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Focus Group Technical Report

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Technical Report of the Focus Group on Smart Cable Television

ITU-T

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TECHNICAL REPORT OF THE FOCUS GROUP ON SMART CABLE TELEVISION

Introduction

This FG Technical Report is the final output of the Focus Group on Smart Cable Television (FG SmartCable). The Focus Group was established under the auspices and charter of the ITU Telecommunication Standardization Sector Study Group 9 (ITU-T SG9) in April 2012, and concluded its business in December of 2013. Six standing working groups (WGs) were responsible for the deliverables in this FG Technical Report, and their deliverables are contained in the chapters below.

The purpose of the FG SmartCable was to collect and familiarize ITU-T and interested parties with the emerging technologies that make up "Smart Cable Television"; namely, advanced services and technologies for cable broadband networks, and the potential impact on future standards development projects under ITU-T SG9.

The charter of the FG SmartCable was to solicit and collect input from individuals and entities working on the forefront of these innovative technologies, and it received contributions from experts throughout the world. The cumulative efforts of the members and leaders of the FG SmartCable are contained in this FG Technical Report.

This FG Technical Report is organized as follows:

Chapter 1: Smart cable television use cases

This Chapter describes smart cable television service use cases and their technical overviews, particularly from such aspects as home energy management, health care, net supermarket, multi-device services, harmonization between set-top box (STB) and mobile devices, integrated broadband broadcast television (TV), content discovery, augmented smart television, content protected adaptive hypertext transfer protocol (HTTP) streaming and cable digital rights management (DRM).

Chapter 2: Provisional requirements for smart cable television

This Chapter describes provisional requirements for smart cable television services particularly from such aspects as accessibility, terminal device harmonization between STB and mobile devices, home energy management, health care, net supermarket, identifier (ID) cooperation, TV everywhere service, user interface and access networks.

Chapter 3: Smart cable television transport

This Chapter describes the means by which cable networks address challenges for the implementation of advanced services and applications, where many of these services are being implemented across different transport and delivery mechanisms.

Chapter 4: Content and application delivery including security for smart cable television

This chapter addresses content and application delivery, including security issues, that have been identified by the use cases and provisional requirements defined herein. Content and application delivery via hybrid networks and their linkage information is also addressed in this chapter.

Chapter 5: Smart cable television usability and accessibility

This Chapter summarizes user interface issues and proposes 'participation taxonomy' and a format for a user profile for standardization. The participation taxonomy can be used as a tool to analyse usability and accessibility issues with respect to different use cases for advanced human interfaces for digital TV.

Chapter 6: Multi-screen and mobile devices for smart cable television

This Chapter elaborates the merger of services available between fixed television screens, personal computers, and mobile devices, known as multi-screen services. This chapter describes three modes of multi-screen services, compares network topologies and service flow in four basic patterns, and analyses function modules.

Appendix I: User centred design in EU GUIDE project for multi-screen services

This Appendix provides a synopsis of user-centred design in the GUIDE project for multi-screen services that is sponsored by the European Commission.

Appendix II: Example of multi-screen service architecture

This Appendix provides an example of multi-screen service architecture.

Appendix III: Living list of SmartCable pertinent organizations

This Appendix provides a list of organizations performing studies related to SmartCable technology and services.

Appendix IV: Terms and definitions

This Appendix provides definitions for the terms used within this FG Technical Report.

Appendix V: Abbreviations and acronyms

This Appendix provides the expansion of abbreviations and acronyms used within this FG Technical Report.

Bibliography

The Bibliography identifies the source material referenced within this FG Technical Report.

Chapter 1 – Smart cable television use cases

Chapter 1 Summary

Chapter 1 is part of the deliverables produced by Working Group 1 of Focus Group on Smart Cable Television (FG SmartCable). This Chapter describes smart cable television service use cases and their technical overviews particularly from such aspects as home energy management, healthcare, net supermarket, multi-device services, harmonization between STB and mobile devices, integrated broadband broadcast TV, content discovery, augmented smart television, content protected adaptive HTTP streaming and cable DRM. None of the material contained in this Chapter is intended to define normative specifications or Recommendations, but to provide technical information that could become target use cases of future possible Recommendations, which may be developed by ITU-T SG9.

1 Scope

This Chapter describes smart cable television service use cases and their technical overviews. Any of the materials contained in this Chapter is not intended to define normative specifications or Recommendations, but to provide technical information that could become target use cases of future possible Recommendations, which may be developed by ITU-T SG9.

2 Home energy management

2.1 Name of use case

Home energy management

2.2 Description of situation

Figure 1 shows the situation related to the home energy management.

2.3 Description of service

2.3.1 Visualization service of consumed power

The system is required to measure the consumed electric power of each distributer, breakers and consent, the generated power by solar cells, to calculate the fee of power and to inform the cable customer of the result. The current sensor is required to transmit measured data (consumed or generated electric power) to the radio terminal device by ZigBee or wireless fidelity (WiFi) radio chip. The residential gateway (RGW) is required to store the data temporarily (e.g., for one day) and to upload the data to the collection server of sensor information.

The system is also required to present the cable customer with a regional power saving period, a power saving announcement, and information on power balance from a municipal office or power company. In other words, the system should not only display consumed/generated power. The system can provide, optionally, recommend services for power and cost saving, in line with the customer's power consumption pattern.

Furthermore, the system can optionally provide any additional support including regional ranking information of power saving or additional incentive services. The system is required to be operated on RGW at home and on a smart phone or tablet terminal, and in an outdoor environment through the cable portal function. The system is required to send the information by e-mail to the assigned address.

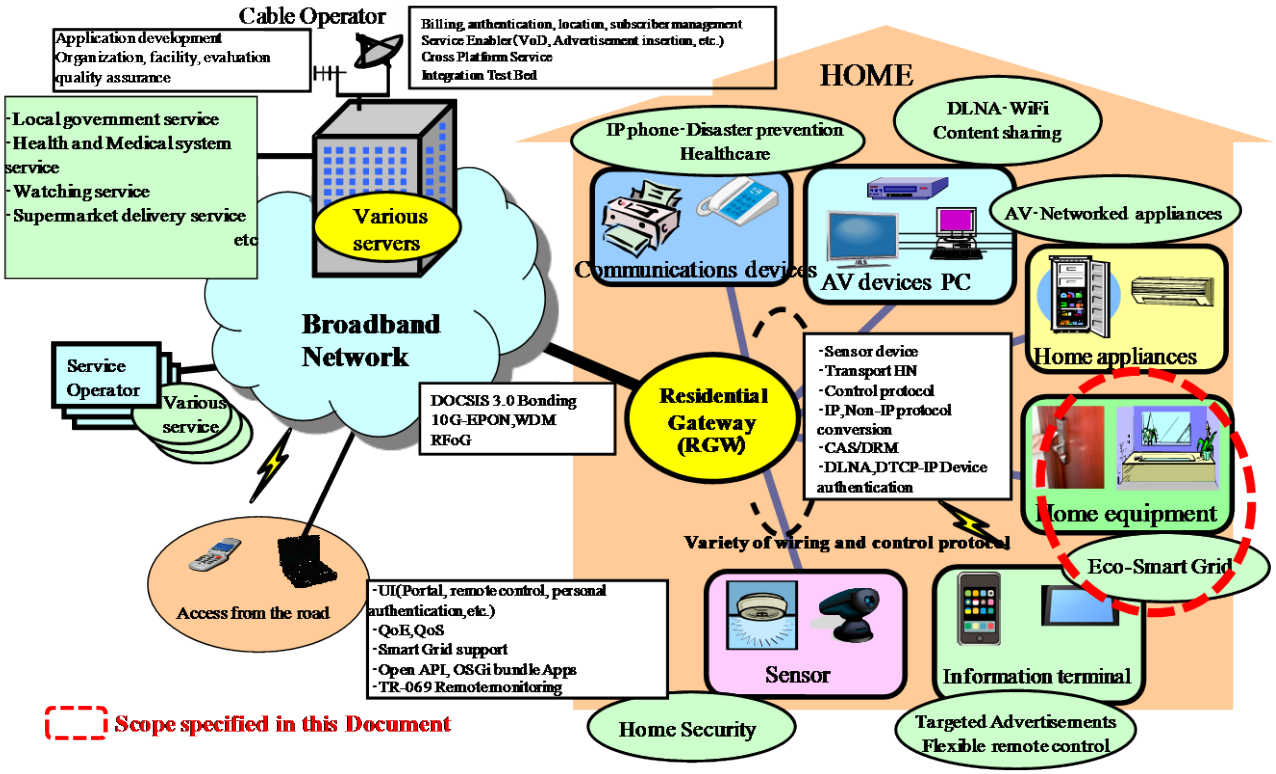


Figure 1-1 – RGW and related entities for home ICT services

2.3.2 Solar power cell maintenance service

This is an information service to the cable customer on the maintenance of the solar power cell. The system is required to report to the cable customer the necessity of surface cleaning, the existence of malfunction through the monitoring of past power generation record and comparison with regional standard generation value.

In general, the detection of the failure of the solar panel module is difficult; hence, it is normally left without maintenance even during the guarantee period. It is also useful for the customer to be informed that the trouble is caused by climate change or a stain/malfunction of the solar panel. The system has to report the result to the cable customer. In case of a home battery, the system has to provide the appropriate exchange date of the defective battery or advise on the economical usage of the battery based on a past operation record. The system must send the information by e-mail to the assigned address.

2.3.3 Presentation items

The presentation items are shown below to realize the aforementioned services:

(1) Electric power consumption (real time, every hour, past record, regional ranking).

(2) Electric power generation (real time, every hour, past record, regional ranking).

(3) Electric power fee (time zone, monthly, comparison with previous year)

(4) Battery status (real time, charge/discharge record) and exchange date.

(5) Usage report by the power company (regional power balance).

(6) Malfunction of the solar power panel and/or necessity of cleaning.

(7) Setting threshold of power consumption and control.

(8) Alert indication over threshold, usage recommendation, sending e-mail.

(9) Power saving schedule in region.

(10) Economical usage information.

(11) Contract detail with the power company.

(12) Setting of presentation.

2.4 High-level system architecture

Figure 1-2 shows the high-level system architecture for home energy management services.

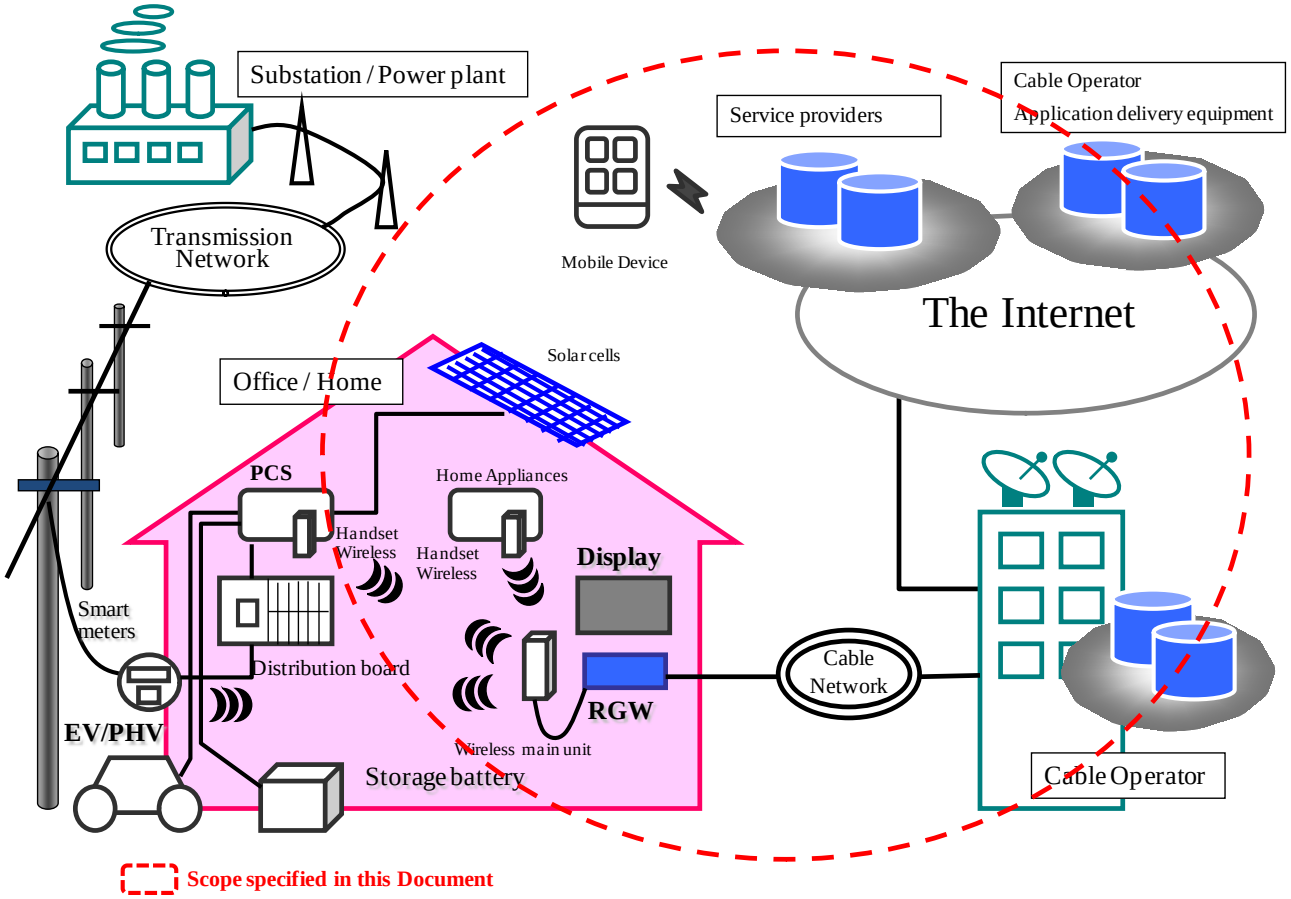


Figure 1-2 – High level system architecture for home energy management

2.5 Pre-conditions

- The residential gateway and measurement devices for power consumption should be provided in the customer premises.
- The interface conditions and transmission protocols (device discovery, capability check, data acquisition, etc.) between the measurement devices and the gateway, and between the gateway and the cloud should be standardized.
- The application for the visualization service of consumed power should be provided.
- The application download function should be provided in the application distribution system and the terminal devices.
- Data processing in the cloud should be available in real time by the application.

- The terminal devices (RGW and mobile devices) should have a browser function to present data processing results.

2.6 Main steps

1. The customer downloads beforehand the application for the visualization service of consumed power in the terminal devices.
2. The customer selects the service (visualization service of consumed power) on TV or on a mobile device screen and logs using their ID and password.
3. At the selection of the service by the customer, the functions for the discovery of measurement devices and communication to the gateway are activated.
4. The measurement device reports the obtained data to the gateway function periodically or at the time of customer access.
5. The gateway function transfers the measured data to the cloud by the application, the cloud processes the data, and the results are conveyed to display terminals (TV or mobile devices) through the gateway function.
6. The terminals present the processed data on their screens.

3 Healthcare services

3.1 Name of use case

Healthcare service

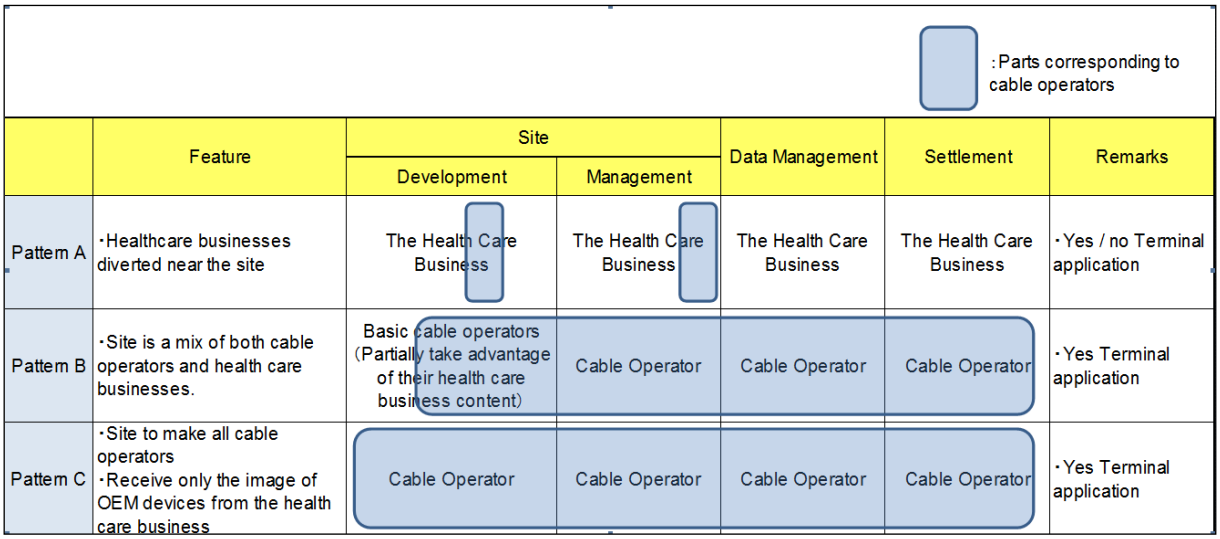
3.2 Description of situation

Service objective and relationship with other services

Provisioning of simple handling and easy use of the healthcare service for the cable customer are the objectives of this service. The system has to establish the relationship between the healthcare device vender and the medical consultant to enhance this service.

Service operation pattern

In this service, the following three patterns are assumed. In case of cooperation with healthcare operators, the provision of healthcare devices, data collection and control, site development and operation, and settlement are negotiable matters. Adding a terminal site application to this web application will also enhance the service area.



	Feature	Site		Data Management	Settlement	Remarks
		Development	Management			
Pattern A	・Healthcare businesses diverted near the site	The Health Care Business	The Health Care Business	The Health Care Business	The Health Care Business	・Yes / no Terminal application
Pattern B	・Site is a mix of both cable operators and health care businesses.	Basic cable operators (Partially take advantage of their health care business content)	Cable Operator	Cable Operator	Cable Operator	・Yes Terminal application
Pattern C	・Site to make all cable operators ・Receive only the image of OEM devices from the health care business	Cable Operator	Cable Operator	Cable Operator	Cable Operator	・Yes Terminal application

Figure 1-3 – Operation pattern of healthcare services

(1) Pattern A

In this pattern, most of the service function is provided by healthcare service operator, and not by the cable operator. Very limited customization will be done by the cable operator such as instruction of the service, provisioning of healthcare devices, etc. All the collected healthcare data from the user is stored in the healthcare service operator server and controlled by it. This pattern corresponds to a small start-up service by a cable operator.

(2) Pattern B

This pattern shows an equal partner service between the cable operator and the healthcare service operator. Based on the web service by the healthcare service operator, the cable operator can add this service in its system. The obtained data will be stored in the cable operator server.

(3) Pattern C

This pattern is based on borrowing the data collection mechanism from the healthcare service operator and the cable operator. The cable operator can process all the healthcare data with their own application.

Healthcare data

A) Collection of data

Two ways of collection are assumed.

(1) Automatic storing in the server from the sensor:

The data is stored in the web server automatically via a sensor, a transmission line (wireless) and RGW. It is also assumed that there is a direct data transaction to the server from the sensor.

