streaming

The RealHome Media Server delivers the electronic program guide from the cable set top box and streaming live channel with support for:

- HLS protocol while accessing at home
- HLS protocol while remotely accessing with UPnP
- RTSP protocol while remotely accessing with relay service
- Live transcoding

Live TV Streaming		
HLS Streaming for Live		
Input	Container	MPEG-TS
	Audio Codec*	MP3, AAC,AAC+, MPEG1 audio, MPEG2 audio
	Video Codec*	H.264, MPEG2, MPEG4
Output	Container	MPEG-TS
	Audio Codec*	AAC
	Video Codec*	H.264

\*RealHome Media Portal implements the native media Codec of docked devices. Final media capability is decided by hardware.

#### 2.1.5 User access control

- Does not require user authentication at home
- Password authentication out of home

#### 2.1.6 Advertising

The RealHome Media Server can insert advertising to provide a new channel for advertisers to reach customers.

#### 2.1.7 Device discovery

The RealHome Media Server supports discovery service so that hybrid app clients can automatically find the RealHome Media Server in the local area network.

### 2.1.8 Digital rights management

Premium content is protected with a hierarchical security structure including CAS and DRM as well as integration with other third-party security solutions in full compliance with the content owner's security requirements. As an open system, RealHome Media Server can integrate with any DRM or CA solutions defined by operators.

### 2.1.9 System resource requirements

Required system resources for RealHome Media Portal are determined by the features supported. When more features are supported, more powerful hardware is required. Transcoding requires that docked devices have native hardware encoder capabilities. Other software components mainly consume CPU process timeslots and RAM capacity as well as the FLASH size of code footprint.

Different scenarios and networks have different hardware requirements. RealHome Media Server transcodes the media content to adapt to the mobile device.

- If the original broadcasting TS stream received by the STB is based on the MPEG4 AVC/H.264 video codec and AAC, AAC+,MP3 audio codec, the RealHome Media Server formats the video container and streaming protocols for smooth playback of live TV content on mobile devices. The RealHome Media Server consumes CPU process timeslots and RAM.
- If the original broadcasting TS stream received by the STB is NOT based on the MPEG4 AVC/H.264 video codec and AAC, AAC+, MP3 audio codec, the transcoder component is required. RealHome Media Server will transcode, for example, convert all TS streams into H.264 and AAC-based video packages. After transcoding is complete, RealHome Media Server will continue to trans-format so additional hardware resources are consumed.
- High definition TV streams consume more hardware resource than standard definition TV streams.

Minimal requirements are shown below:

Features Combination <sup>1</sup>			"Sling" – like Live TV streaming service				+DRM support <sup>2</sup>	+ DVB ad extension to mobile <sup>3</sup>	+ Home cloud service <sup>4</sup>		
			SD Live TV		HD Live TV (bitrate:~8Mbps)				+ 1 SD Video	+1 HD Video (bitrate:~15Mbps)	
			1 live TV channel	+1 live TV channel switch	1 live TV channel	+1 live TV channel switch					
Codec Format of TS input	Video codec: MPEG4 VC/H.264  Audio Codec: AAC, AAC+, MP3	RAM (MB)	30	+20	40	+30	+5		+20	+30	
		FLASH/Hard-disk of DVR (MB) <sup>5</sup>	15				+1	+5	+5		
		CPU capability <sup>6</sup>	>1000DMIPS								
		Transcode	Optional								
		Tuner <sup>7</sup>	1	+1	1	+1					
	Video codec: None H.264 (MPEG2/4, etc)  Audio codec: AAC, AAC+, MP3, MPEGG1, DTS, AC3, etc.	RAM (MB)	40	+30	50	+40	+5		+20	+30	
		FLASH/Hard-disk of DVR (MB) <sup>5</sup>	15				+1	+5	+5		
		CPU capability <sup>6</sup>	>1000DMIPS								
		Transcode	1	+1	1	+1	Optional				
		Tuner <sup>7</sup>	1	+1	1	+1					

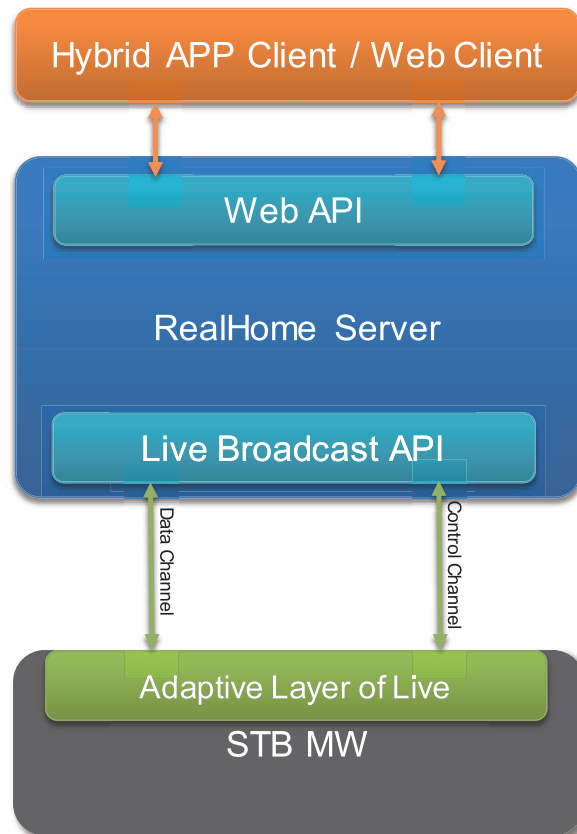
Note:

- Support for live TV is a basic feature, and other features are extended over live TV feature. Usage of resources will increase with extra features supported.
- Resources to support DRM are variable for different DRM solutions. The figure in the table is an assumption.
- FLASH size for ads is decided by video quality and length of inserted ads.
- Consumption of RAM during run-time dynamically changes with the number of concurrently playing videos.
- RealHome Media Server code can be kept on the DVR hard drive.
- Only cable and satellite TV STBs need additional tuners, IPTV STB does not require this

### 2.1.10 System integration guidelines

As a software media server on embedded devices, RealHome Media Server has two types of external interfaces:

- A socket connection is used to integrate with system software inside the STB. It includes a data channel and control channel.
- A Web API is used to remotely talk to clients on mobile devices. Web browsers or third-party apps can easily call the video service from RealHome Media Server.



### 2.1.11 UI adaption

RealHome Media Server recognizes the device type of the connected client, as well as its system capabilities including hardware codec, panel size, OS and language. The server automatically adapts by generating matched UI Web pages to each connected TV all controlled by the CMS.