(2) Manual storing in the server:

The user stores their healthcare date in the assigned server manually.

B) Collected data

Collected data are assumed to be fundamental data, obtained calorie data, and consumed calorie data.

(1) Fundamental data:
- Age, gender, height, walking step;
- Blood test result, weight, blood pressure, body fat, glucose, etc.

(2) Obtained calorie data:
- Obtained food calorie data.

(3) Consumed calorie data:
- Total walking steps per day;
- Consumed calorie by other exercises.

3.3 Description of service

3.3.1 Application example

Maintaining the user's motivation is quite important for the healthcare service. To do so, the following applications are recommended.

(1) Collection and analysis application

Graphical display is effective after the collection and accumulation of healthcare data. The timing of the presentation of the data is periodical and should be based on the user's access. Both a presentation on the web page and the terminal application should be available.

A graphical example can include:
- Weight graph per hour;
- Calorie graph;
- Food calorie balance;
- Target graph;
- Ranking of healthcare competition.

Graphical samples for weight and calorie measurement are shown respectively in Figure 4.

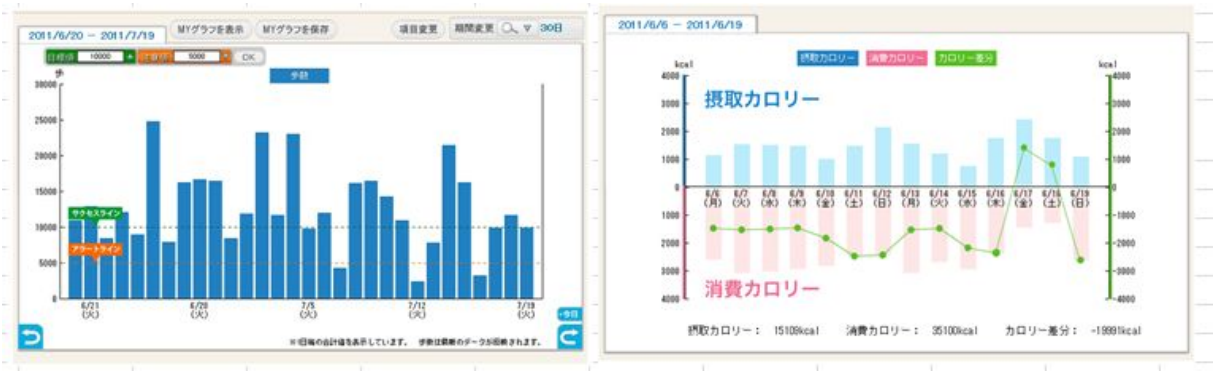


Figure 1-4 – Weight graph (Left), Calorie graph (Right)

(2) Terminal application

To deploy large displays on TV and to have an interactive nature of RGW, the following applications (portal and pop-up messages) are recommended. It seems useful to show healthcare pop-up messages at power-on stage, at a given time or on a specific day. Graphical samples for portal menu and pop-up messages are shown respectively in Figure 1-5.

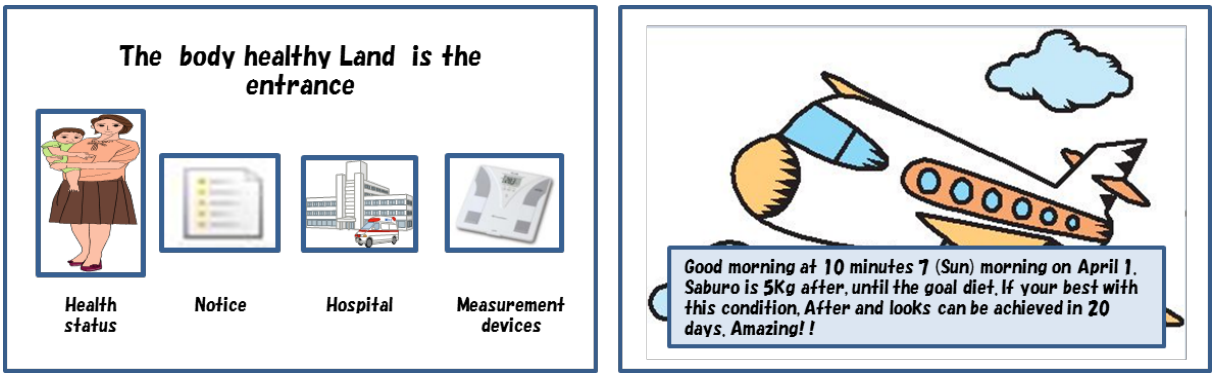


Figure 1-5 – Portal menu example (Left), Pop-up message example (Right)

3.3.2 Other possible services

(1) Healthcare channel and exercise for the elderly:
The commercial channel of the cable operator must be used effectively. The local healthcare event is also broadcasted.

(2) Promotion of healthcare devices and installation aid:
Promotion of healthcare devices is also available by the cable operator. The cable operator can insert a banner to help the user navigate. When installing the system, an additional installation aid programme is also one of the possible available services.

(3) Co-work with the municipal office:
In order to expand this home healthcare service to the local community healthcare service, co-working with the municipal office is important. As a part of the local medical network, the cable operator will be able to form a healthcare network involving the medical office, the hospital, the pharmacy and the health consultant. A local healthcare programme can be provided for this purpose.

(4) Face-to-face healthcare and security:
The TV telephone function of RGW can be used for this service. The customer can communicate with the health consultant or nurse via the TV telephone and can receive the appropriate healthcare advice. This service can be extended to the home security services when appropriate sensor devices are introduced.

3.4 High-level system architecture

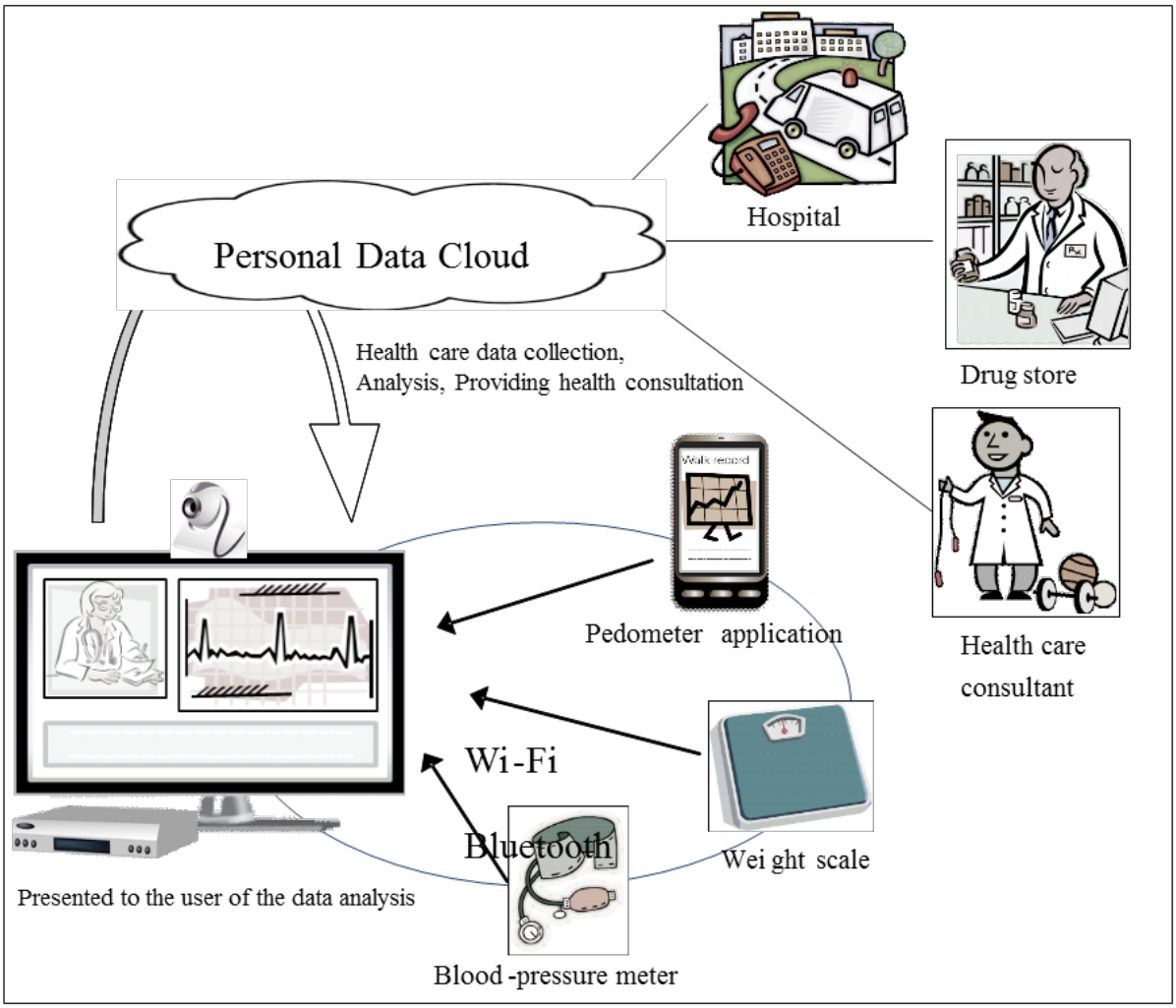


Figure 1-6 – Simplified healthcare image

3.5 Pre-conditions

- The residential gateway and measurement devices for the health care service (with transmission function) should be provided in the customer premises.
- Interface conditions and transmission protocols (device discovery, capability check, data acquisition, etc.) between the measurement devices and the gateway, and between the gateway and the cloud should be standardized.
- The application for the health care service should be provided.
- The application download function should be provided in the application distribution system and the terminal devices.
- Data processing in the cloud should be available in real time by the application.
- The health consulting service by the professional health consultant should be available by the application.
- The terminal devices (RGW and mobile devices) should have a browser function to present data processing results.

3.6 Main steps

1. The customer downloads the application of the health care service in the terminal devices beforehand.
2. The customer selects the health care service on TV or mobile device screen and logs in using their ID and password.
3. At the selection of the service by the customer, the functions for the discovery of the health care measurement devices and communication to the gateway are activated.
4. The measurement device reports the obtained data periodically or at the time the customer accesses the gateway function.
5. The gateway function transfers the measured data to the cloud by the application, the cloud processes the data, and the results are conveyed to display terminals (TV or mobile devices) through the gateway function.
6. The terminals present the processed data on their screen.

4 Net supermarket service

4.1 Name of use case

Net supermarket service

4.2 Description of situation

Definition of operator

In this FG Technical Report, operators are classified into three categories as shown in Table 1-1.

Table 1-1 – Categories of operators

Operator	Description
Net-supermarket operator	The operator who runs a supermarket as well as a net-supermarket (e.g., a major supermarket chain).
Net-supermarket ASP	The application service provider (ASP) that provides a platform and a mechanism for managing a net-supermarket, without having the functions of a supermarket and a small retail shop (e.g., a major transportation company).
Supermarket operator	The operator who runs a supermarket only and does not carry out a net-supermarket business. A personal retailer is included in this category.

4.3 Description of service

This clause describes the net-supermarket service. Figure 1-7 shows the outline of the service; the business models and the corresponding management flows are also explained.

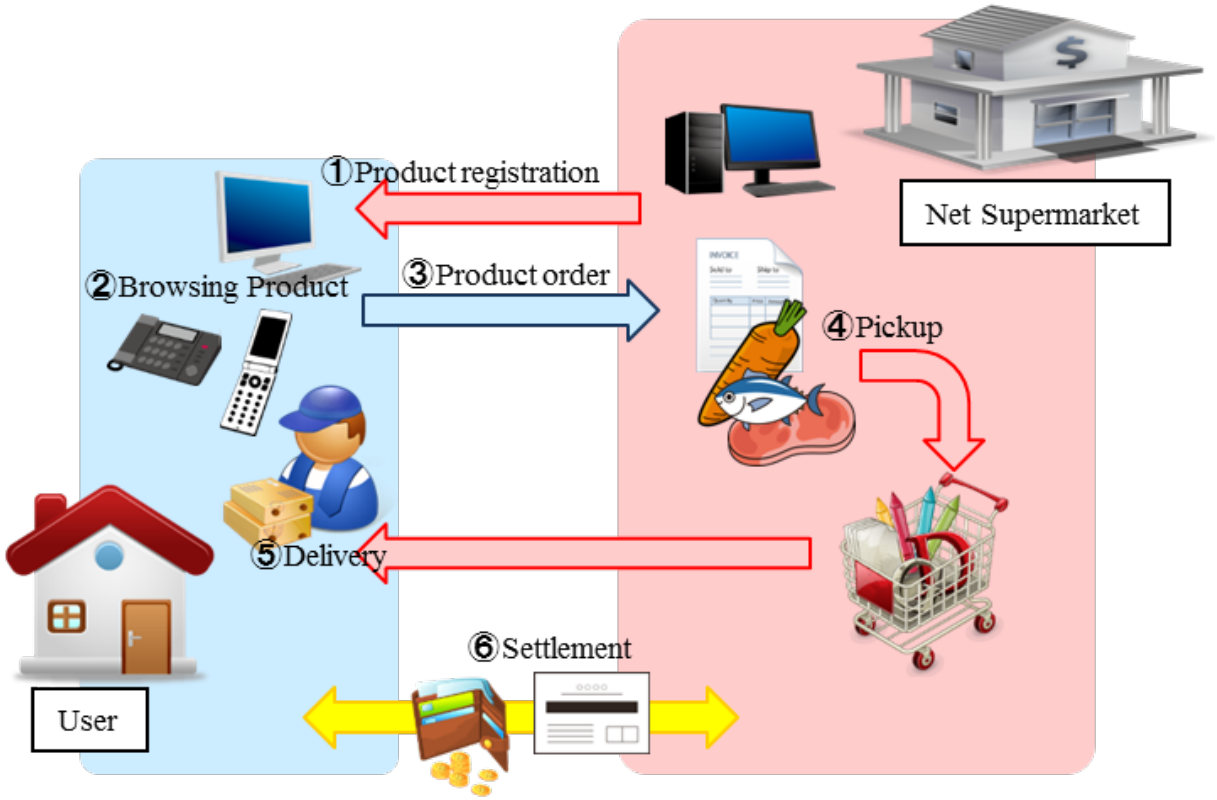


Figure 1-7 – General management flow of net-supermarket

(1) Business model

The business model of a net-supermarket is shown in Figure 1-8.

Model	Product advertisement Product introduction	Product registration Product Management	Order reception	Merchandise procurement Pickup	Pickup and delivery	Settlement
A	Cable Operator	Net Supermarket Operators				
B	Cable Operator			Supermarket		Cable Operator
C	Cable Operator					

Figure 1-8 – Business model of net-supermarket

[Model A] Collaboration between an advanced net-supermarket operator and a net-supermarket ASP shows the operation flow of Model A. The cable operator provides the cable system for advertisement and browsing of goods. Model A is the collaborative work with net-supermarket operator, and in some cases the net-supermarket operator may consist of net-supermarket ASP and real supermarket. . Flows from the acceptance of order until the settlement of the bill are covered by the collaborator. There are some advantages for the collaborator such as the expansion of the size of the market and use of TV screens for advertisement or announcing information on sales, etc.

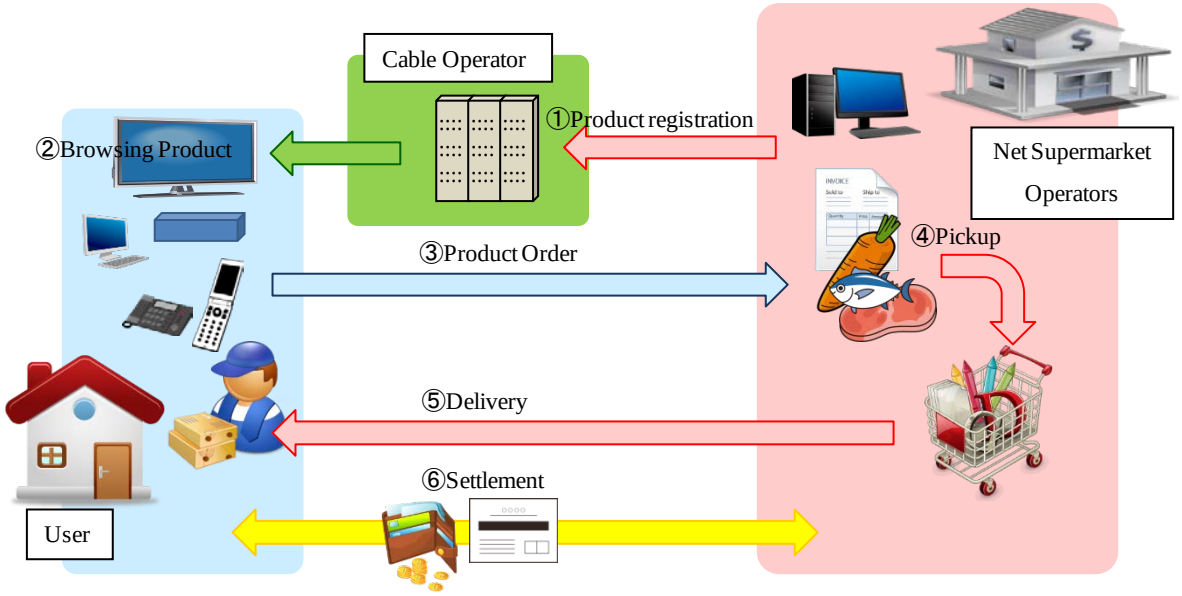


Figure 1-9 – Operation flow of Model A

[Model B] Enablement of a regional supermarket, a small shop and a shopping arcade to net-supermarket shows the operation flow of Model B. The cable operator constructs a net-supermarket platform and allows regional shops or shop arcades to use the platform. The case where the cable operator deals with the pickup and delivery services may also be included in Model B. This will contribute to the activation of the regional economy and promotion of special products in rural districts; these are the most expected roles for cable operators. The cable operator has all the functions except for the pickup and provisioning of delivery.

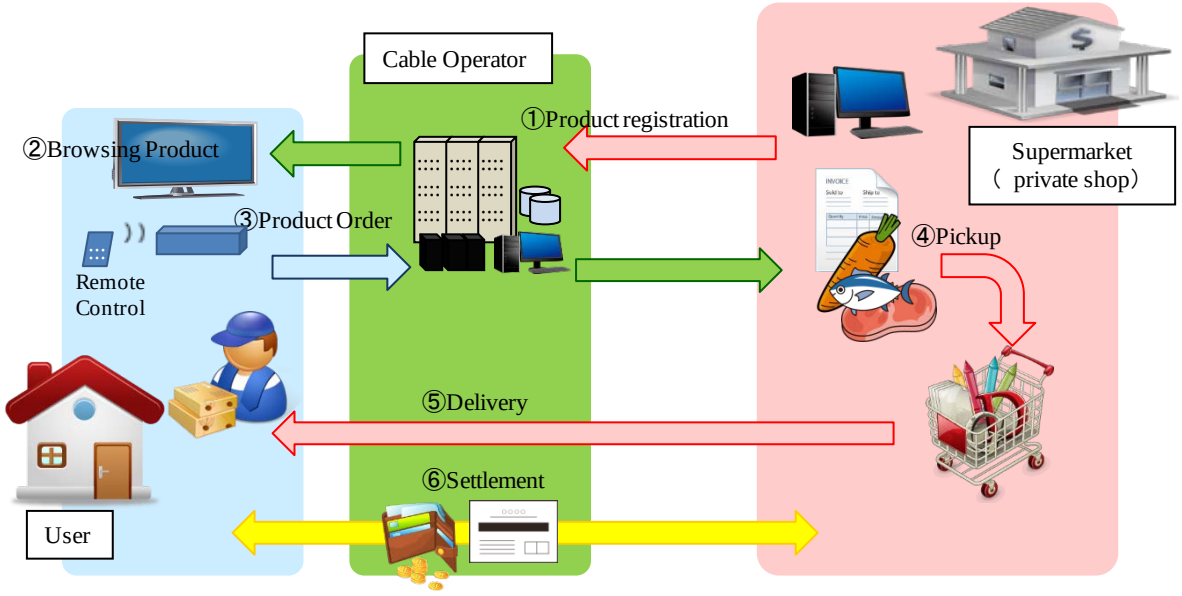


Figure 1-10 – Operation flow of Model B

[Model C] Development of net-supermarket business in rural districts shows the operation flow of Model C. The cable operator deals with the net-supermarket business in a small population area with the aid of shopping support for the residents alongside the cooperation of a municipal office or rural government. Gaining profit seems to be a hard task of this business model.

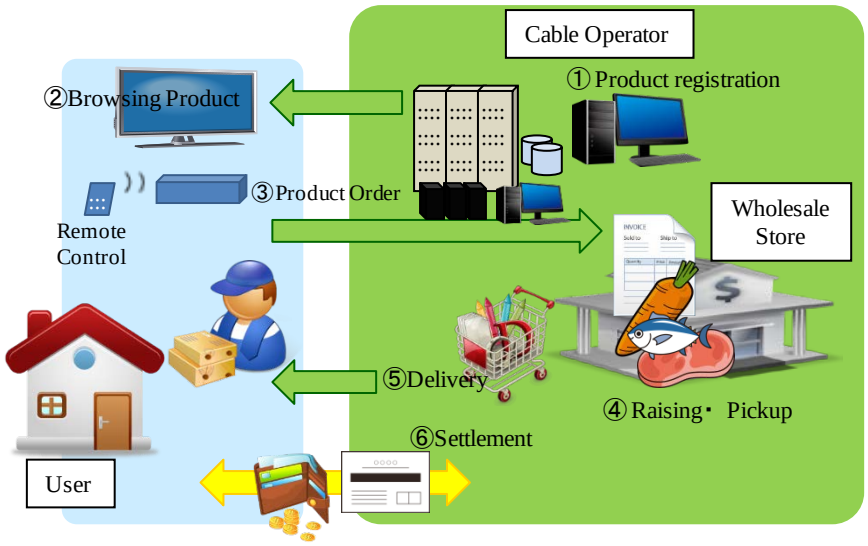


Figure 1-11 – Operation flow of Model C

4.4 High-level system architecture

The high-level system architecture of the net-supermarket (Model C) is shown in Figure 1-12.

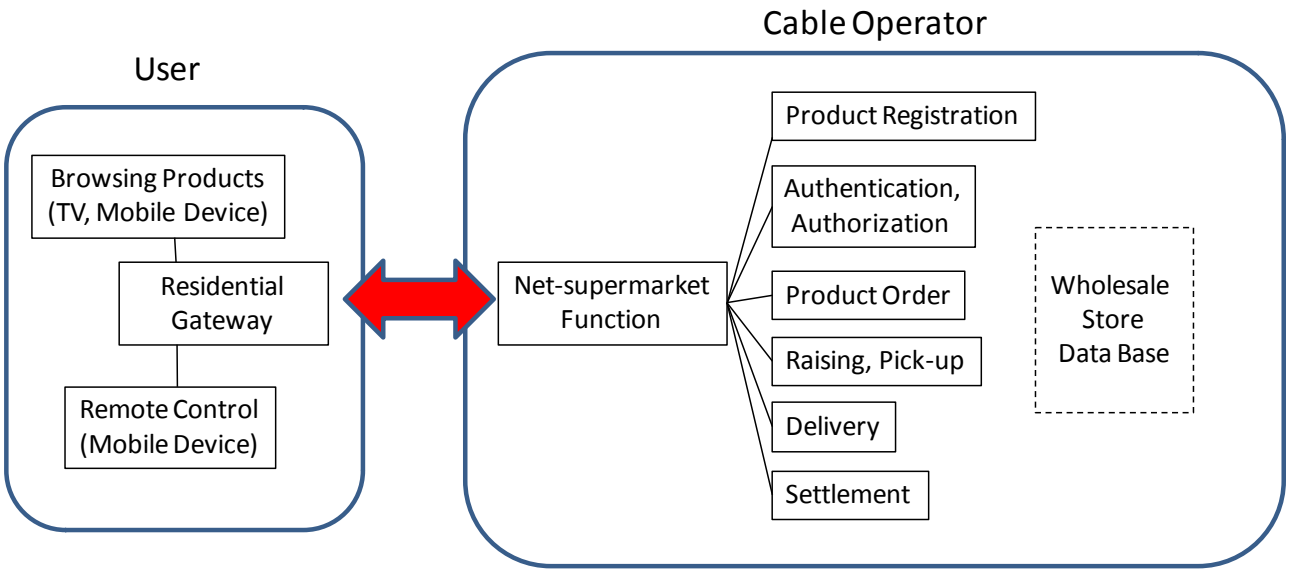


Figure 1-12 – High-level system architecture of the net-supermarket (Model C)

4.5 Pre-conditions

This clause describes the pre-conditions for Model C, which seems to be the most typical case.

- The residential gateway and terminal devices for net-supermarket services should be provided in the customer premises.
- The interface conditions and transmission protocols (authentication, billing, data exchange, etc.) between the databases of the cable operators providing the net-supermarket services and the gateway should be standardized.
- The application for the net-supermarket service should be provided.

- The application download function should be provided in the application distribution system and the terminal devices.
- Data accessing to the databases of the cable TV operators and data processing should be available in real time by the application.
- The terminal devices (RGW and mobile devices) should have a browser function to present data processing results.

4.6 Main steps

Table 1-2 shows the main steps for net-supermarket services.

Table 1-2 – Main steps of net-supermarket services

Functions of net-supermarket	Functions of cable operators	Description
1.Browse and search	Registration and control	Browsing or searching for goods on TV screen
2.Order	Order（order acceptance）	Decision of purchase by ordering
3.Provisioning	Pickup and delivery provisioning	Assembling goods and provisioning of delivery
4.Delivery	Transportation and delivery	Receiving goods after transportation and delivery
5.Settlement	Payment	Payment of goods

5 Multi-device service

5.1 Name of use case

Multi-device service

5.2 Description of situation

The cable operators, or other service providers, provide a linear broadcast and a video on demand (VoD) service not only to the cable STB but also to multiple devices:

An assumed linear broadcast service is the subscription type.

Assumed VoD services are:

- Subscription model service;
- Pay-per-view model service.

In this service, the user can use multiple devices (such as a smart phone, a tablet, etc.) to watch the video streaming. Therefore, the cable operator is required to provide a specific user ID used by these multiple devices.

5.3 Description of service

- Seamless multi-device TV watching experience;
- Social media assisted-TV watching.

5.4 High-level system architecture

Figure 1-13 shows the high-level system architecture for seamless multi-device TV watching.

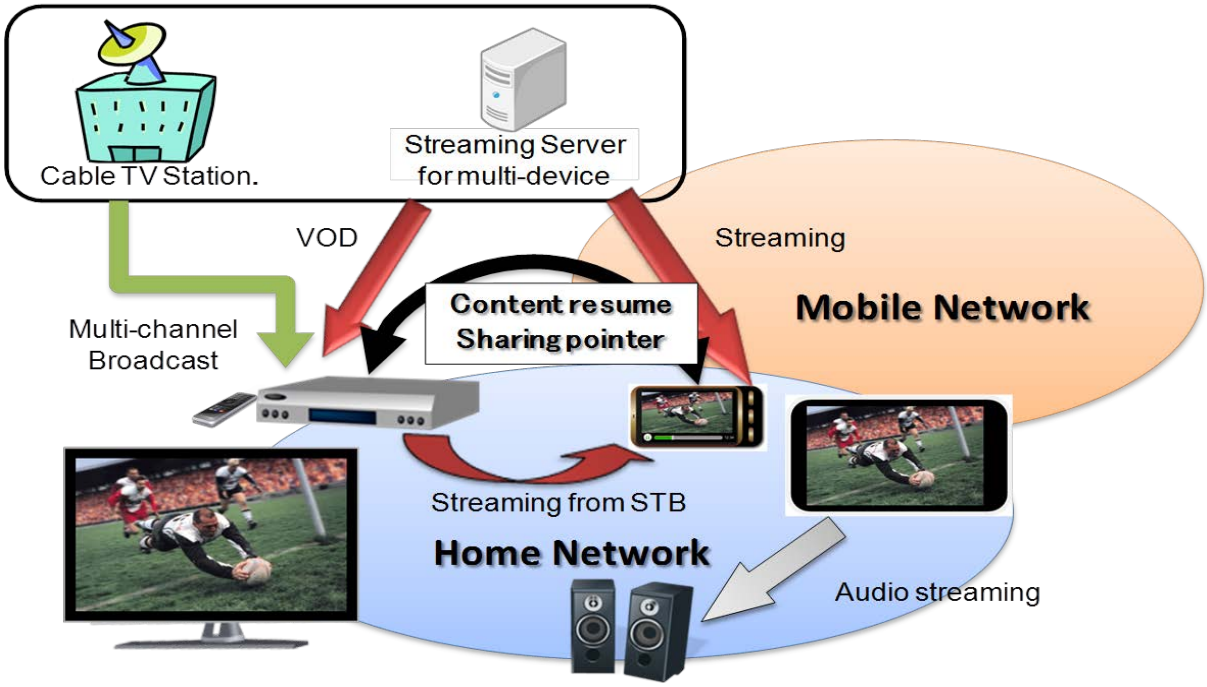


Figure 1-13 – Seamless multi-device TV watching experience

Figure 1-14 shows the high-level system architecture for social media assisted TV watching.

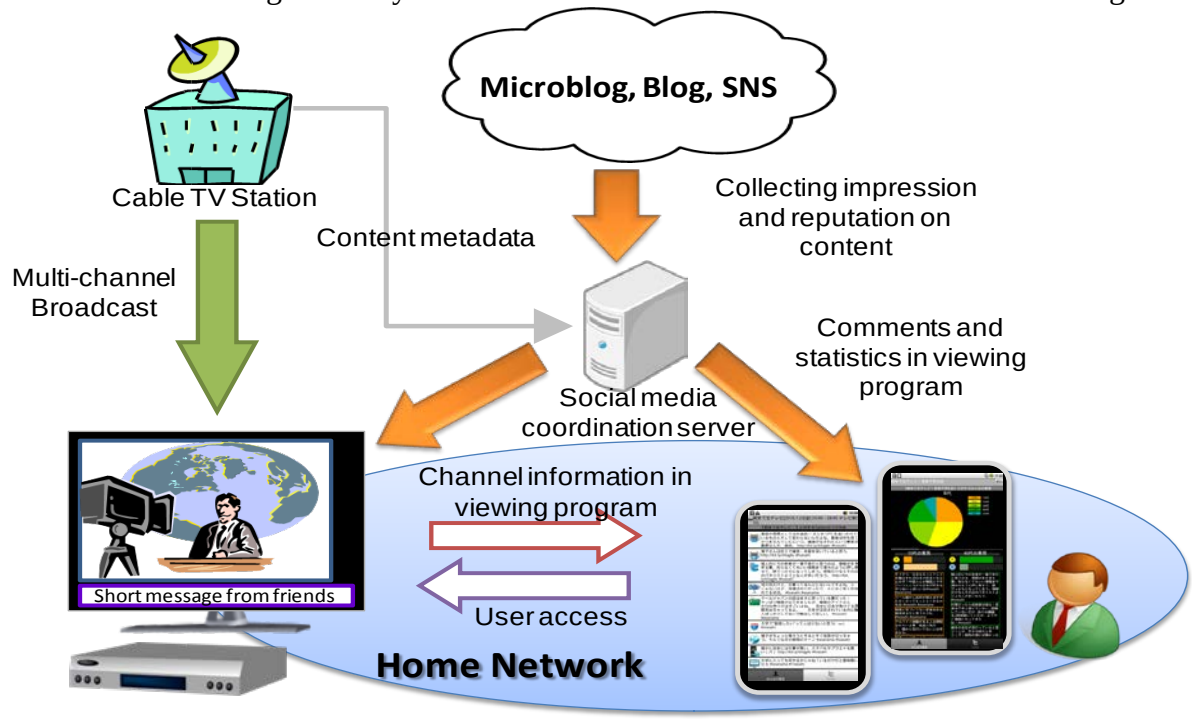


Figure 1-14 – Social media assisted TV watching

Figure 1-15 shows the high-level system architecture for cloud-based seamless multi-device watching and social media.

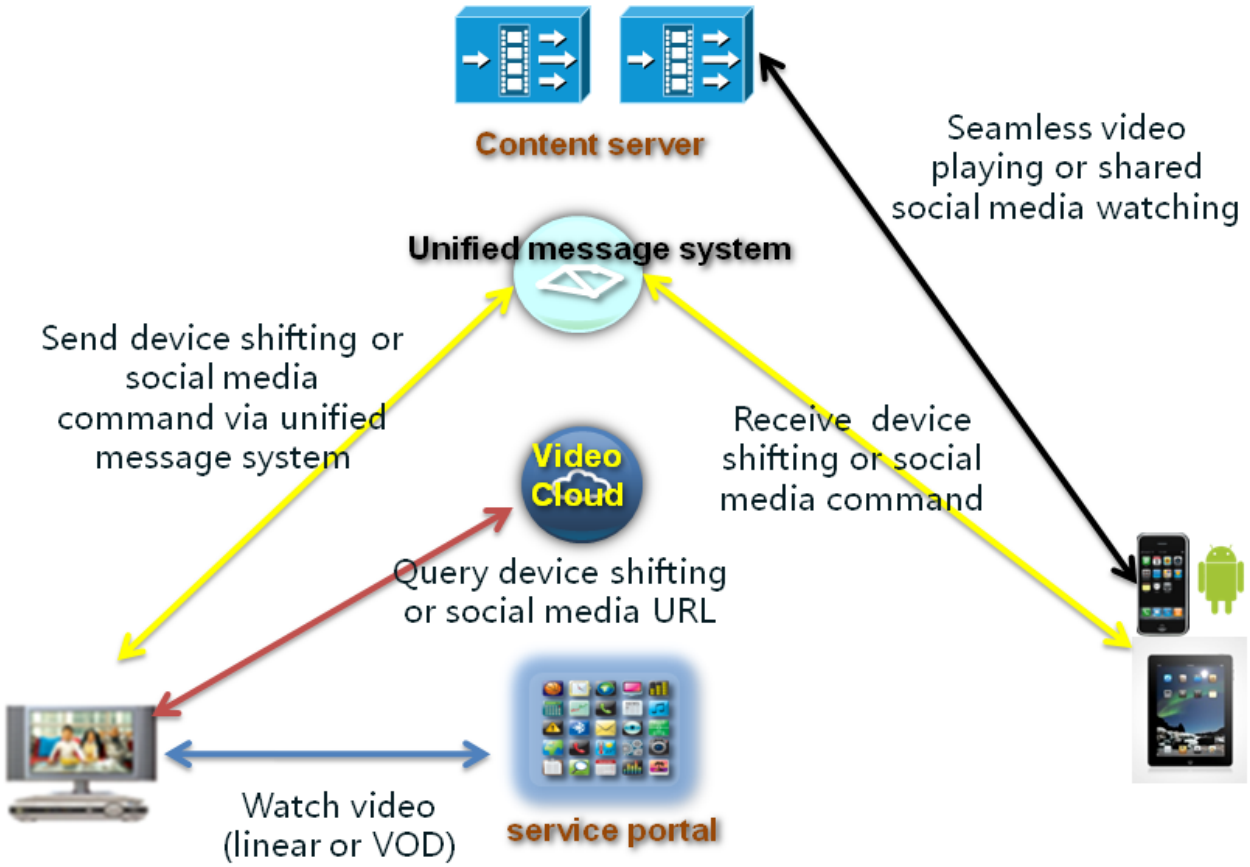


Figure 1-15 – Seamless video play and social media between multiple devices

5.5 Pre-conditions

When the user buys a cable television (CATV) service, the cable operator gives a VoD user ID associated with STB (default ID). This VoD user ID is also available for the other devices including a smart phone, a tablet, and a personal computer (PC) as well as STB. Therefore, the user can obtain other IDs from the other devices.

STB has a setting menu to maintain the VoD user ID. The user can register any number of additional VoD user IDs by inputting ID and password. Therefore, if the user already has the VoD user ID for a smart phone, a tablet, or PC, the user can register that ID for STB. When multiple VoD user IDs are registered with STB, the user can easily switch the "active" (currently logged in) IDs on STB.

5.6 Main steps

5.6.1 Multi-device VoD service:

1. When the user uses a multi-device VoD application and accesses any pay content, the application checks the "active" VoD user ID. If the user purchases the content, the content is associated with the "active" user ID.
2. When the user stops the video playback, the streaming server stores the resume point. The resume point is stored for each VoD user ID. Therefore, when the user accesses the content again, the streaming server resumes the content playback from the resume point even if the user accesses the content from different devices.

3. If the user switches the active user on STB, the VoD application changes the available content list, bookmark, and all customized setting corresponding to the new active user.

5.6.2 Social media assisted TV watching:

1. When the user launches the social media assisted TV watching application on the tablet, that application establishes the pairing between STB and the tablet. Then, the application acquires the TV programme information displayed by STB. Based on that information, the application accumulates the comments and statistics from the social media coordination server and displays it to the user.
2. Content sharing mode: After the customer finds the target user in his friends' list, he or she can then send content sharing command to the target user who still needs a service authorization to view this content.
3. Content presentation: The content presentation command will also be sent to the video cloud system to store this content purchase record, so that the target user can watch this content without paying additional cost.

5.6.3 Cloud-based seamless video watching as push mode:

1. Video push case: When the customer watches a video on one device such as STB, he or she can send this video to a new device which logs in by the same username to continue watching this video.
2. The shifting between the two devices should be seamless; in other words, the last picture displayed on the source device should be the first picture on the target device.
3. The key point is that the video cloud can detect all the status for all devices such as information about playing video. Moreover, all commands or messages will be sent via some unified message system mechanism, for example, extensible messaging and presence protocol (XMPP).

5.6.4 Cloud-based seamless video watching as pull mode:

1. The video pull case: The customer has two or more devices login to a unified message system.
2. The customer can query the content which is played on other screens, and then they may enable the current screen to continue playing the same video such as pull video from the remote to the nearest screen.

6 Harmonization between STB and mobile devices

6.1 Name of use case

Harmonization between STB and mobile devices

6.2 Description of situation

The hybrid cable STB and tablet/smart phone are connected to the same home network and some advanced applications are running on the tablet/smart phone.