## 2.2 RealHome Media Client

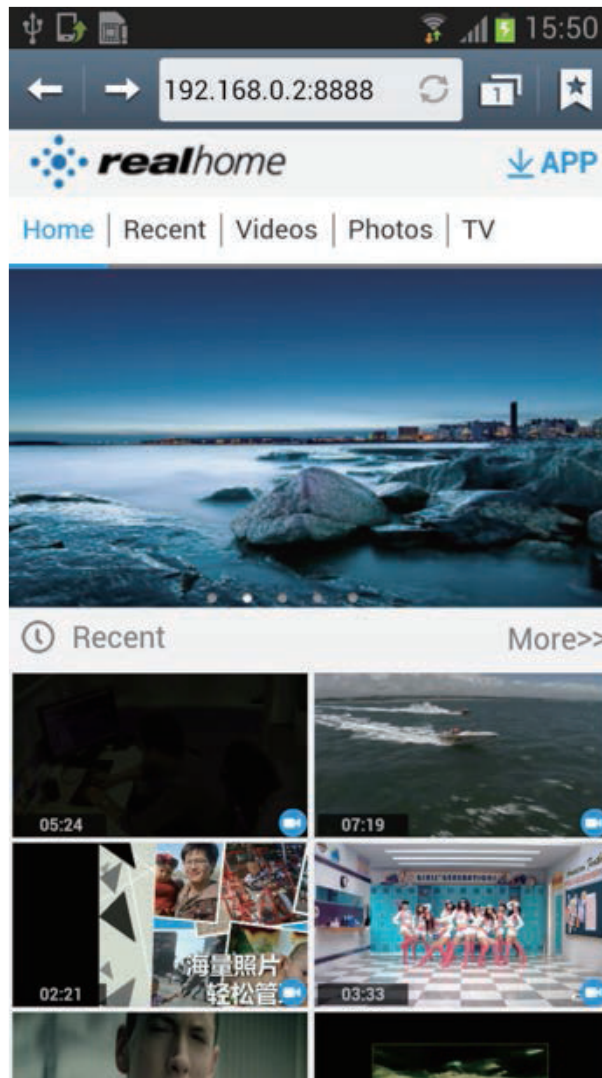
### 2.2.1 Overview

With an open architecture, the RealHome Media Client can be based on a HTML5 Web client, hybrid Web app or third-party-secured media player to reduce the cost of playback on diverse mobile devices.

#### Web client

The RealHome Media Client is a light client, based on HTML5 technology. A user can use the native web browser on their phone, tablet or PC to access RealHome services by inputting `http://Real home server IP address:port(TBD)` in their browser. The interface adapts to the device screen size automatically.

#### Sample Web Client Experience:

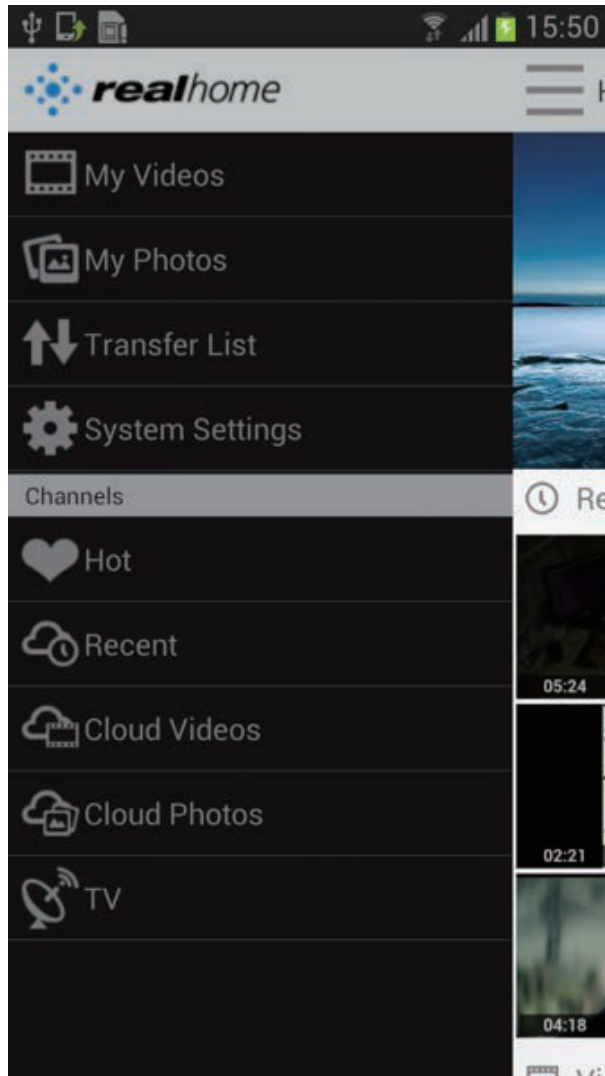


Once users select video clips or TV episodes, the Web browser calls the native media player or any third-party player to play the selected video stream. Service providers can easily and quickly customize the UI design with HTML5 technology. The Web UI can be easily updated by simply replacing relevant HTML files in the media server.

### Light hybrid Android/iOS app

A light hybrid app is capable of supporting more features and a better user experience than a pure Web client by automatically discovering and accessing the RealHome Media Server. Because millions of apps are available in various app stores, a light app is familiar to users and easy to install.

### Sample web app experience:



## 2.2.2 Features supported

	Web Client	Android Hybrid App	iOS Hybrid App
Local Photo Browsing	√	√	√
Local Video Streaming**	√	√	√
Content Uploading	x	√	√
Content Downloading	x	√	√
Live Streaming	√	√	√
Remote Access Enable/Disable*	x	√	√

\* The hybrid app can enable/disable remote access only in the LAN

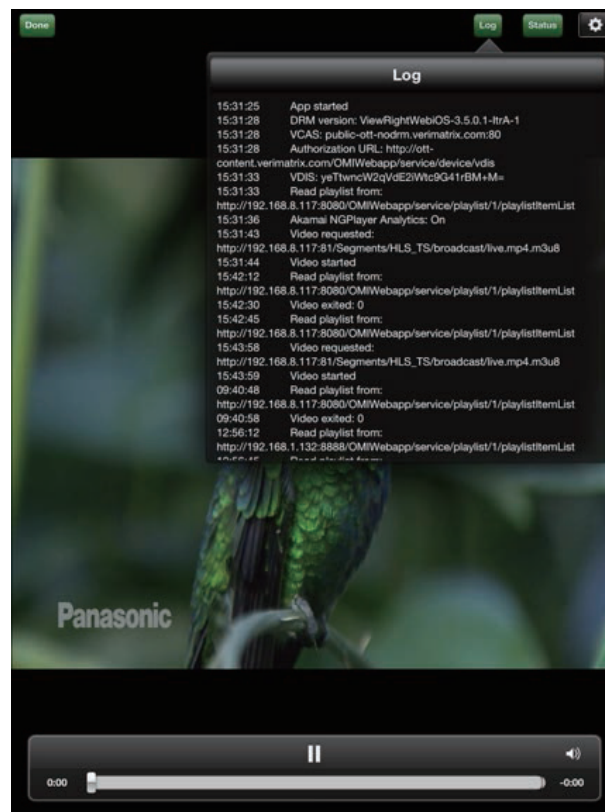
\*\* Client will use system native player or third-party player There is no embedded player in the client.