These devices are also connected to the head end so that every inter-operation message will be transferred by this head end; this situation can also be called a cloud-based interactive system.

6.3 Description of service

The STB remote control application has the following functions:

1. electronic program guide (EPG) for the tablet;
2. button and mouse input emulation;
3. remote text input;
4. launch and control of STB applications;
5. pairing between the tablet and STB.

6.4 High-level system architecture

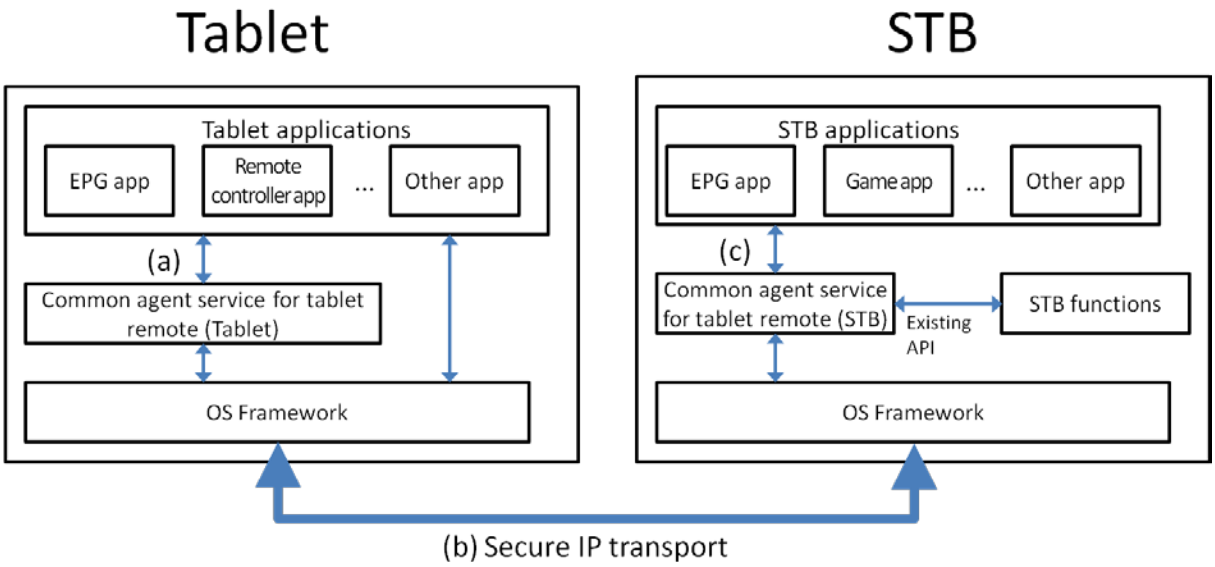


Figure 1-16 – High-level system architecture

6.5 Pre-conditions

Prior to running the STB remote control application, the common agent service is installed in STB. When STB is turned on, the common agent service is automatically launched as the background programme with the following functionalities:

STB power/status management:

i. STB's power on/off status checks and wake up command from the tablet.
ii. STB's status checks to avoid resource conflict.
iii. Pairing between the tablet and STB (both directions).

Channel control and EPG:

i. Acquisition of stored/currently watched channel information (STB to tablet).
ii. Transfer of EPG information to the tablet (STB to tablet).

Input emulation:

i. Channel button and mouse input emulation (tablet to STB).
ii. Text input from tablet (tablet to STB).

Application control:

i. Launch and control of STB applications (tablet to STB).

6.6 Main steps

6.6.1 Home network connection-based STB remote control:

1. When the user installs the STB remote control application in the tablet, the common agent service is also installed.
2. When the user launches the remote control application, it searches for all available STBs in the home network. If multiple STBs are on the home network, the application shows the list and the user can choose the target STB. If STB's power is off, the application sends the wake up command to STB.
3. The tablet application acquires the required information such as service area information, available channel lists, and user rating information from STB.
4. When the user chooses EPG on the tablet, the application acquires the latest EPG information. The EPG application can acquire it from both Internet and STB and provides it to the user with the format that is optimized for the tablet.
5. When the user uses any form of tablet remote control functions (such as the keyboard input emulation, pointing device emulation, and text input, etc.), all input from the tablet is transferred to STB through the home network. When STB receives this input, the common agent service of STB interprets it and sends it to each STB functions/application.

6.6.2 Cloud-based STB remote control:

1. The traditional remote control for STB is quite simple, and it is not easy to input complex words.
2. Main operation of cloud-based STB remote control: The user presses the function button or inputs the numbers and characters on a smart control application, and the application should send all these commands to STB via a unified message system.
3. The parameters of the remote control commands should include channel change, voice change, switching to specific live broadcast channel and cursor move (up, down, left, right) and other function keys such as confirm, quit, and cancel.
4. Another use case is when the application can integrate a voice recognition module, so that it can replace the button press or manual input, and the user can control STB more easily.

7 Integrated broadband broadcast TV

7.1 Name of use case

Integrated broadband broadcast application

7.2 Description of situation

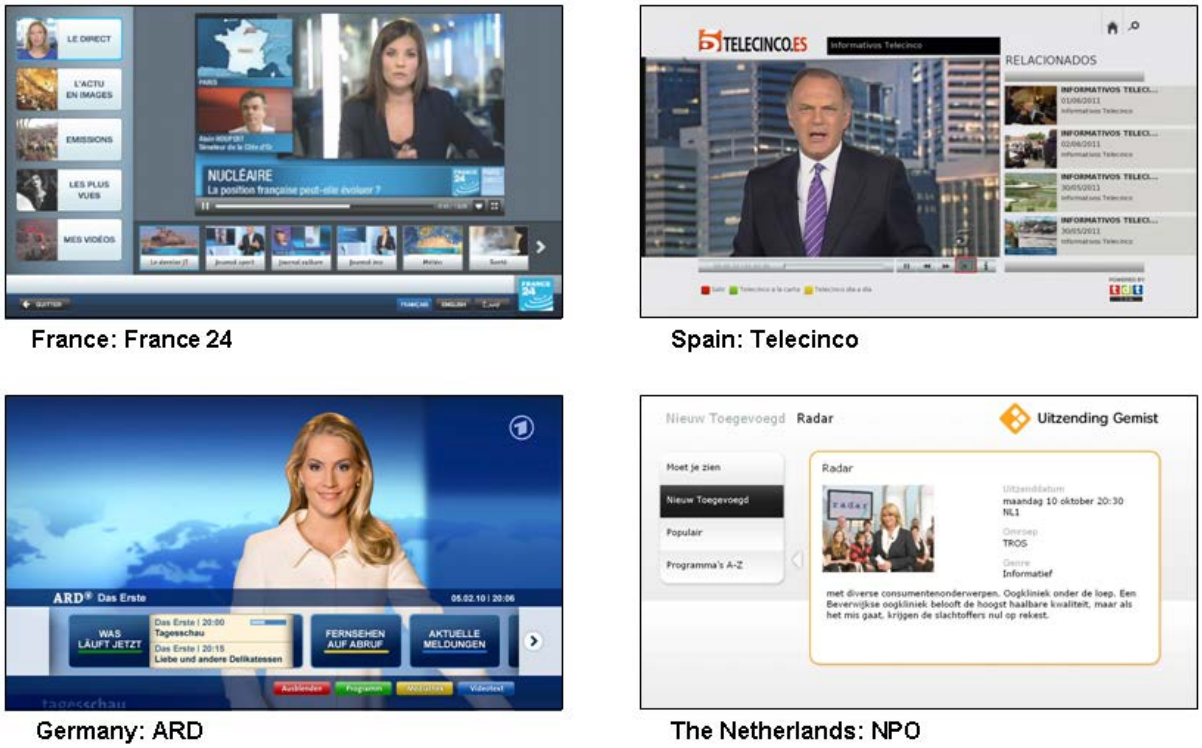
A connected TV set is not necessarily apt for truly hybrid interactive viewing experiences. While, in general, all connected TV sets have two inputs: one for the broadcast signal (TV tuner) and one for the Internet (Ethernet/wireless LAN (WLAN)) connection, they do not necessarily offer converged services by making use of both distribution paths. Such a device is usually only equipped for access to proprietary portals for content and applications via the Internet. In addition, some include a slimmed-down browser for viewing regular web pages, however, usually with limited functionality (which commonly leads to odd user experiences). This cannot be considered as converged equipment; it is merely a multi-purpose device that just allows the viewing of broadcast television content or uses separated and limited add-on functionalities through the Internet connection on the same screen.

For the truly hybrid services enabling a seamless user experience, an "engine" is required that links the broadcast content offered via the cable TV network and the Internet content offered via the interaction channel, such as also via cable TV or any other IP connection. Integrated broadband broadcast TV provides such an engine, and it encompasses the necessary signalling and includes customer electronics (CE)-based browser that has combined access to both, the data in the broadcast stream as well as to the services, applications and content provided via the Internet.

7.3 Description of service

The following services are supposed examples as integrated broadband broadcast applications:

- A user would like to have more information related to the TV programme currently on the air, say "Napoleon". The result of the search will be a list of all Napoleon-related video clips that are stored and offered by the collaborating broadcasters. Potentially, sound radio programmes and adapted web-pages (including pictures and text files) could also be comprised in the result list. Viewing of the retrieved content is currently accomplished on the TV set but may in future also happen on a second screen, e.g., on a tablet computer.
- Cable TV operators can deploy integrated broadband broadcast TV-based portals offering a broad variety of services on any integrated broadband broadcast TV-equipped device. A TV channel may be used to signal an application which by the integrated broadband broadcast TV auto-launch functionality is immediately kicked-off when the device tunes to the service channel. For example, Eutelsat's "Kabelkiosk choice" is an hybrid broadcast and broadband (Hbb)TV-based service portal that is pre-configured for cable network operators.
- A user might listen to a synchronized audio description provided through the IP network with a second device (e.g., a smart phone with earphones), while the other users in the room listen to the original sound on the TV set (or vice versa).



France: France 24 | Spain: Telecinco

Germany: ARD | The Netherlands: NPO

Figure 1-17 – Example of integrated broadband broadcast applications

7.4 High-level system architecture

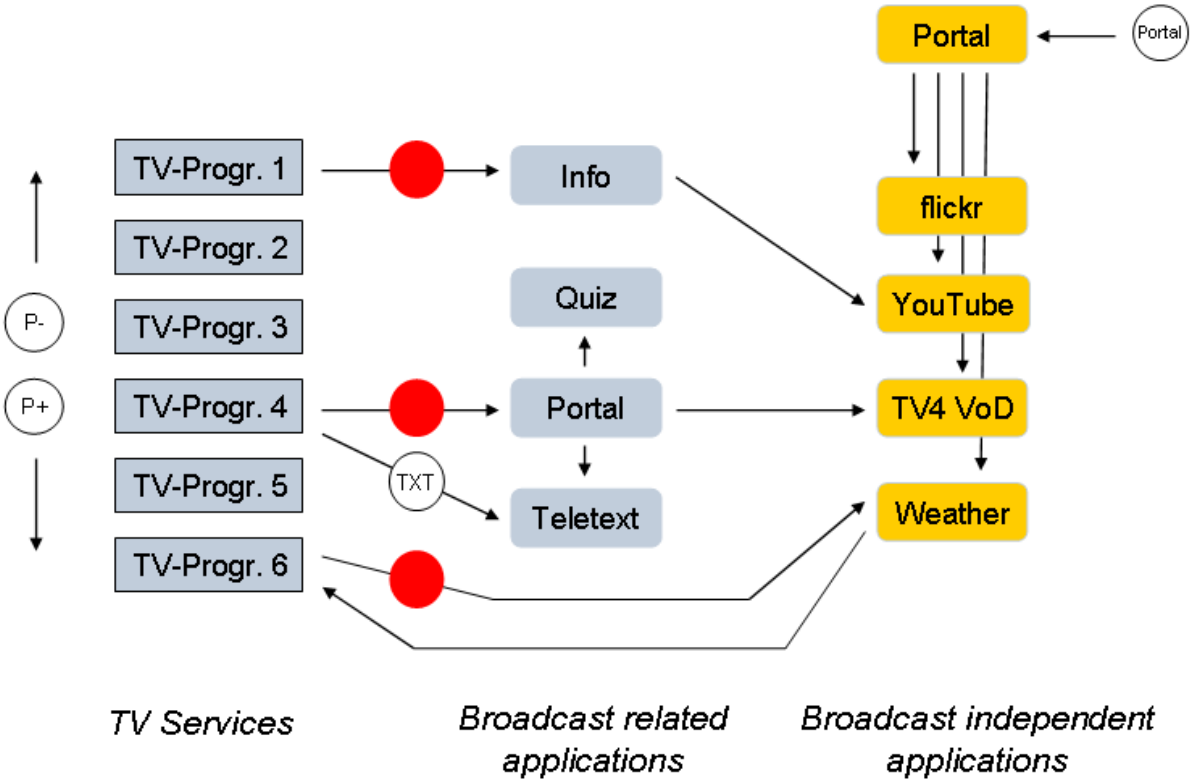


Figure 1-18 – High-level system architecture for integrated broadband broadcast application

Integrated broadband broadcast TV does not only support applications which are tied to a broadcast service ("broadcast related applications") but also applications with no relation to any broadcast service ("broadcast independent applications"). Such broadcast independent applications can be "TV editions" of existing web services like *flickr*, *YouTube* and very many more as they may be provided by the big brands as well as on a regional level or even by individuals. Integrated broadband broadcast TV does not define detailed access mechanisms for broadcast independent applications. It is left to the CE manufacturers to implement flexible portals allowing the end users to find and access all the services they could be interested in. Integrated broadband broadcast TV portals and search functions for interesting applications could also be provided by third-party operators. It is left open to the market development in an open retail market to find access strategies serving best the end customers need. In vertically integrated market segments with subsidized devices, more closed portal services may be provided.

7.5 Pre-conditions

- The broadcaster prepares supplemental content related to the TV programme, which will be provided through the IP networks.
- The broadcaster determines whether the application will launch automatically or manually.
- The broadcaster embeds application control messages including application attributes, auto-launch flag, an initial uniform resource locator (URL), etc., into the broadcasting signal.
- Users have a cable STB supporting integrated broadband broadcast applications.
- Users are connected to cable TV networks capable of the Internet access or cable TV for broadcasting reception and other high-speed data networks.

7.6 Main steps

- The cable STB receives TV programmes where the application control messages are embedded.
- According to the application control message, the cable STB launches the application automatically if the auto-launch flag is set as true. Otherwise, users can start the application by pressing a specified button on the remote if the auto-launch flag is set as false.
- The application obtains content from the server specified by URL contained in the application control message.
- The content of the application shows up in the browser of STB or in the second device.
- Users can see, hear or enjoy the content of the application.
- Users can also use the interactivity of the content including an URL link to other resources, if available.
- When the subsequent TV programme is not associated with the application, the application will automatically disappear.
- Users will also close the application when they press a specified button on the remote.

8 Content discovery

8.1 Name of use case

Content discovery

8.2 Description of situation

Cable TV is currently providing a number of TV channels compared to terrestrial broadcasting TV so that it is relatively difficult for users to find their favourite programmes through the conventional electronic program guide (EPG). In addition, additional media such as operators' video on demand (VoD) as well as over-the-top video (OTT video) are becoming popular, where millions of video content are ready to be provided to the users. Recording capability and home video server are also popular functionality of the recent cable TV set-top box (STB). This means that at a certain moment, when the user wants to see TV, the user has to choose an appropriate title from the huge inventory of the video content including broadcasting TV, VoD, OTT, recorded video, content in the home video server, etc., and finding a favourite content will be sometimes difficult in such cases.

Taking this situation into account, content discovery is a quite important functionality for cable TV services. Rather than a text-based list of the available content, an intuitive graphical user interface including thumbnails, summary texts, linkage to the relevant content, content search, etc., is quite important. If the operator or the service provider is able to obtain users' profiles, content recommendation or social networking connection can be provided as advanced content discovery services.

8.3 Description of service

The following provides examples of the content discovery services.

A) Multi-source transversal content discovery:

This type of the content discovery will provide a comprehensive content guide consisting of all the video content available regardless of their types such as broadcasting TV, VoD, OTT video, digital video recorder (DVR), and sometimes even such content stored in the home server.
Some user interface implementation will be a thumbnail-based content list. Grid guide-based user interface is also possible, where a small icon can be put on the content grid to show the content attributes or the source of the content.

B) Content recommendation based on user profiles:

If the operator or the service provider is able to obtain user profiles, content recommendation functionality can be provided in the content discovery services. Such user profiles may include, but not limited to, pre-determined attributes such as age, gender, areas of interest, as well as their behaviours including content access history, access statistics to web pages, etc. In addition, how the video content is precisely expressed in the metadata is quite important. In some cases, content metadata is provided by the creator, but this is not always the case.
Content recommendation is one of the efficient ways to narrow the video content candidates to be displayed in the content discovery services.

C) Social networking connection:

Content discovery services could be equipped with the functionality to provide a relationship with social networking services. For example, if the user presses the thumb up button on the remote, the favourite flag of his associated account of the social networking service will be set. It will be also possible that the favourite content of his friend in the social networking service will be shown on the content discovery screen of the cable TV set-top box. Furthermore, the user can find a new friend in the social networking service who is watching the same video content or who likes that video content.

D) Advanced content search:

Content search is also one of the ways to narrow the candidates to be displayed in the content discovery services. In the typical system, the user will input some keywords, e.g., “baseball”, “travel Italy”, etc. On the other hand, there are new technologies that enable users to use a natural phrase to search content. For example, “Jinni” developed by Jinni Inc. provides content search with spoken language terms such as “I’m in the mood for…”

9. Augmented smart television service

9.1 Name of use case

Augmented smart television services

9.2 Description of situation

Augmented reality (AR) technology has been in use for quite a long while and is a kind of mixed reality which 2D/3D graphics are integrated into the real world in order to enhance user experience and enrich information. As smart devices become more common, AR has been adopted in various applications such as AR-book, -shopping, -social networking services (SNSs), etc. It was often questioned if AR-technology could be applied to TV broadcasting; other related works have also been studied. In fact, this service known as AR-broadcasting has been already used in cases of virtual advertisement and additional information in television broadcasts such as football games and ballot counting (Figure 1-19). These cases are to handle all augmentation before the video image is transmitted to the broadcasting network. Therefore once it is transmitted, the TV viewer at home

can neither influence this compositing nor the selection. This could ultimately lead to viewers never returning in front of the TV.

Figure 1-19 – Augmented reality in sports broadcasting

To overcome the limitation of the one-sided augmented broadcasting service by broadcasters, a novel augmented television service technology was used to do rendering in order to blend with broadcasting content and augmented content (2D/3D graphic object) in real time on a receiving terminal such as TV or set-top box (STB). When this technology is applied to TV, viewers can watch the mixed broadcasting contents when they want to watch that service only and can watch the original broadcasting content when they do not. In addition, the content rendering on the receiving terminal allows every viewer to choose their own preferred contents or control them.

TV broadcasting would become more attractive when interactivity is allowed and interesting information is shown while watching a TV programme at the right time. For example, when a viewer is watching a golf channel where a player is putting on the green, a 3D map of the green is displayed on the right top of the TV screen. Then the viewer can manipulate the detailed green image on TV and see the player's career on a second device. In order to achieve this goal, the original video/audio contents and augmented contents should be delivered via a hybrid broadcasting-broadband network separately. Their linkage information such as metadata needs to be sent together toward a receiving terminal such as a smart-STB or smart-TV.

9.3 Description of service

9.3.1 Augmentation region-based application

The augmentation region is a coordinate space in the video image that 2D/3D objects should be overlaid. The objects should be synchronized with the movement of the augmentation region. Figure 1-20 shows an example of augmentation region based AR. The augmentation region and its tracking information should be described beforehand because a current STB may not have enough power to process tracking automatically from the video stream in real time. Therefore, it is necessary to prepare the trajectory of the movement and transmit the trajectory together with the video data. Moreover, it would be possible to transmit a prepared mask, depth-information, 3D object, or other additional data such as an illumination resource for the natural composition of 3D objects.

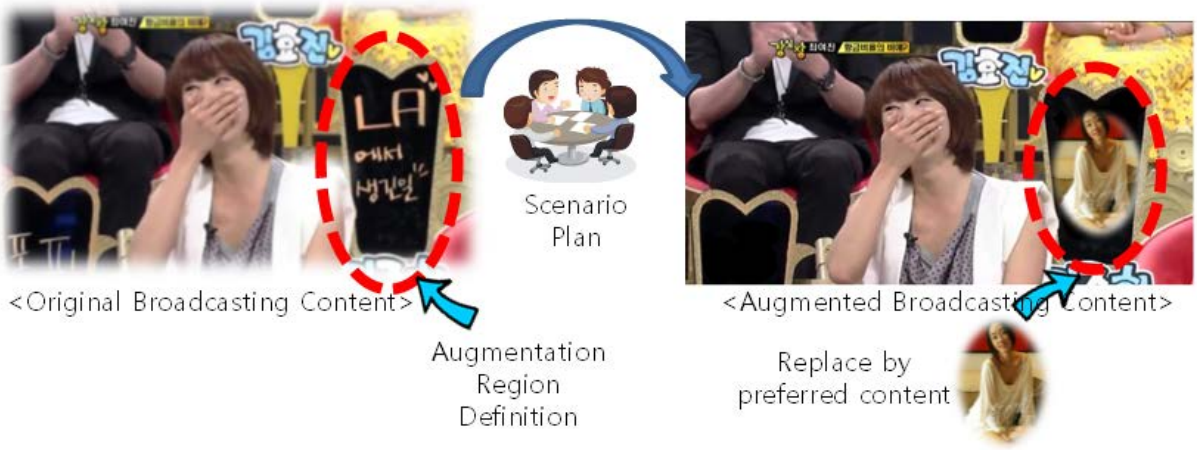


Figure 1-20 – Content replacement in augmentation region

9.3.2 Interactive application with manipulation of the 3D object

Enabling a user to manipulate a 3D object augmented over the background video will enrich the user experience. For example, a student is watching a TV programme about the organ of the human body. While the teacher is explaining about the functionality of each part of the human heart, a 3D model of the heart will show up and the student may manipulate the 3D object by handling a remote control equipped with a motion sensor. Another option to manipulate the 3D object is to run image recognition algorithms for the tracking of the marker image. This will be possible if the cost of the set-top box decreases and more calculation power and CPU speed are available to STB in the near future.

Figure 1-21 – Interactive broadcasting with manipulation of the 3D object

9.3.3 Location-based application

Location-based AR-services are very popular in mobile devices nowadays. Mobile devices usually have a location sensor and an orientation sensor. However, TV does not have such sensors and the video stream is not related to the location of the user's watching point. Then what if the video stream contains the location and orientation signal obtained from the camera? A TV camera equipped with a location sensor and an orientation sensor has already been used in AR-advertisement in sports game broadcasts. Not only the advertisement, but various useful information based on the location could be possible. For example, in the golf game broadcasts with location information, the AR service provider may give the users the ground shape of the field. Another service provider may give information about the golf club. Similarly in a tour broadcasts, the location information allows the user to have more useful information such as transportation guidance or the location of some restaurants nearby the place of the scene.

Figure 1-22 – Location-based broadcasts

9.4 High-level system architecture

Figure 1-23 shows the service model of augmented smart television broadcasting. The augmented broadcasting provider defines the augmented region from the audio/video content and information expressed in the region. The information is formatted as augmented broadcasting metadata and generated by an authoring tool. The metadata includes a unique name, an object type, a position, presentation/life time, resource location of augmented objects and rendering attributes for mixing augmented objects according to the augmented broadcasting scenario. A service scenario could be planned in a process of content production. Content providers produce augmented content database harmonized with the scenario. A broadcasting programme is transmitted together with metadata to set-top boxes or smart TVs. When viewers want augmented broadcasting service in the middle of watching TV, they can enjoy it by clicking a service button. Therefore, viewers can watch the mixed broadcasting contents when they want to watch that service only and watch the original broadcasting content when they do not. In addition, the object rendering technology on the receiving terminal allows every viewer to choose own purchasing the contents or control them via a user interface/user experience (UI/UX). Moreover, viewers can select a preferred provider form several content providers, and they might consume the same video content newly even when re-watching by selecting another content provider.

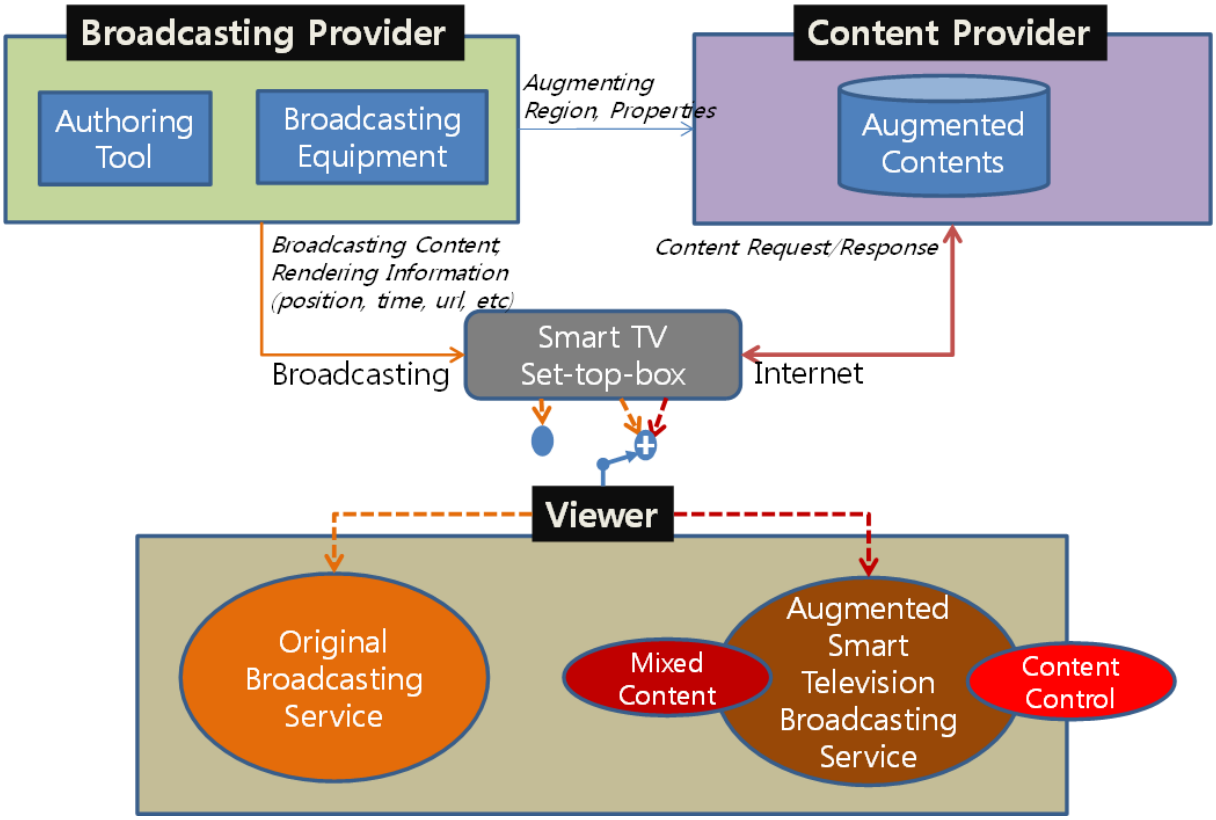


Figure 1-23 – Service model of augmented smart television broadcasting service

9.5 Pre-conditions

- The broadcaster plans the scenarios on a process of content pre-production or post-production for augmented smart television service.
- The broadcaster has an agreement or contract with the content providers which provide 2D/3D graphic objects in order to augment an original broadcasting programme.

- The content provider produces provision for augmentation contents which are appropriate for the planned scenarios.
- TV viewers have a reasonable right to access the content providers via the broadcasting programme.

9.6 Main steps

1. The augmented broadcasting provider creates metadata which defines the augmentation region from the audio/video content and information being expressed in the region.

NOTE – The metadata includes spatial positioning, presentation time, transaction time, resource address of augmentation objects and rendering attributes for mixing augmented objects.

2. The augmented broadcasting provider transmits the original broadcasting content and metadata together to the broadcasting network.
3. The receiving terminal such as TV/STB downloads the augmented contents from the content providers.
4. The receiving terminal informs the TV viewer that the terminal is ready for augmented broadcasting service on the output screen.
5. The TV viewer who wants the augmented smart television service executes the playing-button from a remote control.
6. At the augmented presentation time, the receiving terminal shows the mixed broadcasting contents in the augmentation region.
7. The TV viewer with a secondary device may manipulate the augmented contents which are being overlaid on the original broadcasting content and the augmented contents are changed.

10 Content protected adaptive HTTP streaming

10.1 Name of use case

Protected smart cable content delivery based on adaptive HTTP streaming

10.2 Description of situation

- The service operator wants to provide pay-video contents (linear and non-linear) to all types of user terminals including TV, PC, tablet, and mobile devices which are equipped with software platforms.
- Segment-based adaptive HTTP streaming protocol is used for the content delivery method.

10.3 Description of service

- Channel group subscription, pay-per-view (PPV), pay-per-maximum-quality (PPMQ) services are considered to be provided through this content protection method.
- PPV examples:
  - A user can watch VoD content, delivered over an adaptive HTTP streaming protocol, after he receives temporary entitlement.
  - A user can watch a programme or series of programmes, delivered over an adaptive HTTP streaming protocol, after he receives temporary entitlement.
- PPMQ examples:
  - If a user subscribes to high quality video content (e.g., full high definition (HD)) channel groups, he can watch standard (e.g., HD/standard definition (SD))/low

quality (e.g., quarter video graphics array (QVGA)) video as well as high quality video content. Here, all video contents are delivered over an adaptive HTTP streaming protocol.

– If a user subscribes to standard quality video content channel groups, he can watch low quality video content as well as standard quality video content. Here, all video contents are delivered over an adaptive HTTP streaming protocol.

10.4 High-level system architecture

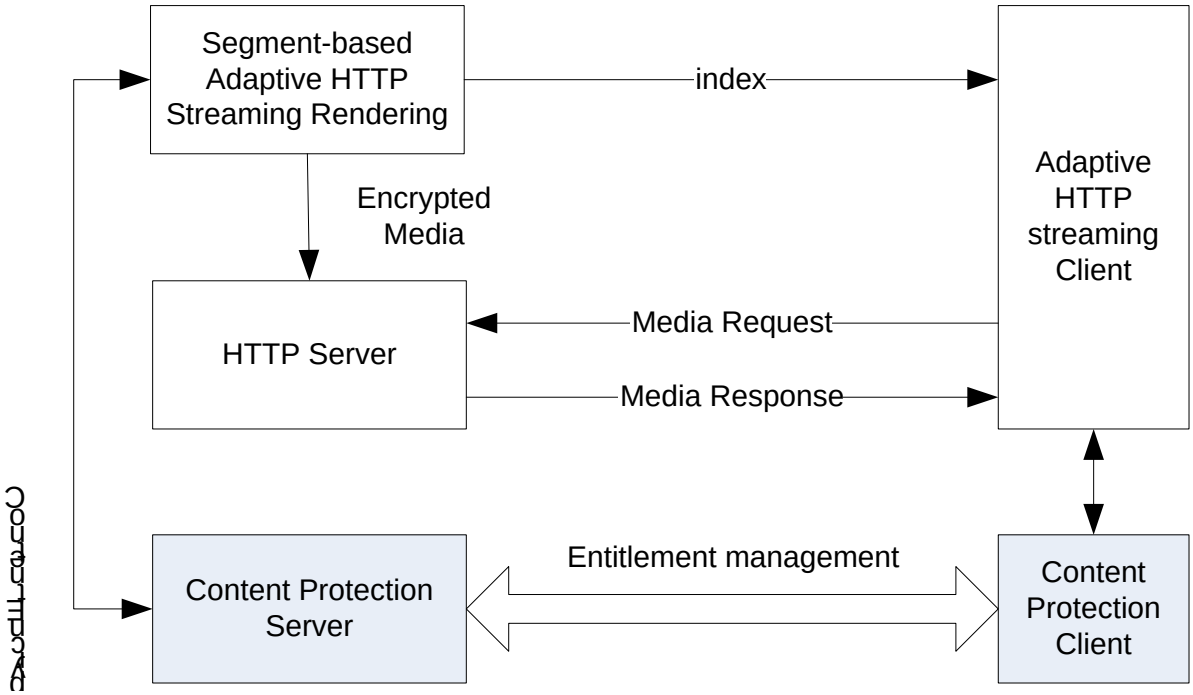


Figure 1-24 – High-level system architecture

10.5 Pre-conditions

- Content protection information is recorded in the 'index' prior to starting the content protection service.
- A hierarchical key architecture is used for entitlement group management.
- Each 'content protection client' has its own unique personal key which is located in the highest level of the hierarchical key architecture.

NOTE – Content key such as control word (CW) is called the lowest key in the hierarchical key architecture in this FG Technical Report.

10.6 Main steps

1. The adaptive HTTP streaming client downloads and interprets the index.
2. The adaptive HTTP streaming client parses the protection information in the index.
3. The content protection client checks for the availability of a suitable entitlement for the content.
4. If necessary, suitable entitlement information is requested by the content protection client from the content protection server.

5. The content protection server checks the request and returns the entitlement object which includes the entitlement information such as content key, content ID, entitlement expiration date, and possibly other information.
6. If the programme is PPV, the requested entitlement information is temporary; otherwise, the requested entitlement information is a channel group entitlement.
7. Subsequently, the adaptive HTTP streaming client requests media segments from the HTTP server via the segment addresses in the index.
8. As the entitlement information and thus the content key is available at the content protection client, the content protection client delivers the keys to the adaptive HTTP streaming client which decrypts and renders the received media segments.
9. Before the entitlement key expiration, the content protection client requests updated entitlement key information from the content protection server, and the content protection server replies with the updated entitlement key information.

11 Cable DRM

11.1 Name of use case

Cable DRM

11.2 Description of situation

A rapid deployment of smart phones and tablet devices has changed people's style in watching TV, be it at home or outdoors. Bringing out recorded content in mobile devices increases the traffic of media streaming and download over an IP two-way communication. In such a case, DRM technology rather than conditional access system (CAS) is required for content protection based on device authentication. DRM means not only digital content right protection but also its usage and re-production. DRM is defined to be a method of control and protection of digital contents among the authenticated devices situated in the IP communication environment.

11.3 Description of service

DRM requires key management and distribution functions for IP video delivery through the Internet (for content right protection).

11.4 High-level system architecture

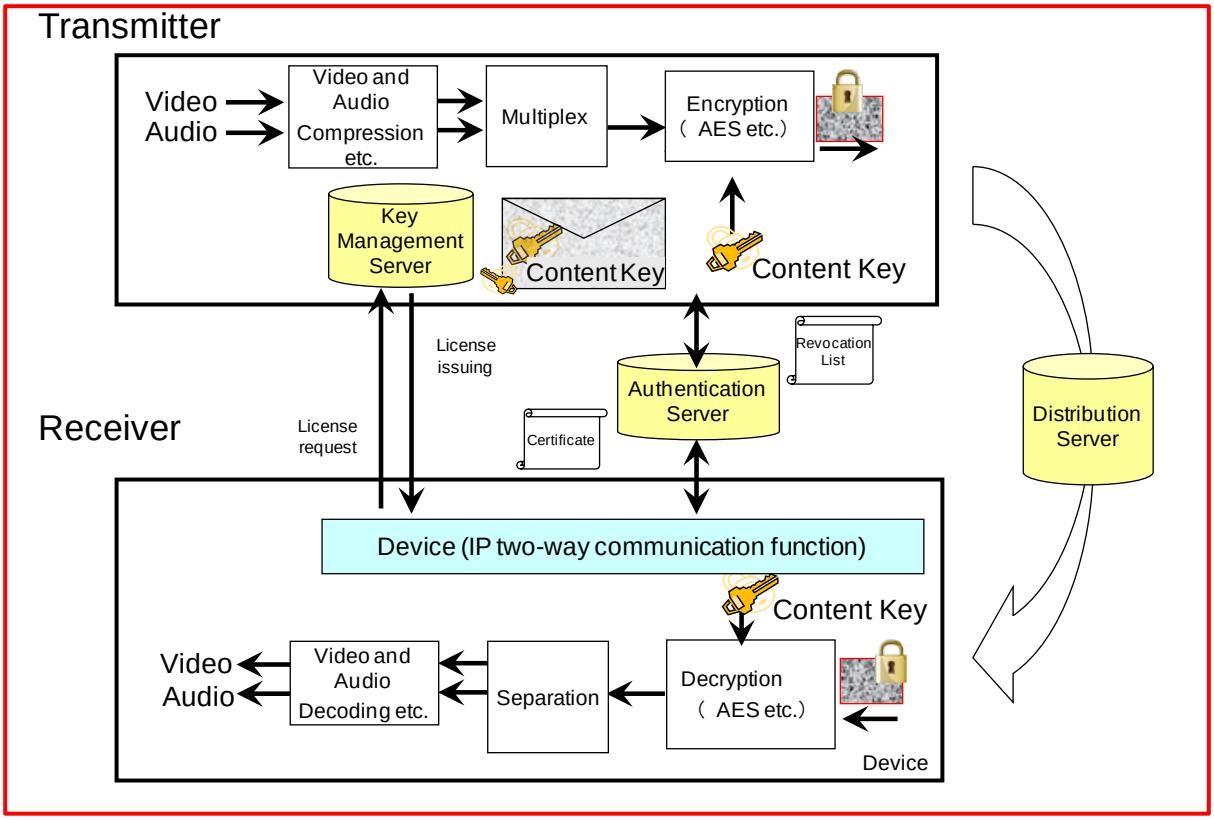


Figure 1-25 – One aspect of DRM

11.5 Pre-conditions

- The server and the device should establish in advance a two-way communication via IP.
- There should be contents to distribute.
- An authentication server should be installed.（The communications protocol for authentication should be standardized.）
- A device should receive terminal authentication from an authentication server.