### Third-party media players

Third- party media players are supported by RealHome Media Portal. Users access the third-party player installed on their mobile device to play video content from RealHome Media Server. Additional UI design may be required.

### Third-party player example:

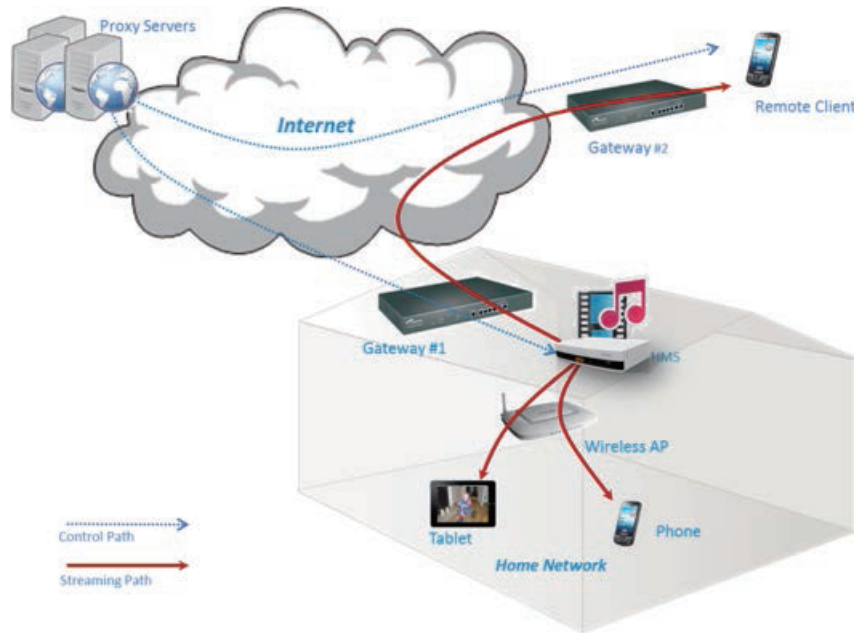
RealNetworks can provide reference designs for the Web client and hybrid client. Customers can easily customize the interface and features by adding their logo and integrating with their own middleware.





## 2.3 RealHome Media Proxy

Proxies provide a bridge to allow users to access the RealHome Media Server from outside the home. The RealHome Media Proxy includes several server components to manage all RealHome Media Servers, and to provide home server addressing, NAT traversal and TCP relay services.



The RealHome Media Proxy is based on a Web API to provide a search engine-like user experience. Users can send the name of the specified home server to the Proxy and it will redirect to the relevant IP address.

### Sample proxy interface:



Note: The RealHome Media Proxy Server is not a mandatory module. It can be removed if out-of-home access is not required.

### 3. Live Broadcasting Service

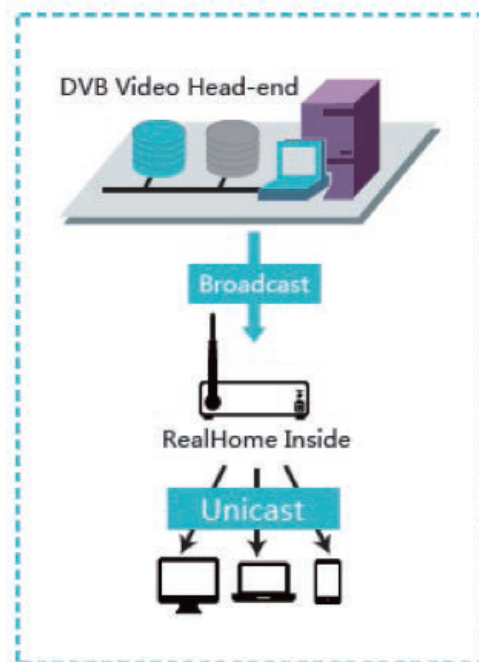
The live broadcasting signal can be acquired from cable, satellite, IPTV and LTE networks; RealHome Media Portal receives decrypted live channel signals from the STB/TV middleware and streams content to mobile devices, such as a smart phone or tablet. If needed, RealHome Media Portal will transcode and trans-format the media content according to device specifications and network quality, allowing users to watch one channel on a TV and another, simultaneously, on a smart phone or tablet.

With RealHome Media Portal, operators can provide new managed OTT services alongside their existing pay TV service.

#### 3.1 OTT video service controls flow for live broadcasting

RealHome Media Portal uses an existing DVB head-end to remotely enable/disable the RealHome Media service. Operators do not need to purchase a new OTT head-end for the OTT video service. One DVB provisioning system can manage both DVB and OTT video services.

RealHome Media Server is managed by the existing STB middleware. DVB head-end systems can broadcast the command to specific STB/TVs and the CAS and middleware will process the command to turn on/off the live channel signal to the RealHome Media Portal. In this way, the existing DVB head-end can enable/disable the RealHome Media service according to the billing status of users.



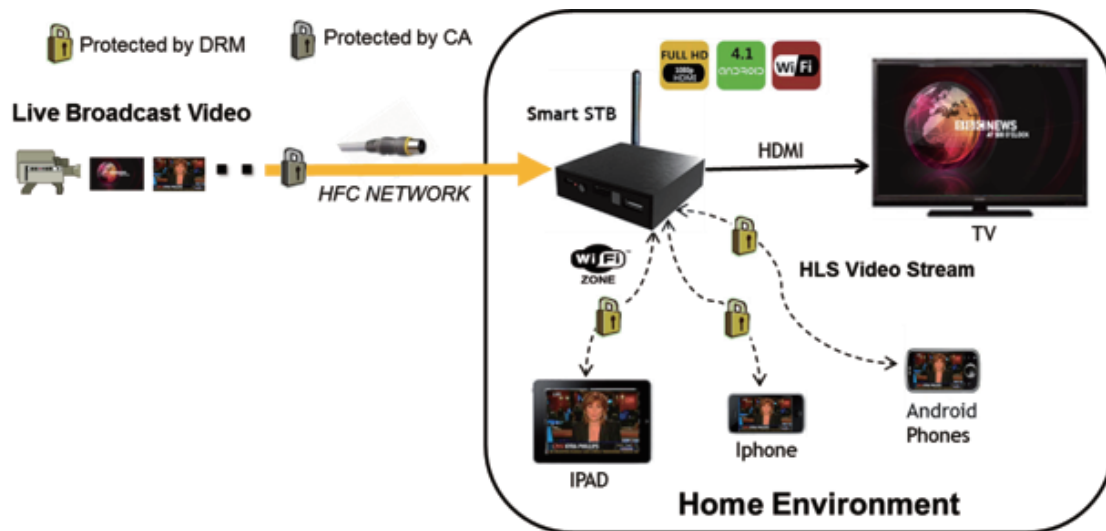
Compared to deploying a dedicated OTT head-end, RealHome Media Portal provides these benefits:

- No impact on back-end office systems: existing DVB operations and billing systems manage both DVB and OTT video services
- Lower OPEX because operations costs are transferred to subscribers
- Easy deployment of the OTT video service through software integration on terminals

## 3.2 User scenarios

### 3.2.1 Live TV broadcasting at home

RealHome Media Portal converts the video broadcast to IP video.