11.6 Main steps

1. The encrypted content is put on a distribution server.
2. The content key is stored separately in a key management server.
3. The device which needs the content must obtain device authentication beforehand.
4. After authentication, the device requests a license to the key management server and obtains it.
5. A license means an envelope (i.e., encryption by public key of device) having content key which is encrypted by another key.
6. In the receiver, the content key can be recovered by unsealing the envelope (i.e., decryption by a personal key), and the content can be obtained after decryption of this content key.

Chapter 2 – Provisional requirements for smart cable television

Chapter 2 Summary

Chapter two is one part of the deliverables produced by Working Group 1 of Focus Group on Smart Cable Television (FG SmartCable). This Chapter describes provisional requirements for smart cable television services particularly from such aspects as accessibility, terminal device harmonization between STB and mobile devices, home energy management, healthcare, net supermarket, ID cooperation, TV everywhere service, user interface and access networks. Any of the materials contained in this Chapter is not intended to define normative specifications or Recommendations, but to provide information that could be the base of future possible Recommendations, which may be developed by ITU-T SG9.

1 Scope

This Chapter describes provisional requirements for smart cable television services. Any of the materials contained in this Chapter is not intended to define normative specifications or Recommendations, but to provide information that could be the base of future possible Recommendations, which may be developed by ITU-T SG9.

2 Requirements

2.1 Accessibility

2.1.1 General accessibility requirement

[ITU-T FG-AVA] describes the general requirements and considerations for accessibility.

2.1.2 Advanced UI adaptation

Support of the following functionality for adaptive personalization of UI:

- Common data storage format for UI data;
- Common calibration/validation technique.

UI adaptation of the following parameters:

- Minimum font size;
- Colour blindness;
- Colour contrast;
- Button spacing.

2.2 Requirements for terminal device

The requirements for STB are defined in [ITU-T J.295].

2.3 Requirement for home energy management

The functions required for home energy management are shown in Figure 2-1.

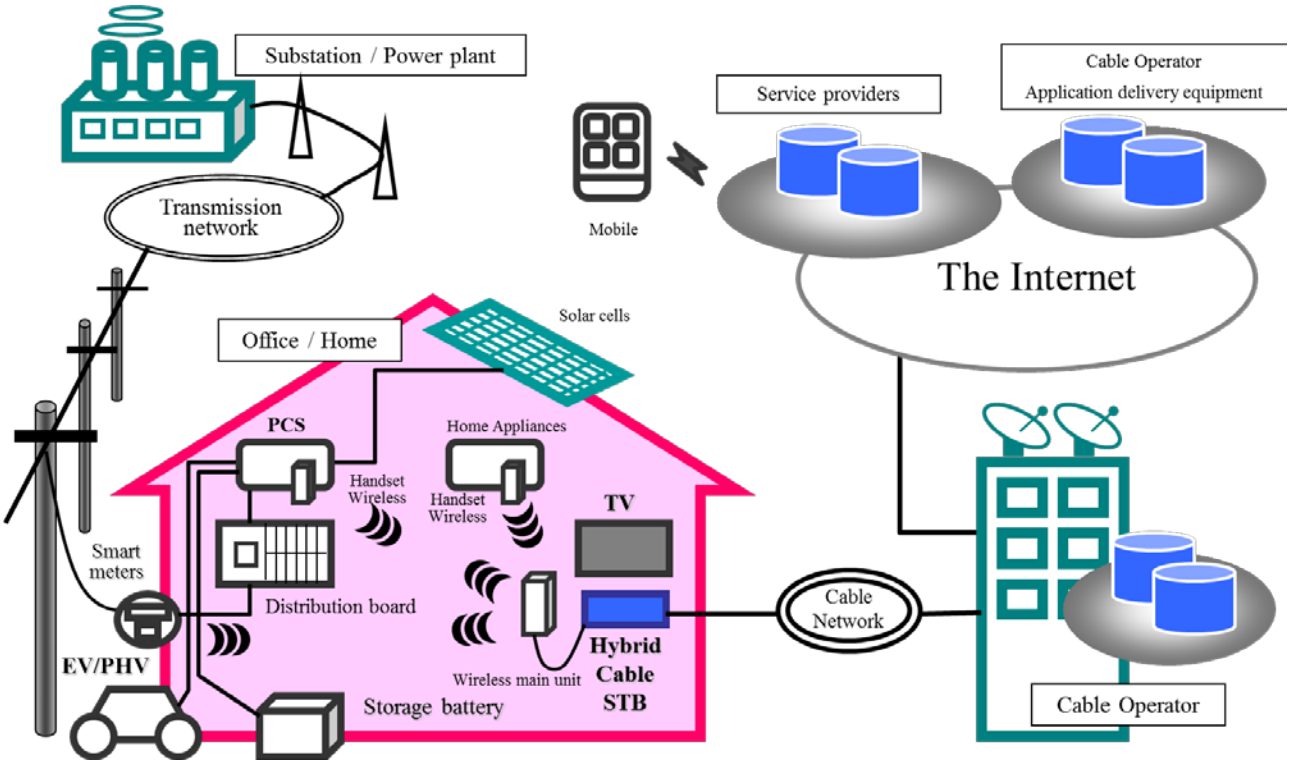


Figure 2-1 – Overall service aspect for home energy management

2.3.1 Collection server of sensor information

The collection server of sensor information to be located in a service delivery platform (SDP) is required to collect the sensor information through the hybrid box and store it. The server is required to store the process result by the application and transfer of data at the time of request by the cable customer, or at the pre-set time toward the display device (e.g., tablet device, smart phone) assigned via the hybrid box.

2.3.2 Access network

The wide area network (WAN) for the home energy management service must be the Internet. The cable operator network must be used between the head-end equipment and the hybrid box.

Depending on the volume of the energy management traffic and the cable operator bandwidth policies, it may be required to account for energy management traffic separately so that it does not impact bandwidth caps, user traffic or billing.

2.3.3 Home network and hybrid box

The wireless communication method can be optionally chosen from WiFi, ZigBee, Z-wave, Bluetooth and other small power radio specifications such as propagation, power consumption, location and operational condition. The radio terminal must be connected with the hybrid box. The hybrid box is required to provide the following functions by the application described in clause 2.3.7 of Chapter 2.

1. Registration, provisioning, setting of communication for sensor device;
2. Installation and deletion of sensor device;
3. Accessing sensor device at pre-set time or periodically and displaying the information obtained;

4. If there is no response from the target device within the pre-set period, it is required to inform the display device of such status.
5. Displaying data on assigned display terminal in response to customer request after accessing the sensor information collection server and other related database;
6. If there is no response from the above-mentioned server or database within the pre-set period, it is required to inform the display device of such status.
7. The Echonet Lite protocol can be optionally used for the communication between the hybrid box and target devices. If it is not used, the open and standardized protocol must be chosen.
8. Internet protocol version 6 (IPv6) can be optionally used through the remote control of the home appliance.

2.3.4 Target device

The target device is shown in Figure 2-2 it includes, but it is not limited to, the following elements:

- Home appliance: Air conditioner, refrigerator, electric range, rice cooker, etc.;
- Power distribution: Distributer, hot water supply (outside plant), etc.;
- Power generation: Solar power equipment, bio-electric generation, fuel battery, etc.;
- Power storage: Battery, car battery (electric vehicle, plug-in hybrid vehicle), etc.

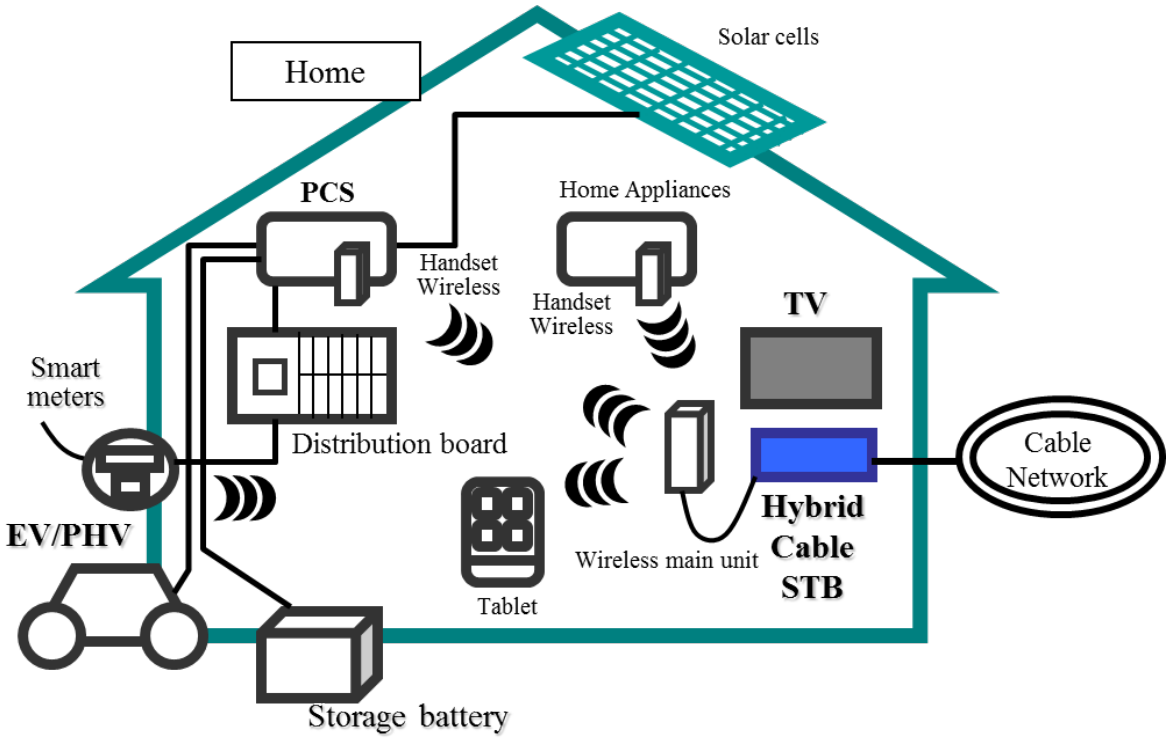


Figure 2-2 – Target device for healthcare services

2.3.5 Operation and display device

This element is normative.

Operation devices in this service should be the remote control unit (RCU) of the hybrid box, the tablet device and the smart phone, etc. Display devices should be TV, the tablet device and the smart phone, etc. An appropriate user interface (UI) is required for each display device and for the elderly in a stress-free operation.

2.3.6 Sensor device (radio chip)

The system is required to assign an identification code to the sensor device to be associated with the target device. The radio chip must respond to the access request from the hybrid box. The chip must be installed simply and be maintenance-free for a considerably long period of time.

2.3.7 Application

The application is required to be tested and certified by the regional authorities in charge of cable television. The application is also required to be capable of customization of the user interface or display method taking into account the age of the customers. The application is required to register an identification code, which may be set by the customer, of the target device.

2.3.8 Obtaining application

The hybrid box is required to obtain an application via the cable operator through an application distribution system provided by Japan Cable Laboratories.

2.3.9 Access network

If there are critical mission applications for health monitoring, the access network must provide 99.999% availability or better (similar to E911 call requirements).

Depending on the volume of health monitoring traffic and cable operator bandwidth policies, it may be required to account for energy management traffic separately so that it does not impact bandwidth caps, user traffic or billing.

2.3.10 Security

The system is required to provide following countermeasures (see Table 2-1) to maintain an appropriate security level.

Table 2-1 – Countermeasures for security in healthcare service

Object		Countermeasure
Hybrid box or home gateway (HGW)	Body	Prevention of illegal access, detection of DoS attacks.
	Application	Prevention of alteration.
Operator server	System（website, database, etc.）	Prevention of illegal access, detection of DoS attacks, prevention of alteration.
Communication	Local area network (LAN)	Prevention of tapping and alteration over transaction.
	WAN	Prevention of tapping and alteration over transaction.
	Sensor	Prevention of tapping and alteration over transaction.
Target device		Prevention of negative effect on other devices (malicious operation, induction to error operation), prevention of unexpected observation from external sources.

The system must provide the following methods for device and customer authentication:

1. Device authentication: A specific device method (media access control (MAC) address, etc.) in the home network connection, and a service set identifier (SSID) in the WiFi connection must be used. Customer authentication described in item 2 should be used alternatively for the device authentication without a home network connection.
2. Customer authentication: Pre-assigned password and ID must be used.

2.4 Requirement for healthcare services

2.4.1 Functional requirements

The functional requirements are described below.

2.4.1.1 Sensor function

2.4.1.1.1 Transmission means (interface):

The sensor function is required to transmit the healthcare data collected from the user to the gateway (GW) by at least one of following means:

- Continua Health Alliance (ZigBee, Bluetooth, Z-wave, WiFi);
- WiFi;
- Near field communication (NFC) (Type-A, Type-B, All Felica interface);
- Wired (Ethernet, universal serial bus (USB), Wireless (infrared).

The following international standards (Table 2-2) can be used optionally for the healthcare services.

Table 2-2 – International standards for healthcare device interfaces

[ISO 11073-10404]	Pulse oximeter
[ISO 11073-10407]	Blood pressure monitor
[ISO 11073-10408]	Thermometer
[ISO 11073-10415]	Weighing scale
[ISO 11073-10417]	Glucose meter
[ISO 11073-10441]	Cardiovascular fitness and activity monitor
[ISO 11073-10442]	Strength fitness equipment
[ISO 11073-10471]	Independant Living Activity Hub

2.4.1.1.2 Sensor and user identification

Upon access by the user, the sensor is required to inform GW of its identification number. If user identification is available, the sensor must report to GW the identification number.

2.4.1.1.3 Data transmission and timing

The sensor is required to send the collected healthcare data with its own identification number to the service provider server. The activation trigger (whether automatic or manual) must be set by the cable operator. The data transmission timing should be based on the specification of the Continua Health Alliance.

2.4.1.2 Terminal function

1. The terminal device is required to identify the user.
2. The terminal device must have a user changing function (for example, selection icons, ID and password) so that several users can access the hybrid box.
3. The terminal device must authenticate the identified user, and authorize whether the service can be used or not, and then provide the service to the user.
4. The terminal must confirm by server identification that the cable head end is the right one to be used in the event of user authentication.
5. The terminal device must be used with the hybrid box as well as with the smart phone, the tablet and PC, which are devices connected with a non-cable network.
6. The terminal device must obtain the past healthcare data from the user with a simple operation (for data back-up), restore them via the server.

7. The terminal device must use IP as the transmission protocol.
8. The terminal device must have an automatic software updating function.

2.4.1.3 Gateway function

1. The GW function must work with transmission means described in clause 2.4.1.1 of Chapter 2; however, it is not required to work with all the means at the same time. It is recommended to use a transmission adapter such as USB dongle where required.
2. The GW function must collect healthcare data from the sensor and store them temporarily until the data are transmitted.
3. The GW function must be able to set the activation trigger (whether automatically or manually) by the cable operator.
4. The GW function must have means (ID, PW, etc.) to identify user.
5. The GW function must associate the sensor with the service by id numbers.
6. The GW must have a user change function in the event where the mapping function (see (item 5) above) is not available and the functions for family use are incorporated in the hybrid box.
7. The GW function must authenticate the identified user, and authorize whether the service can be used or not, and then provide the service to the user.
8. The GW function must confirm by server identification that the cable head end is the right one to be used in the event of user authentication.
9. The GW function must encrypt the data with an advanced encryption standard (AES) 128-bit or even use a much stronger encryption after confirmation of the send address.
10. The GW function must have an automatic software updating function.

2.4.1.4 Cable network function

The required cable network is the same as the current cable operator network and no specific function is required.

2.4.1.5 Other network functions

The other required network functions in this deliverable are the entire bilateral communication network except for the cable network and no specific function is required.

2.4.1.6 Cable head-end function

1. The cable head-end function must authenticate the user and authorize the status where the service is available.
2. The cable head-end function must be capable to access the cable network function as well as the non-cable network function.
3. The cable head-end function must have a server certification signed by a third party.
4. The cable head-end function must convert the healthcare data to an unidentifiable and untraceable data when such data is sent to any system located outside the cable network.
5. The cable head-end function must provide the means for the user to continue his/her healthcare service by using a back-up list (see clause 2.4.1.2 of Chapter 2), when the user changes his/her cable operator due to house-moving or some other reason.
6. The cable head-end function must be capable to charge a service fee with other cable TV services with the cooperation of the service provider server.

2.4.1.7 Service provider server function

1. The service provider server function must store the healthcare data in the database in accordance with the user identification information.
2. Considering the common operation by multiple operators, the accessible data must have a unique structure available only in the cable network.
3. The service provider server function must provide exclusive applications to be capable to have access from the terminal or the GW functions.
4. The service provider server function can be optionally accessible from a browser implemented in the terminals.
5. The service provider server must have an anti-tampering function against illegal access. Even if the data is stolen, the healthcare data must be encrypted and stored safely so that it will difficult to de-encrypt it.

2.4.2 Other system requirements

2.4.2.1 Application

Application for this healthcare service assumes a web application which is in the service provider server and an Android application on the terminal device or GW; both applications are accessible from the terminal device or GW. One application must, at least, be implemented. The application must have an automatic software updating function. Refer to clause 3.3.1 of Chapter 1 for an application example.

2.4.2.2 Protection of personal information and reset

All personal information including collected data from the user must be protected. The transaction must be encrypted. All the information collected from the user must be cleared easily by the user.

2.4.2.3 Authentication and charging

As described in clause 2.4.1.2 of Chapter 2, the cable head-end function must authenticate the user and authorize the status whether the service is available or not. In addition, it must be capable to charge a service fee with the other cable TV services with the cooperation of the service provider server, considering the situation where any family member may use the service.

2.5 Requirement for net-supermarket service

The functional requirement for net-supermarket is described in clauses 2.5.1 to 2.5.3 below.

2.5.1 Requirement for registration, control, ordering and settlement

The requirements for registration, control, ordering and settlement are shown in Table 2-3.