#### How it works

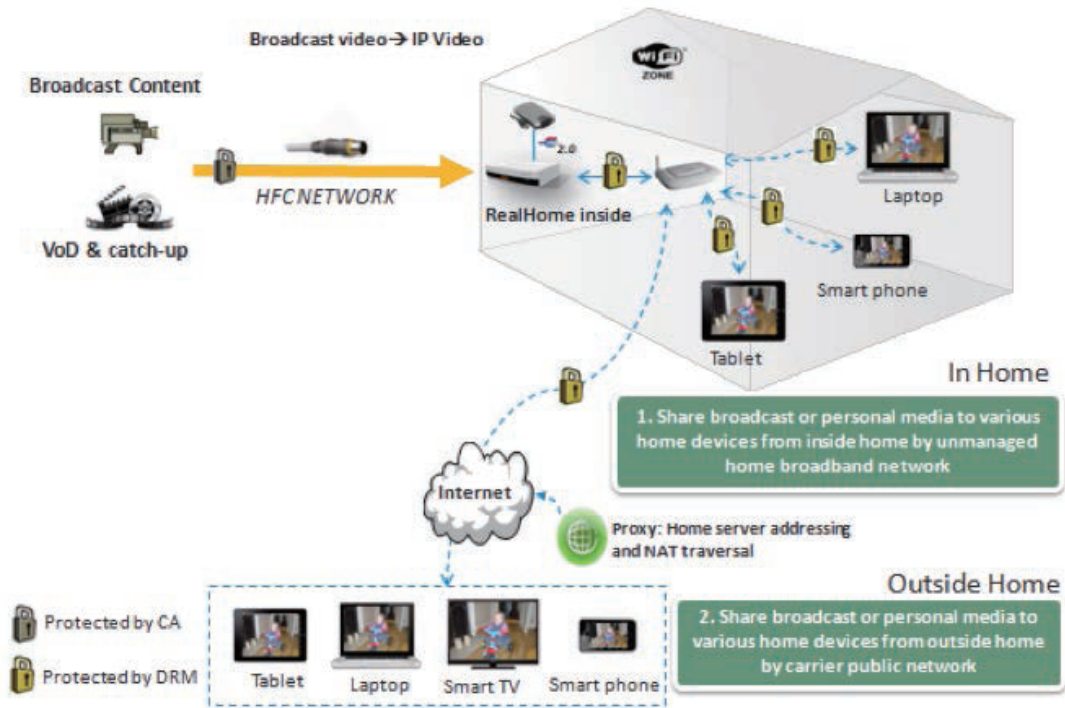
- The set top box is enabled for both traditional DVB TV services and OTT live video services
- In addition to displaying live broadcast content on a TV, the system can deliver OTT video to mobile devices such as smart phones and tablets
- Smart cards with different price packages can enable different number of channels to users
- Subscribers can view different TV programs simultaneously on their TV and connected devices

The user has a superior viewing experience on their mobile device compared to OTT video over the Internet:

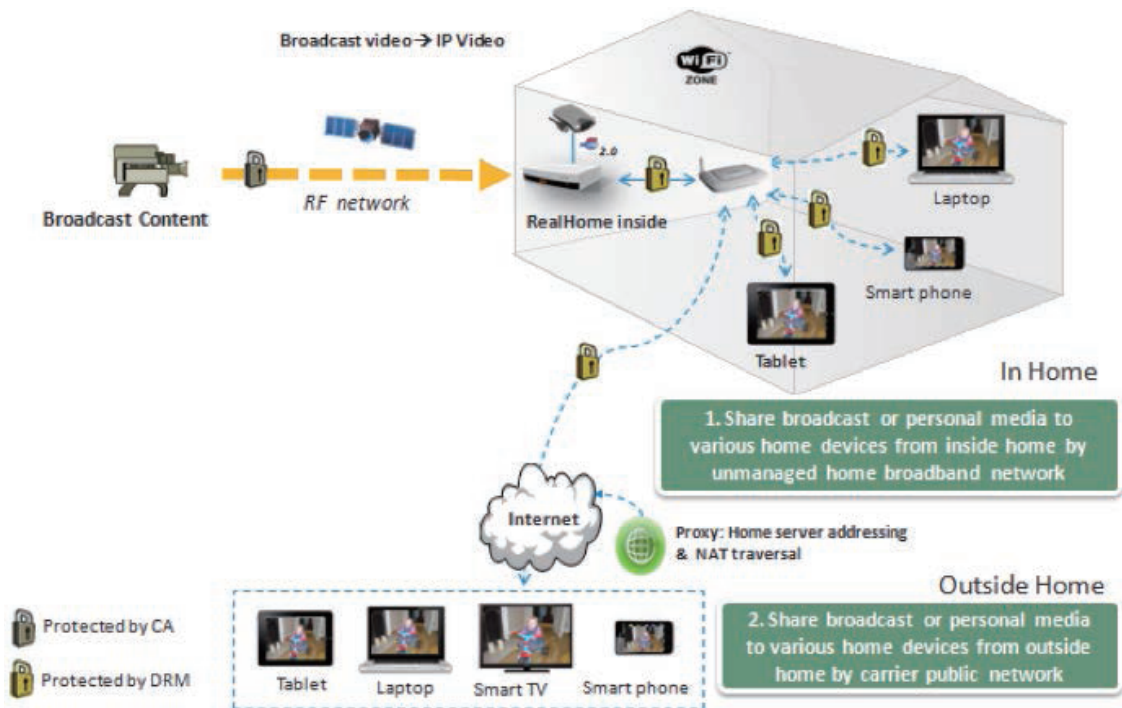
- The combination of a managed network and home wireless network delivers a better viewing experience than existing unmanaged OTT services over the Internet
- A higher resolution and frame rate is available with RealHome Media Portal