Table 2-3 – Requirements for registration, control, ordering and settlement

No	Category	Function name	Function Content	Request level
1	Authentication Function	Password authentication function	ID of the user who Registration administrator/Password Login	MUST
2		Registration administrator	Be able to register more than one administrator	MUST
3	Top page	Simple display summary information	Top page displays the current sales and the number of members	MUST

Table 2-3 – Requirements for registration, control, ordering and settlement

No	Category	Function name	Function Content	Request level
4	Basic information setup	SHOP master	Setting and editing of company information required for the operation site	MUST
5		Consumption tax calculation method set	Sets whether to calculate any of the truncation / rounding / truncation in what fraction digit sales tax	MUST
6		Free delivery fee on condition setting	Setting Conditions for delivery fee will be free from the total purchase price, etc.	MUST
7		Act on Specified Commercial Transactions	Entry and editing requirements, etc. prescribed in the Act on Specified Commercial Transactions	MUST
8		Time setting / charge / delivery company	Set delivery time ,delivery charge and delivery companies	MUST
9		Setup handing fee / payment methods	Set payment method and a handing fee of each payment method	MUST
10		Terms and Conditions set payment methods	Setting of upper and lower limits of the purchase price, limit use of the method of payment	MUST
11		Terms and Conditions set	Entry and editing of a convention to check availability at the time of registration	MUST
12		Registration e-mail templates.	Mail to set up and register contents of a letter (Auto-answer inquiries, purchase auto-answer)	MUST
13		SEO management	Embed the keyword in the meta tag	MUST
14		Setting site management	Whether to use the feature set	MUST
15		Setting regular holiday	A setup of regular holiday of the calendar	MUST
16	Product Management	Products search/List	Search for products, and view the list	MUST
17		The CSV output of Products information	The CSV output of Product data	MUST
18		Products information CSV registration	The CSV Product data in the batch registration	MUST
19		Products registration/Editing function	Product basic data registration of a Product name, a price, a comment, a SHOP remarks column, etc.	MUST
20		Products image registration	Upload of a product image and registration	MUST
21		Products video registration	Upload of a product video and registration	Should
22		Stock information registration	Registration of stock figures	MUST
23		Sales restrictions	The number of goods which can be purchased simultaneously by one-time order can be restricted	MUST
24		Manual registration Related products/Edit	Manual registration of the related product recommended to the person who purchased products can be performed.	MUST
25		Standard Registration	The standard of Product can be registered	MUST
26		Category registration/Edit	Display style selection of functional product, registration/edit of a class (e.g. CSV output)	MUST

Table 2-3 – Requirements for registration, control, ordering and settlement

No	Category	Function name	Function Content	Request level
27		Sort by products	A display order displayed on each category product list can be changed	MUST
28		Products review management	Review management of goods can be performed	MUST
29		Multi-category	Product can be registered into two or more categories, and can be managed	MUST
30		Registration keyword search items	The item of the keyword of product can be registered	MUST
31		Trackback management	Information, including the blog etc. which are carrying out trackback, can be known	Should
32	Customer Management	Search customer information/List	Search of customer data and a list display	MUST
33		The CSV output of Customer information	The CSV output of customer data	MUST
34		Editing customer information	Edit of customer data	MUST
35	Order Management	Search order information/List	Search of ordering information, list display (e.g. CSV output)	MUST
36		Information input new orders	Registration of the ordering information which occurred by a telephone or FAX	MUST
37		Edit order information	Edit of ordering information	MUST
38		Configuration support status	The status under unsettledness, product arrangements, and delivery etc. can be set up.	MUST
39		Send various e-mails	"Shipped products Mail" etc. is transmitted to arbitrary timing to the visitor of an order.	Should
40		The PDF output of statement of delivery	The PDF output of statement of delivery. It is also possible to carry out a batch output.	MUST
41		Batch change support status	Batch change about two or more ordering status	MUST
42	Sales totalisation	Totalisation by period	The arbitrary sales total results of a period can be displayed by the graph and list (e.g. CSV output)	MUST
43		Totalisation by product	The sales total result according to products can be displayed by the graph and list (e.g. CSV output)	MUST
44		Totalisation by age	A buyer's results of total sales according to age can be displayed by the graph and list (e.g. CSV output)	Should
45		Totalisation by occupation	A buyer's results of total sales according to occupation can be displayed by the graph and list (e.g. CSV output)	Should
46		Totalisation by membership	A buyer's results of total sales according to membership can be displayed by the graph and list (e.g. CSV output)	MUST
47	Email Newsletter Distribution	Distribution reservation / Search Email Newsletter distribution	Email newsletter distribution place narrows down and they are search and a distribution reservation setup	Should
48		Create a TEXT / HTML template	Email newsletter template of a TEXT/HTML base can be created	Should

Table 2-3 – Requirements for registration, control, ordering and settlement

No	Category	Function name	Function Content	Request level
49		Recent	The check of the distribution history of an email newsletter, the contents of distribution, and distribution conditions	Should
50	Contents Management	New information management	Registration/edit of the What's New displayed on front TOP etc.	Should
51		Recommended management	Registration of the recommendation products displayed on front TOP etc. (a maximum of eight pieces)	Should
52		Campaign management	A setup of campaign, the Page creation	Should
53		File management	Upload and download of a file	MUST
54		Movie management	Upload and download of a movie	Should
55		CSV output item setting	A setup of the contents indicated when outputting by CSV	MUST
56	Design Management	Layout editing	The layout of TOP, a goods list, and a goods detailed page is changed	MUST
57		Block editing	The block displayed by TOP page layout edit is registered	MUST
58		Edit headers and footers	Edit of the header footer which is common to all the pages	MUST
59		CSS editing	Edit of CSS from a management screen	MUST
60		Template Settings	Applies with the exclusive template and one button which were prepared beforehand	MUST
61	System Setting	Member Management	Management of the member who can log in to a management screen	MUST
62		Update management	Version management	MUST
63		Backup management	Backup of the present registration product etc. and customer data is saved.	MUST

2.5.2 Requirement for browsing, search, order and payment

The requirements for browsing, search, order and payment are shown in Table 2-4.

Table 2-4 – Requirements for browsing, search, order and payment

No	Category	Function name	Function Content	Request level
1	Product Introduction	Product list page	The registration product is displayed by list for every category.	MUST
2		Product thumbnail display	A thumbnail display of the product is given by list Page.	Should
3		List sorting function	Product can be sorted in the order of a price, and new arrival.	Should
4		Product detailed page	View description, product image display, display to basket button.	MUST

Table 2-4 – Requirements for browsing, search, order and payment

No	Category	Function name	Function Content	Request level
5		Product detailed page (movie)	Products are introduced by an animation.	MUST
6		Product status	Recommendations and display few of which status (manual operation).	Should
7		Stock termination status	When stock goes out, a stockout is displayed automatically.	Should
8		User review	Product reviews on the product detail page can be displayed and registered.	Should
9		product favourite registration	Product can be registered into a favourite.	Should
10	Product Order	Shopping cart function	A fundamental function to register multiple products into shopping cart.	MUST
12		Another receiver's address input function	One user can hold multiple receiver's addresses. (a maximum of 20 pieces)	Should
13		Delivery time specification	The delivery time registered on the administrator screen can be specified.	Should
14		Select settlement method	The method of payment registered on the administrator screen can be chosen.	Should
15		Point purchase function	Product can be purchased using the point accumulated by Product purchase.	Should
16		Estimates display before purchase	After calculating a delivery fee and a handing fee automatically, the check page of order contents is displayed.	MUST
18		Order processing	Thanks mail is transmitted automatically and simultaneously with order registration, and order receptionist mail is transmitted also to an administrator. Or it is followed by Thanks call.	MUST
19	Visitor Page (MY Page)	Membership function	Member registration can be performed.	MUST
22		List Order History	The past order is indicated by list.	MUST
23		Check function order details	The present order contents are displayed.	MUST
24		Another receiver's address edit function	It can be made to perform registration, edit, and deletion of multiple addresses for delivery.	Should
25		Favourite product list	The products registered as favourites are indicated by list.	Should
27		Email Newsletter release / change	Release and change of email newsletter subscription registration can be performed.	Should
29		Recommendation product display	The recommendation product set as the recommendation frame of a top page are displayed.	Should
30		What's New display	What's New can be displayed.	Should
31		Product category search	It can search based on a goods category.	Should
32		Product search by keyword	It can search by keyword search (a part of brand name and product name, etc.).	Should

Table 2-4 – Requirements for browsing, search, order and payment

No	Category	Function name	Function Content	Request level
33		Inquiry form	It can mail an inquiry for an administrator from inquiry form.	Should
34		Campaign application	Product purchase and member registration are carried out from the campaign page created from the management screen.	Should
36	Multilingualization	Multilingualization	It corresponds to a multilingual site by adoption of UTF-8.	Should

2.5.3 Requirement for Pick-up and Delivery

The requirements for pick-up and delivery are shown in Table 2-5.

Table 2-5 – Requirements for pick-up and delivery

No	Category	Function name	Function Content	Request level
1	Pick-up management	Pick-up member's store list display	The member's store which collects cargo is indicated by list.	MUST
2		Pick-up information display	Pick-up information is displayed	MUST
3		Pick-up information printing	Pick-up information is printed	MUST
4		Renewal of status	Pick-up status is updated (finishing [un-collecting cargo and collection of cargo] etc.).	MUST
5	Delivery management	Delivery information list display	Delivery information is displayed. Moreover, rearrangement of the address for delivery is enabled.	MUST
6		Delivery information detailed display (every user)	The delivery information for every user is indicated in details.	MUST
7		Delivery information printing (every user)	The delivery information for every user is printed.	MUST
8		Renewal of status	Delivery status is updated (finishing [undelivered and delivery] etc.).	MUST
9	History display	Delivery information history list display	The delivery information history is indicated by list.	MUST
10		History list CSV output	The CSV output of the delivery information history is carried out.	MUST

2.6 ID cooperation between existing cable system and multi-device video service

This is a methodology to realize the proper ID management and cooperation of cable subscriber ID and 3rd party user IDs. It also includes the mechanism to simplify the user's login operation in multiple user environments.

1. Management of the viewing right of the purchased content over the multiple types of viewing environments.

2. Methodology to restrict the maximum number of devices to allow simultaneous content watching.

2.7 Harmonization between STB and mobile device

- STB and the mobile device should equip the common agent service which has the following capability:
  - Receiving user inputs, transfer them to the other device, and invoke the required functionality.
- STB and mobile device should equip the following interface:
  a) Tablet application – Common agent service (Tablet) interface;
  b) Tablet – STB interface;
  c) Common agent service (STB).

2.8 Integrated broadband broadcast application

Requirements of integrated broadband broadcast applications are already defined in [ITU-T J.205]: Requirements for an application control framework using integrated broadcast and broadband digital television.

2.9 Requirements for TV Everywhere service by cable user

TV Everywhere service will become one of the new cable services in a short time. The service aims at content consumption not only indoors but also outdoors, as shown in Figure 2-3.

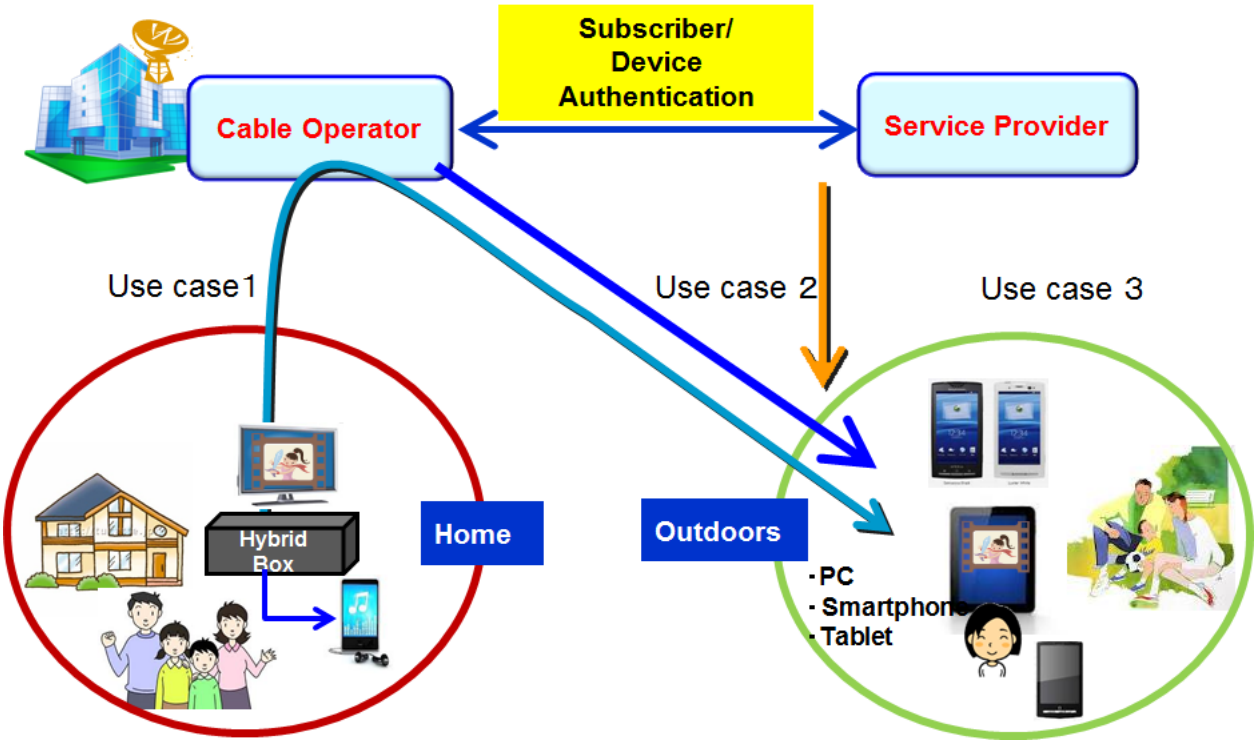


Figure 2-3 – Use cases for TV Everywhere service

Use cases for TV Everywhere service are described below:

- Use case 1: All family members can watch broadcast programmes and contents outdoors using registered multi devices, the contents are stored in STB in home.
- Use case 2: All family members can watch programmes and contents outdoors using registered multi devices, the contents are stored in the cable operator's head-end system.
- Use case 3: All family members can watch programmes and contents outdoors using registered multi devices, the contents are held by the service provider.

Based on the above use cases, the requirements for DRM for TV Everywhere service are described below:

1. HD content should be included. Most devices have HD functions already.
2. Replay period control function should be provided. It is expected to deliver content with replay period control condition.
3. Applicable for streaming and download services.
4. Applicable for subscription service. TV Everywhere service will be bundled with subscription service.
5. The device usage condition should be defined. The service is supposed to be provided only to the registered devices.
6. The maximum usage number should be stated for downloadable devices.MPEG2-TS/MP4 should be adopted. It is one of the defined file formats in TV Everywhere service.
7. The key rotation function should be provided. The need to take permission from the digital licensing administrator (DTLA) as a persistent protected storage of digital transmission content protection (DTCP) protected content. Linear TV may become one of TV Everywhere service in the near future.

2.10 Requirements for multimodal adaptive system

2.10.1 Adaptation

[R1] **Most distinctive user characteristics:** The main differences noticed between elderly users are the following: the capability to read perfectly from close and distant vision; the capability of seeing at night, and colour perception; the capability to hear sounds of different frequencies and to distinguish conversations in a noisy background; cognitive impairments; and mobility diagnosis like muscular weakness and tremors. Therefore, when designing for the elderly, user profiles should be created focusing on these differences (e.g., people with visual problems prefer bigger buttons on the screen, while people with hearing problems prefer to have information provided in both visual and audio forms, content adaptation to user's (daily) schedule, etc.).

[R2] **Personalization of system by each user**: When the user is using the system for the first time, the application should automatically personalize the different parameters (mode of interaction, colours, font size, button size, audio messages volume, etc.) based on the initial configurations performed by the user. After this process, the parameters should be re-configurable by the user at any time.

[R3] **User initialization application (UIA)**: UIA is used in order to adapt to user characteristics, and to provide tutorials on new ways of interaction and create user profiles. A user initialization application should be presented the first time a user interacts with the system. UIA should be as entertaining and as short as possible. The user must be able to cancel the initialization process at any time.

[R4] **Maintenance of user privacy**: Applications should maintain a high level of privacy and user data security, and should explicitly tell the user what data is collected and with which goal.

[R5] **Maintenance of user profiles across channels and applications**: A user profile should be maintained across multiple applications. Adaptation of UIs should work in all UI situations and applications, considering the individual impairments of the user. When a user is using several applications, the same means of personalization should be applied, considering his or her specific profile.

[R6] **Performance of system re-configuration when user characteristics change**: When the user's capabilities experience a change, a re-configuration of the system is required to be performed to re-establish the adequate parameters according to his or her capabilities. The system should also detect the failures and mistakes made by the user when interacting with the system as a possible indication of a loss of capabilities.

[R7] **Support adaptation to different ICT skills**: When the user is using the system for the first time the application should evaluate his previous ICT experience, skills and preferences to achieve a better adaptation of the system (e.g., people with better ICT skills might prefer complex menus which offer more information, while people with less ICT skills will probably prefer simple menus with less information but easier to control).

[R8] **UI mark-up language as first-step for adaptation**: If UI mark-up language is used as an interface between application and automatic adaptation, developers are recommended to keep tools and development environments and, without too much additional effort, take a first step towards accessible design.

2.10.2 Interface

[R9] **Simple graphical user interface (GUI):** A simple layout and limited functionality for any graphical user interface should be provided when designing for elderly users. Instructions should be "easy to understand", and icons should be perceived "intuitive". Elderly users prefer simple UI designs, with less distractive elements (flashes, animations, etc.). Applications should present a short number of interactive elements for each screen, focusing on big and well-spaced buttons. Button size should also be configurable by the user.

[R10] **Colours:** The use of bright colours should be avoided. The use of too dark colours in backgrounds should be avoided. Ultimately, users should be able to specify their own background and foreground colour profile preferences.

[R11] **Configurable text and audio:** Applications should make sure both text size and audio volume are configurable by the user at the beginning as well as during the interaction.

[R12] **Ease of use is more important than branding:** More importance should be given to interaction design than to interface appearance. An easy-to-use interface should be preferred over an eye-catching one.

2.10.3 Application

[R13] **One-touch features:** The most important functionality of applications/services should be accessible via simple interaction schemes such as "one-click" / "one-touch".

[R14] **Provide feedback on user input:** Most of the time, elderly users ask for additional feedback to their input (e.g., a beep, a graphical highlight, a vibration, etc.). This should be supported by any application/interaction.

[R15] **Simplification of novel features:** When the user is using an application and wants to do something he or she is not familiar with (e.g., using the application for the first time), the

required steps to do so should be as few as possible, and the help of the virtual character (or audio output) is highly recommended.

[R16] **Simplified, but not senior:** Modern TV UIs are required to support elderly people, but should not appear to be designed only for senior citizens and be heavily simplified as a consequence. UIs should be maintained clear and simple, without giving the impression that they have been designed for someone with impairments.

[R17] **Keep well-known concepts:** Elderly people have problems to adopt new paradigms in interaction, so concepts such as remote control and traditional TV application paradigms should be kept.

2.10.4 Multimodal interaction

[R18] **Accurate and relevant information on second screen:** All information displayed on the second screen is required to be consistent with the information on the main screen and the respective audio information. Delays between rendering devices should not become relevant for distraction from the ICT application.

[R19] **Always ask for message confirmation:** Whenever a message is given by the system, a confirmation action of its reception should be given by the user. The system is also required to be capable of recognizing if the user has received the message, and, when the message was not received, repeat the process.

[R20] **Automatic speech recognition (ASR) error recovery:** Multimodal systems are required to support the user in the prevention and recovering from ASR errors by presenting recognized commands or giving multimodal feedback.

[R21] **Audio output:** Audio output is required to be clear and easy to understand. Audio output should exist for male and female voice representation. Different volumes are required to be supported to satisfy different user preferences or impairments.

[R22] **Avoid inadvertent activation when gesturing:** A gesture recognition system should minimize the risk of inadvertent activation of application functionality, by unintended gestures.

[R23] **Avoid unknown terms in speech:** UIs should avoid presenting unknown terms to the user as they can result in recognition errors, due to misspelling.

[R24] **Configurable gestures:** The existence of specific gestures to perform specific tasks should be a reality, but all gesture interaction should be introduced to the user.

[R25] **Consider speech characteristics of the elderly:** ASR is required to consider language-related aspects of speech of the elderly (e.g., pauses in finding words, phrases).

[R26] Consider user and interact context in speech: ASR is required to consider the user and interaction context to improve recognition.