### 3.2.2 Access live TV broadcasting outside the home

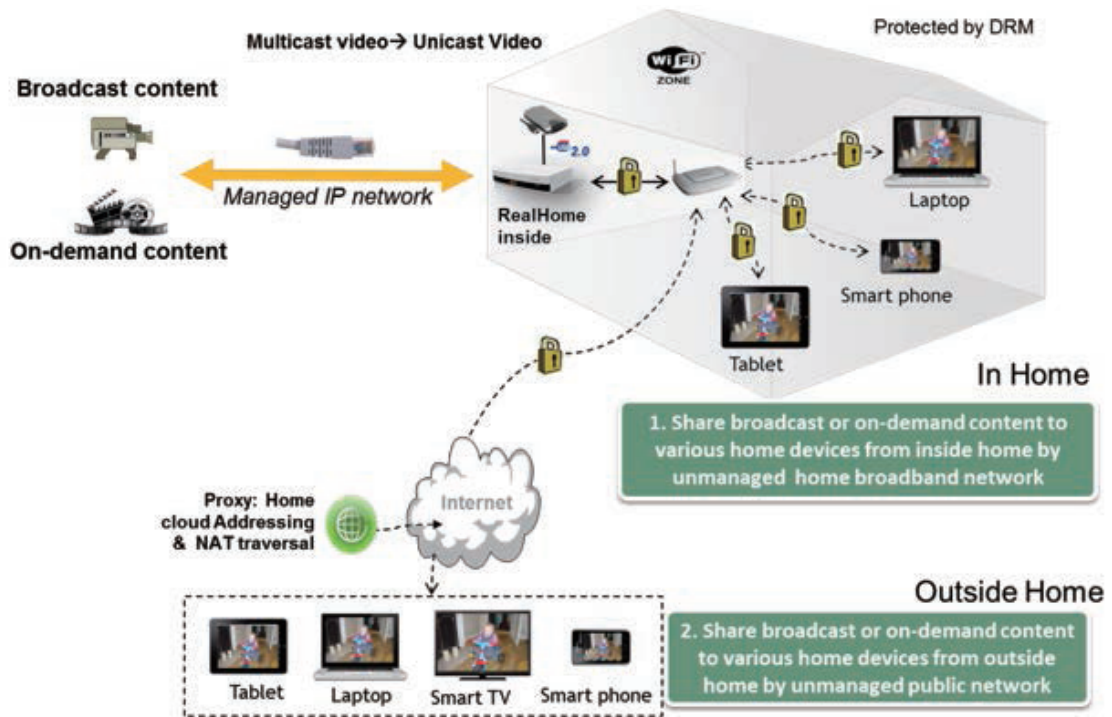
Cable operator scenario:



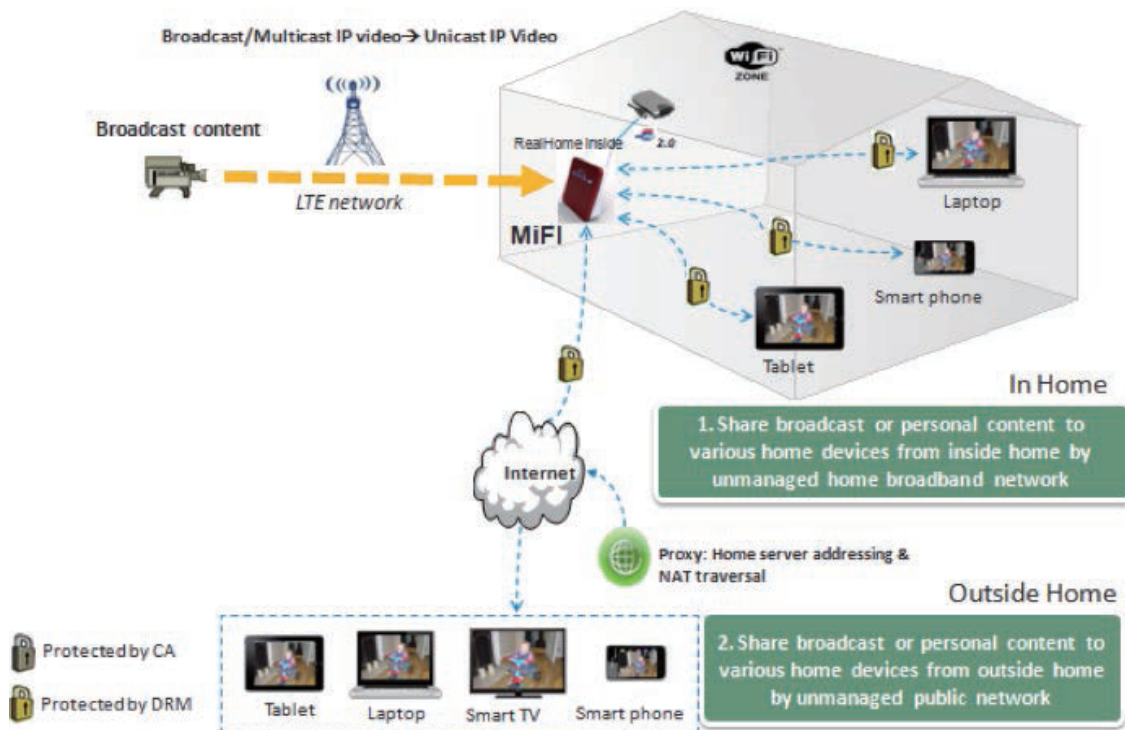
Satellite operator scenario:



IPTV scenario:



eMBMS scenario:



Once the client app is launched, the app passes through client verification and opens the RealHome Media Portal providing:

- The RealHome Media Server address for remote access with password authentication
- Photo browsing
- Local video file streaming
- Live channel streaming with DRM protection

RealHome Media Portal can provide additional pay TV services, such as place-shifting TV and VoD services

### 3.3 Content protection for live broadcasting

DRM is used to protect content distributed by RealHome Media Portal, while CA is used to protect premium broadcast TV content.

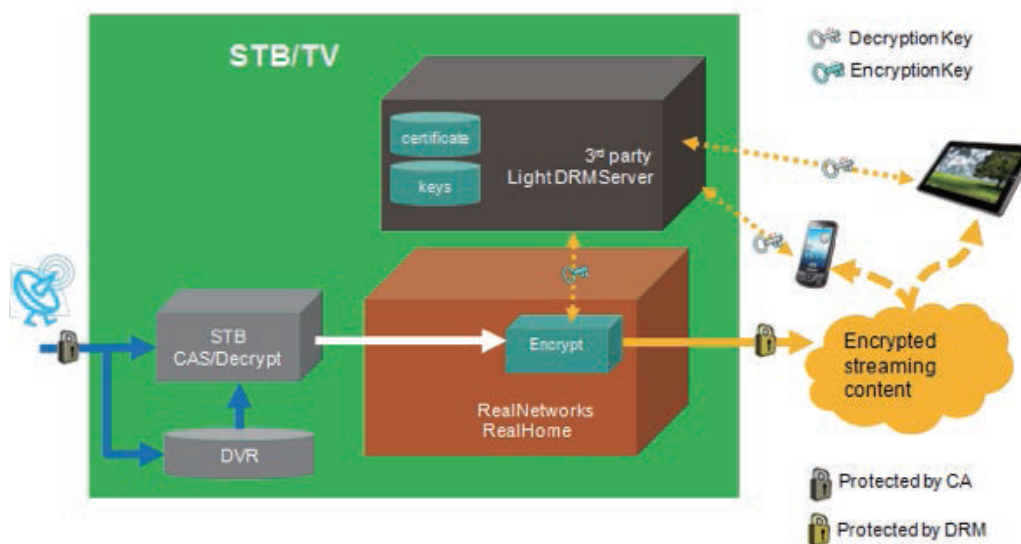
The DVB head-end can control the pay TV service by using the existing DVB provisioning system. RealHome Media Server is fully controllable by STB MW/CA software through CA command or other provisioning systems. In this way, the DVB head end is able to manage OTT video services offered by RealHome Media Portal on the STB.

The RealHome Media Server can integrate DRM for HLS protocol to protect live broadcasting content. Currently we have two DRM solutions. One is to integrate with RealNetworks random key DRM, a simple key generation solution for a low security scenario where the STB/TV does not need to access the Internet. The second DRM solution integrates with commercial high security DRM such as Verimatrix DRM and accesses the DRM key server over the Internet.

#### 3.3.1 CA + Local DRM

When the encrypted digital signal is received:

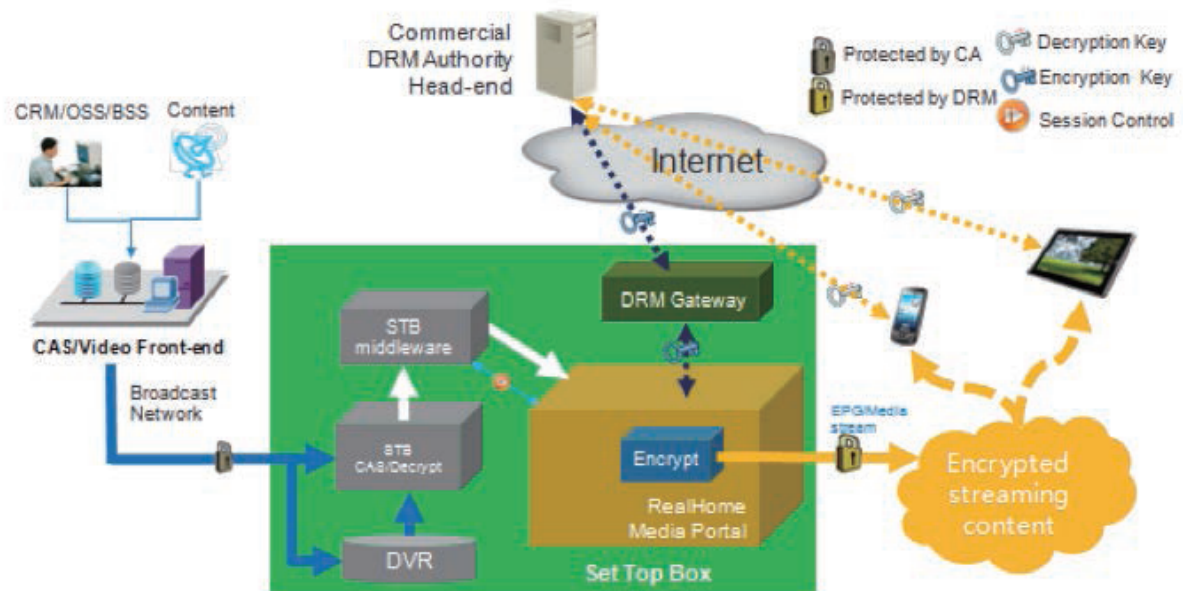
- Legacy CAS in the STB/TV decrypts it and delivers the decrypted TS stream to the RealHome Media Server
- The RealHome Media Server segments the TS stream according to HLS protocol, then encrypts it with the RealNetworks random local key and streams it to client
- When the client receives the m3u8 file, it receives the decryption key from the DRM key server in the RealHome Media Server, then decrypts and decodes the stream



### 3.3.2 CA + Commercial DRM

When the encrypted digital signal is received:

- Legacy CAS in the STB/TV decrypts and delivers the decrypted channel to the RealHome Media Server
- The RealHome Media Server segments the TS stream according to HLS protocol, receives an encryption key from the DRM key server on Internet, then encrypts the stream with the encryption key and streams it to the client
- When the client receives the m3u8 file, it receives the decryption key from the DRM key server on the Internet, then decrypts and decodes the stream

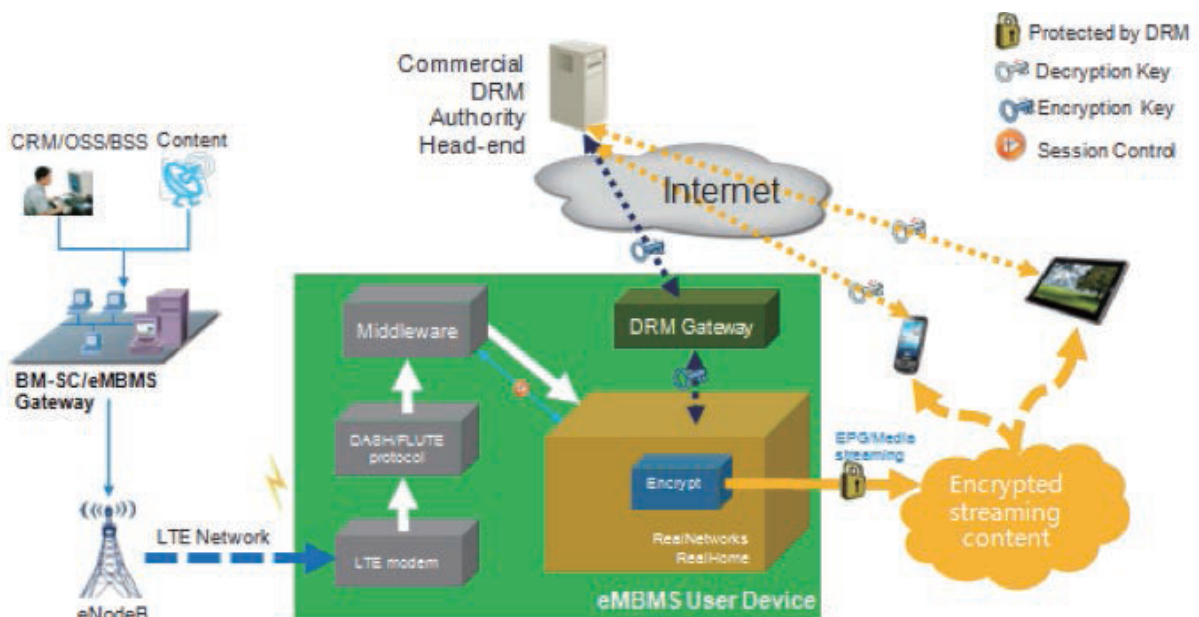


### 3.3.3 IPTV + Commercial DRM

See CA+Commercial DRM

### 3.3.3 eMBMS + Commercial DRM

See CA+Commercial DRM



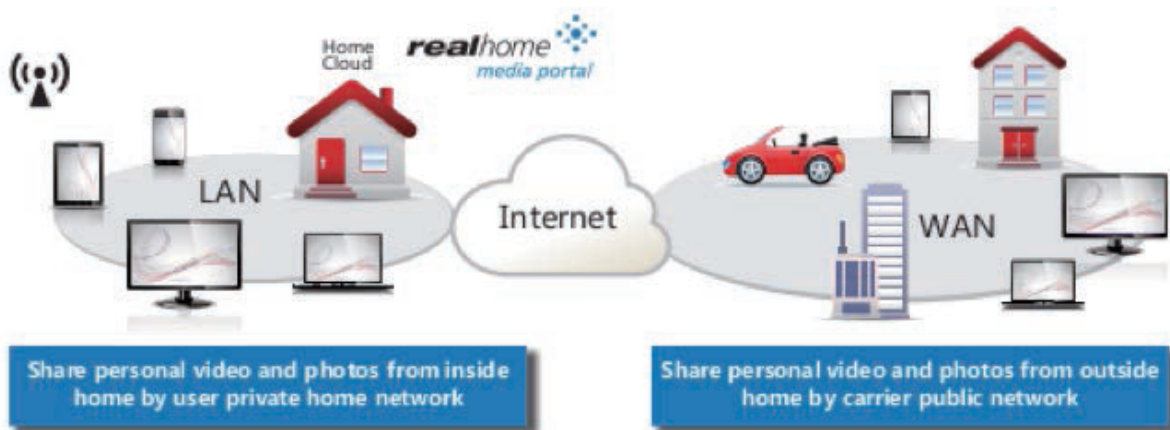
### 3.4 Increased ad exposure

RealHome Media Portal is based on existing DVB advertising rules but takes it beyond TV to all connected devices, offering advertisers an improved impact on their targeted audience. The advertising workflow is shown below:



### 4. Home Cloud Service

RealHome Media Portal can build a privately owned video website for users to back-up and share personal user-generated media with family and friends anywhere and anytime. With the same software solution, users can now enjoy a smart home cloud service.



The home cloud service includes:

- User-generated content management
- Download/upload management of user-generated content
- User-generated video streaming and photo browsing
- Access at home or on the go



## 4.1 User-generated content management

RealHome Media Portal (RHMP) is designed to make content management easier for users. Once user-generated content is uploaded to RealHome Media Portal, it will instantly scan media files, extract metadata and then insert them to an embedded database. To recognize location of photos, a light GIS (geography information system) is included in RHMP as well. With support of GIS and internal database, RHMP can smartly recognize content types and sort them by content type so users will no longer need to take hours to organize their videos or photos.

To help users to find their favorite videos and pictures, RHMP will extract thumbnails from these media files and process them into the same size. For video files, additional logos for the 'play' button and length of video will be added.

## 4.2 Download/upload management of user-generated content

Web client can support users to browse and download all the media files from RHMP. But users have to install dedicated hybrid application to provide additional uploading functionality from both at home and on the go.

RealHome Media Portal can recognize various mobile formats and will adapt its UI (user interface) to different screen resolutions across different devices accordingly so as to provide a user-friendly interface. Users can download and upload user-generated content on RealHome Media Portal client apps and experience the following:

- View recent uploads
- Playback, on different devices, of videos stored in the set-top box without impacting each other
- Upload content from one device and view on another

## 4.3 User-generated video streaming and photo browsing

Aiming at providing an online video website-like experience, RealHome Media Portal will also offer a "Hot" section for users to check on the most frequently viewed videos or photos.

If the metadata is generated during creation and properly obtained by RealHome Media Portal, users could select and arrange the content in following ways:

- Sort videos by video length, time (month or year) and location
- Browse photos by time (month or year) and location

## 4.4 Access at home

- No password authentication required
- Enable/disable remote access
- Browse photos
- Stream local video files
- Upload and download local media

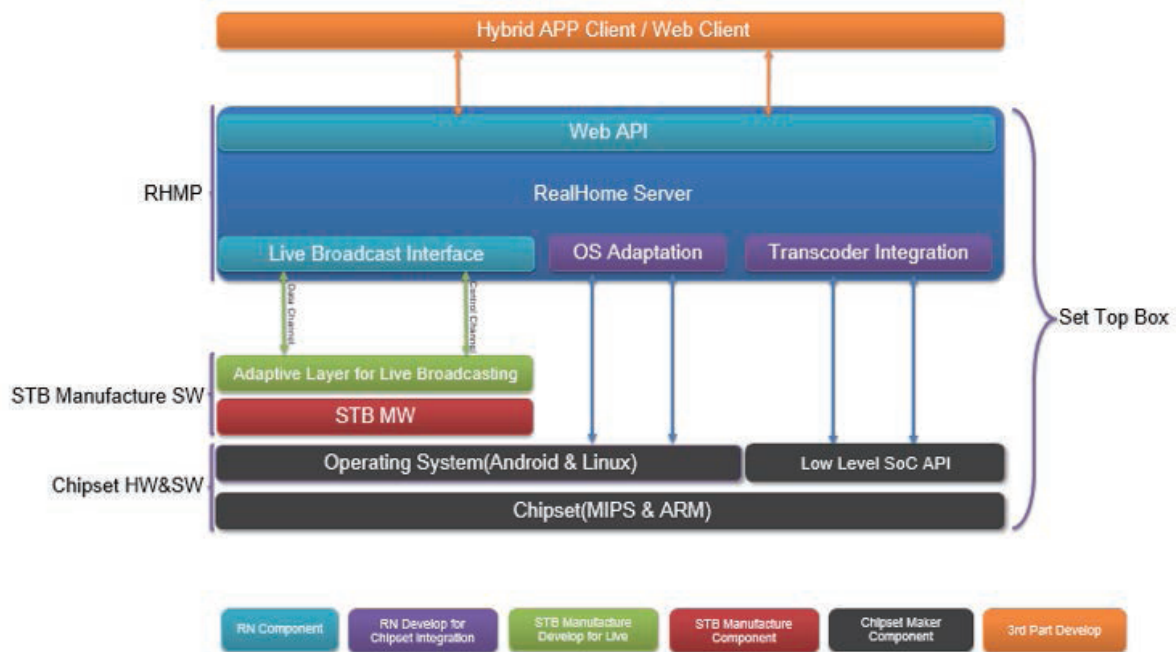
## 4.5 Access on the go

Users can access personal media files on the go with web client or hybrid application. With support of RealHome Media proxy, users can be redirected to RHMP server at home and enjoy same experience as scenario from home and on the go:

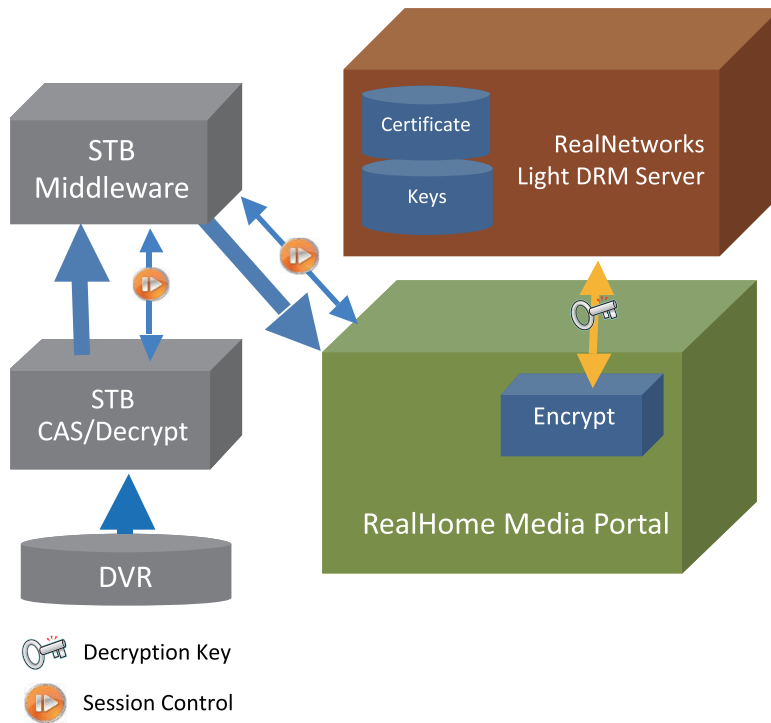
- RHMP proxy to send secured RealHome Media Server URL to authorized mobiles after password authentication
- Photo browsing
- Local video file streaming
- Remote upload/download of media files

## 5. System Integration with STB

The RealHome Media Server integrates with set top box middleware with two communication channels -- a two-way command channel and a single-path data channel transporting data from the set top box middleware to the RealHome Media Server. This requires both set top box middleware and RealHome Media Server to implement APIs defined in the specifications. Through implementing adaptive layer for broadcasting video, STB software will be able to driver whole services provided by RealHome Media Server.



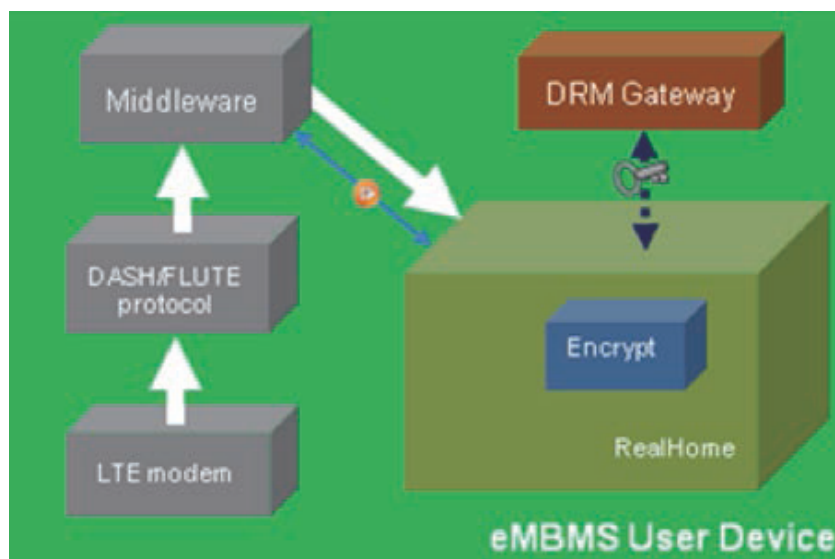
### Set-top Box



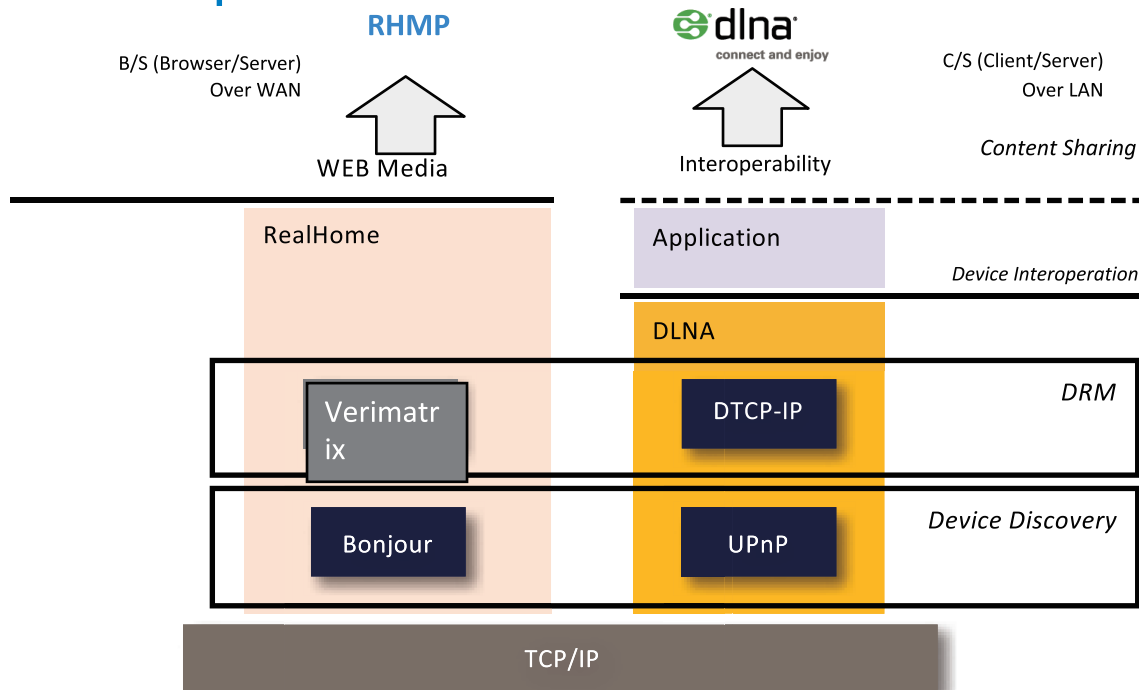
The STB middleware also controls resources occupied by the RealHome Media Server and commands the server to enable/disable services as well as release resources for other applications running on docked devices.

- Extends reach of middleware from closed DVB system to open OTT
- Allows existing CRM/BSS/OSS systems over legacy CAS to manage both DVB and OTT video services
- RealHome Media Portal runs on operating system level with deep integration with the set top box

eMBMS devices control RealHome Media Portal just as the set top box does.



## Appendix: Comparison with DLNA



Features	DLNA	RealHome Media Portal
Multiple streaming servers to adapt to diverse clients	NO	YES
Unified management and sharing of both user-generated content and pay TV content	NO	YES
Content management system	NO	YES
Remote access to media stored at home	NO	YES
Simplified and familiar user interface	NO	YES
Control for devices	YES	NO
Costs	DLNA	RealHome Media Portal
Development: Multi-platform, Multi-OS support, for iPhone/ iPad, Android, Windows 8 devices and more	↑	↓
Customization: For Different operators/OEMs	↑	↓
Competition: monthly upgrade to clients to attract users	↑	↓
Maintenance: App upgrade for each OS	↑	↓
Engineer experience required to develop app or Web clients	Senior	Junior
Certification fee	~\$18K	0

## Contact us

Contact a global representative at [realhome@realnetworks.com](mailto:realhome@realnetworks.com).

Contact a regional representative at:

China +86-10-5954-2832 or +86-10-5954-2817

UK +44-020-7618-4000

US +1-206-674-2700

Korea +82-2-2014-5374

Japan +81-3-6233-1324

To learn more about RealHome Media Portal, please visit [www.realnetworks.com.cn](http://www.realnetworks.com.cn).