[R27] **Increase selection area when pointing:** When a mobility impaired user selects something through pointing, the area of selection should be bigger (e.g., surrounding area of the button can be clickable as well).

[R28] **Messages should catch the visual attention:** When the system shows visual messages on the screen, these are required to catch the user's attention. The elderly should clearly differentiate these messages from the ones that usually appear on TV.

[R29] **Output should always depend on context:** When the user is watching TV, the messages given by the system should be different from the ones rendered when the user is looking at pictures. In addition, the speech volume should depend on what is being watched on TV. Each user should also be able to select in which context they want messages rendered by which modality.

[R30] **Position the icons on the dominant side when pointing:** When users are required to select something, they tend to use their dominant hand independently where the icons are placed. This should be taken into account for placing icons on the screen to increase icon selection efficiency.

[R31] **Provide feedback on the selection of the buttons:** When the user selects something by pointing at it, the system should offer ways of providing additional feedback about the selected button (e.g., if change of button colour is not enough, it is required to be accompanied by voice feedback).

[R32] **Provide feedback when pointing:** A gesture recognition system should provide appropriate means of feedback to the user (e.g., if a button has been pressed).

[R33] **Provide modality help:** Help and explanation for using any device is required to be available at any time in the application/system.

[R34] **Provide one-touch features on tablet:** Tablet UI should provide API to implement single-touch selections to access the major functionality of the application it controls.

[R35] **Provide training steps:** Multimodal systems should provide training steps for the user, for each modality of interaction.

[R36] **Remote control simplification:** The device is required to be simplified so that elderly users can understand it better. Interaction is required to be based more on directional (arrows) and "OK" keys.

[R37] **Reduced time for selection when pointing:** Whenever the user needs to select something by pointing at it, the system should require the selection to be maintained for a given amount of seconds, in order to prevent the user from making unwanted selections. However, the system should also reduce the need for unnecessary physical demands in pointing; otherwise, the user will get quickly tired. One possible solution is to make it dependent on (and configurable by) each user.

[R38] **Support automatic recognition of body posture when pointing:** The user should be able to easily perform gestures or cursor movements when sitting in a chair. The system should detect and track the hand without interference with other body parts.

[R39] **Support recognition of universal speech terms:** When interacting with an application using speech, words such as "Select", "This", "Yes", "No" and "Confirm" should be included in a speech recognition dictionary, and used in helping to select the option the user is pointing to when the command is issued. "One", "Two", "Three", "First", "Second", "Third", etc., should represent keywords, supporting redundancy when a user is pointing and speaking, or when using speech only.

[R40] **Use any modality for any task:** Every task is required to be possible to achieve using any modality of interaction available.

[R41] **Use of activation procedures:** For preventing errors during interaction context changes, specific modalities should be activated by specific procedures (e.g., speech recognition should be activated by specific keywords or gesture interaction should be activated by a specific gesture).

[R42] **Speech recognition as the main alternative to remote control:** If users do not have specific impairments that make it harder to use speech, it should be considered as the main alternative to remote control (RC) interaction.

[R43] **Define preferred modality to prevent contradictions:** When the user accidentally gives contradictory commands between modalities to the system, only one of them should be recognized (e.g., say "Channel 1" and pointing at the same time at "Channel 2" by mistake).

Therefore, the system must pre-establish with the user a preferred modality that will prevail over any other in case of contradiction.

Chapter 5 on user interfaces presents a user profile that can be used to provide adaptation to Smart TV systems.

3 Multiple access network assumptions

Assuming that the authorization and DRM issues are resolved, there are several options for coordinating the actual data transfer between different service providers. For this discussion, we will refer to the "host network" as the network originating the content and the "remote network" as the one the subscriber is connected to. Note that some of the solutions related to coordinating the host and remote network are similar to mobile roaming and the existing 3GPP protocols, such as proxy mobile IPv6 (PMIPv6) that can be used to implement the concepts outlined below:

1. Single path tunnelling: The content is carried over a tunnel between the host network and the remote network. All the services and advertisements are originated from the host network and carried transparently over the remote network and onto the target device.
2. Multipath transmission control protocol (TCP): Some clients can have multiple access links active at the same time. For example, a wireless device might have a WiFi hot-spot connection and a cellular connection. A new breed of protocols called the "multipath TCP" takes advantage of the multiple active paths to improve the subscriber experience and/or reduce costs. In the example above, the cost of streaming a video to a mobile device over the cellular network could be somewhat reduced by having some of the adaptive bit rate (ABR) segments sent over a local hotspot connection, even in cases where the local hotspot connection is not reliable enough to provide a high-quality or buffering-free video user experience. This multipath operation requires a central entity control such as a cartelized software-defined networking (SDN) controller that can consider the use of both networks.
3. Direct IP connectivity: While tunnelling has many advantages, it has some drawbacks as well, to note two significant ones: (a) tunnel overhead and a maximum transmission unit (MTU) issues that result from it, and (b) lack of transparency in the target network since the original packet headers are encapsulated in a tunnel. With an SDN solution, it is possible to set up direct "connections" between the host and target network without tunnelling; however, this requires fine grained flow definitions that are not always available in today's networking equipment.
4. Service level agreement (SLA) coordination: SLA can be coordinated between the networks. For example, a premium subscriber on the host network can be treated as a premium subscriber on the target network. One example of such coordination would be the SDN controller of the host network passing SLA information to the SDN controller of the remote network (with proper authentication).
5. Billing and accounting: The most straightforward way of handling billing and accounting is to separate a roaming user on the remote network to a dedicated service flow.
6. The SDN controller needs to have access to the provisioning systems that have information on the subscriber identity and service level profiles.

Chapter 3 – Smart cable television transport

Chapter 3 Summary

Future networks will be very solicited for agnostic integration of services and applications originating from many different sources and delivered by networks (wired and wireless) from around the world. Currently, the deployment of machine-to-machine services/applications is placing additional demand on already stressed networks, necessitating the dependency on networks not necessarily in-synch with each other as of today. In many markets around the world, carriers have nearly reached the saturation point with mobile phones, and are now turning their attention to the hybridization of wired-wireless transport architectures. While many operators are currently leveraging their proprietary networks for such architectures, there is a growing need for the same seamless leveraging of inter-operator transport technologies around the world. There is a need for operators to forge new transport and/or service/application delivery mechanisms that leverage wired and wireless technologies across multiple operators seamlessly.

Establishing as many commonalities as possible for the navigation of services/applications across wired-wireless network infrastructures is imperative. We will seek to leverage as many of these common elements in order to "simplify" transport-related issues of service/application delivery for cable networks, as well those related to the assimilation of cable network services/applications to other networks as well.

1 Scope

The SmartCable Focus Group considered the functional characteristics needed for the implementation of advanced services in cable networks. For these services to be enabled, it will be necessary for the network agnostic communication of service-related information to occur across networks around the world. For this to happen, the seamless transport related to the enablement of future applications/services is needed. Currently, many of these services are being implemented across many different transport and delivery mechanisms, creating a lot of complexity that must be reduced if the onslaught of these services will be successfully supported in the near future. Chapter 3 seeks to describe the means through which cable networks address these challenges for the implementation of advanced services and applications.

2 Architectural framework of SmartCable

Most of the cable specific transport is at the access part of the network, close to the hybrid fibre coax (HFC). Figure 3-1 is a reference diagram from CableLabs CCAP specifications [CableLabs CCAP]. It captures the main elements of the access part of the cable network.

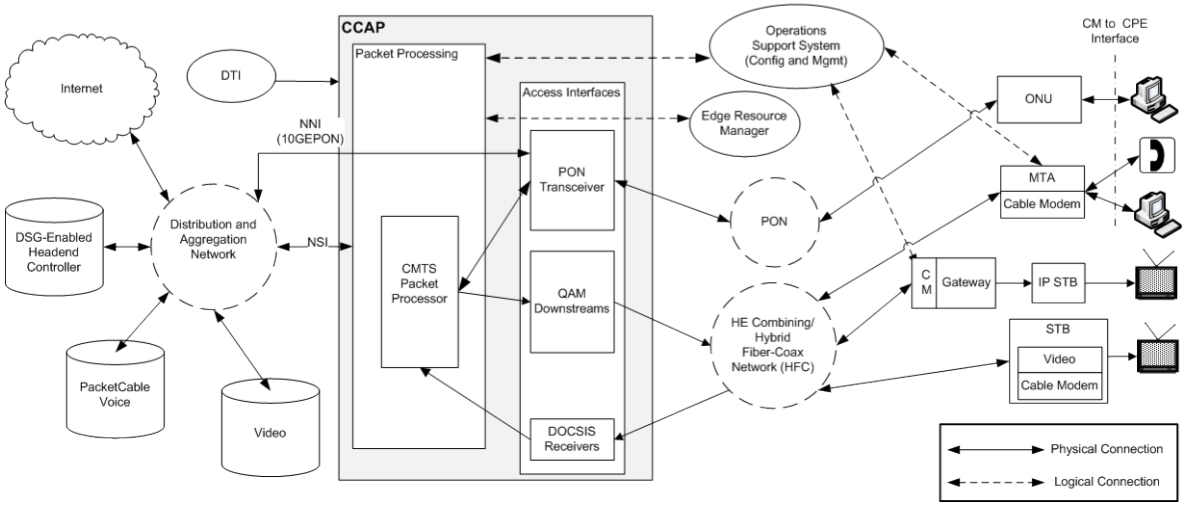


Figure 3-1 – CCAP reference architecture

All the elements above can be connected to an SDN controller. The applications on top of the SDN controller can be used to analyse network traffic and use it to quickly and efficiently orchestrate the network, thereby greatly simplifying network operations in cases where network functionality has historically not been distributed. The following clauses will outline a high level concept of how this access architecture connects to applications, what services it can provide to applications, how it integrates with other network infrastructures and the unique attributes of the cable network.

2.1 Cable specific transport considerations

The cable network is a broadband Internet service provider (ISP) network and as such is similar in more than one way to other types of ISP networks. However, there are some unique characteristics of the physical access elements of the cable network that have managed to creep up the protocol stack into the higher layer transport and management elements. This clause attempts to highlight those areas where cable broadband access differs from other broadband access systems.

The unique elements of the cable transport networks are in the access part of the network as well as at the customer premises equipment. The following points highlight these unique elements:

1. The hybrid fibre coax (HFC) plant.
2. The coexistence of several transport technologies on the radio frequency (RF) spectrum:
    a) DOCSIS for data services;
    b) MPEG transport for digital video services;
    c) Analogue video for legacy video services.
3. The multipoint nature of cable communications.
4. The DOCSIS per-flow quality of service (QoS) model.
5. There is no “subscriber identity”, only “access line identity” which is based on the MAC address of the cable modem (CM).

For business services, it is typical to have Metro-Ethernet point-to-point connections; however, those are standard MetroE and are not unique to the cable.

In addition to the above, several types of equipment are unique to cable networks:

1. The cable modem (CM) as the customer premises equipment;
2. The cable modem termination system (CMTS) as the head-end equipment;
3. The edge QAM (EQAM) for video distribution;

4. The set-top box (STB) for video;
5. The fibre-node for converting RF over coax-to-fibre;
6. The home gateway device is typically customer made for the cable.

All the above make integration with other networks and generic applications a very complex task. Fortunately, there are ways to simplify the cable transport networks which are outlined below.

The cable network of the future will migrate to an all IP transport. This will greatly simplify the network and allow for easier integration with other IP networks.

In addition to that, the physical layer architecture will help isolate the HFC specifics from the IP transport layer and allow for a unified broadband management across several access technologies. Software-defined networking (SDN) is the framework for such a unified management.

The access architecture that facilitates this transition is captured in the CCAP specifications [CableLabs CCAP]. Remote physical access architectures are being discussed in various forums.

DOCSIS 3.1 will increase the bandwidth of the network and will accelerate the migration to an all IPTV transport.

Enhanced cable subscriber identity capabilities will facilitate applications to operate at a finer granularity.

2.2 Applications integration

The network can be thought of as a platform for providing application services. The most obvious service is of course the ability to connect to an end point, e.g., when an application connects to a web it uses the network platform to establish the connection.

An application can request these services in one of the following ways:

1. A direct application call: for example, an application can request a specific QoS directly from the network.
2. Indirect: for example, signalling and PacketCable multimedia (PCMM) are examples where lower protocol layers invoke network services.

The following list contains some of the popular services that the network platform provides. In general, they all fall under the “fine-grained connectivity management” umbrella:

- QoS – The ability to prioritize and shape certain types of traffic.
- Firewall – Protecting the user (and network) from malicious traffic.
- Deep packet inspection – Recognizing traffic types as they flow through the network without the assistance of explicit signalling.
- Monitoring – Requesting the network to report how well it delivered a service.
- Accounting – Detailed statistics to be used by a billing/analytics engine.

2.3 Integration with other networks

Some cable networks will have direct access to non-HFC technologies such as:

- WiFi;
- Passive optical network (PON);
- Mobile (in the form of pico-cells);
- Mobile backhaul.

In some cases, these network accesses are connected to CM (WiFi, pico-cells and mobile backhaul) and in other cases they are a replacement (PON). What is critical to supporting a combinatorial growth in possibilities is a consistent and well-layered story to managing the data plane and control plane. For example, a WiFi hotspot hanging off CM should be similar to a WiFi hotspot hanging off an Ethernet passive optical network (EPON) optical network unit (ONU) or a plain Ethernet.

On the data plane, the common use of IP or various IP tunnelling techniques is an obvious path to convergence.

On the control plane, SDN appears as an attractive method for a consolidation and management of these various networks:

- Since parts of the control plane are moved away from the physical devices into a common management network, it is possible to apply a uniform "look and feel" to managing the different parts of the network. This approach will be referred to as "consistent management".
- An SDN framework can help in consolidating the management of mobile subscribers (across WiFi nodes) with that of fixed subscribers. This fixed-mobile-convergence can be accomplished by unifying the "subscriber identity" of the mobile world with that of the fixed access line world by using SDN to orchestrate the two.
- Because of legacy equipment, there may be a wide variety of transport and tunnelling techniques on the same network and even for the same subscribers. In these cases, SDN can be the glue that unifies a path in a consistent way through those different transport tools.

2.4 Network function virtualization (NfV) and service chaining

In addition to SDN, two other technologies that are emerging in the data centre world may transition into cable operator networks:

Network function virtualization (NfV): NfV is running applications and services on general computer services. These could be control plane entities, such as dynamic host configuration protocol (DHCP) and authentication, authorization and accounting (AAA) servers, but also data plane features that are traditionally handled by a router; for example, carrier grade network (CGN) address translation, deep packet inspection (DPI), etc.

Service chaining: The ability to modularize services, which can help create highly customized subscriber services. For example, subscriber A can request a parental control for high-speed data services, subscriber B can request a firewall service and subscriber C can have both services. If the elements in the chain are implemented using NfV, then it can result in very efficient network resource sizing as computer resources for services are added on-demand versus installing elements with more capacity in advance than required in normal operations.

Chapter 4 – Content and application delivery including security for smart cable television

Chapter 4 Summary

The augmented smart television service and cable DRM service are addressed in Chapter 4 as being the most important issues for smart cable television service within the scope of WG3, which is the content and application delivery including security.

In the augmented smart television service, broadcasting content and augmented content (2D/3D graphic object) are blended in real time on the receiving terminal such as TV or set-top box (STB). When this technology is applied to TV, viewers can watch the mixed broadcasting contents when they want to watch that service only, and they can watch the original broadcasting content when they do not want to watch the mixed broadcasting contents. In addition, the content rendering on the receiving terminal allows every viewer to choose their own preferred contents or control them.

A rapid deployment of smart phones and tablet devices has changed users' style in watching TV, whether they are at home or outdoors. Bringing out recorded contents in removable media increases the traffic of media streaming and download over a two-way IP communication. In such a case, DRM technology rather than CAS is required for content protection based on device authentication. The cable DRM means not only digital content right protection but also its usage and re-production. In this FG Technical Report, the cable DRM is defined to be a method of control and protection of digital contents among the authenticated devices situated in the IP communication environment.

1 Scope

This output document of WG3 addresses content and application delivery including security issues that are identified by WG1 within the scope of FG SmartCable. Content and application delivery via hybrid networks and their linkage information is also addressed in this output document of WG3.

1.1 Standardization considerations

Based upon the focus group study, the following items are recommended for consideration to be standardized. It should not be assumed that the following are the only suitable topics for standardization under the study of WG3. Please note that the first and the third items in the following were already initiated as ITU-T SG9 standardization activities in January 2013 with the work item names of [ITU-T J.drm-req] and [ITU-T J.arstv-req], respectively.

- Requirements of DRM for cable television content delivery service including multiple device viewing experiences.
- Cable DRM functions and interfaces with other devices.
- Requirements of augmented reality smart television systems.
- Metadata format for describing augmented content of augmented reality smart television systems.
- Specification for signalling and synchronization of augmented reality smart television systems.

2 Augmented smart television service based on augmented reality technologies

Augmented reality (AR) technology has been in use for quite a long while and is a kind of mixed reality where 2D/3D graphics are integrated into the real world in order to enhance user experience and enrich information. As smart devices become more common, AR has been adopted in various applications such as AR-book, AR-shopping, AR-social networking services (SNSs), etc. In fact, this service known as AR-broadcasting has been already used in cases of virtual advertisement and additional information in television broadcasts such as football games and ballot counting (Figure 4-1). These cases are to handle all augmentation before the video image is transmitted to the broadcasting network. Therefore once it is transmitted, the TV viewer at home can neither influence this compositing nor the selection. This would ultimately lead to the fact that viewers would never return in front of the TV any more.

Figure 4-1 – AR in sports broadcasting

To overcome the limitation of the one-sided augmented broadcasting service by broadcasters, a novel augmented television service technology was used to do rendering in order to blend with broadcasting content and augmented content (2D/3D graphic object) in real time on a receiving terminal such as TV or set-top box (STB). When this technology is applied to TV, viewers can watch the mixed broadcasting contents when they want to watch that service only, they can watch the original broadcasting content when they do not to watch the mixed broadcasting contents. In addition, the content rendering on the receiving terminal allows every viewer to choose their own preferred contents or control them.

TV broadcasting would become more attractive when interactivity is allowed and interesting information is shown while watching TV programmes at the right time. For example, when a viewer is watching a golf channel where a player is putting on the green, a 3D map of the green is displayed on the right top of the TV screen. Then the viewer can manipulate the detailed green image on the TV and see the player's career on a second device. In order to achieve this goal, the original video/audio contents and augmented contents should be delivered via a hybrid broadcasting-broadband network separately. Their linkage information such as metadata needs to be sent together toward a receiving terminal such as a smart-STB or a smart-TV.

2.1 Possible scenarios of augmented smart television services

2.1.1 Augmentation region-based application

The augmentation region is a coordinate space in the video image where 2D/3D objects should be overlaid. The objects should be synchronized with the movement of the augmentation region. Figure 4-2 shows an example of augmentation region-based AR. The augmentation region and its tracking information should be described beforehand because a current STB may not have enough power to process tracking automatically from the video stream in real time. Therefore, it is necessary to prepare the trajectory of the movement and transmit the trajectory together with the video data. Moreover, it would be possible to transmit a prepared mask, depth-information, 3D object, or other additional data such as an illumination resource for the natural composition of 3D objects.

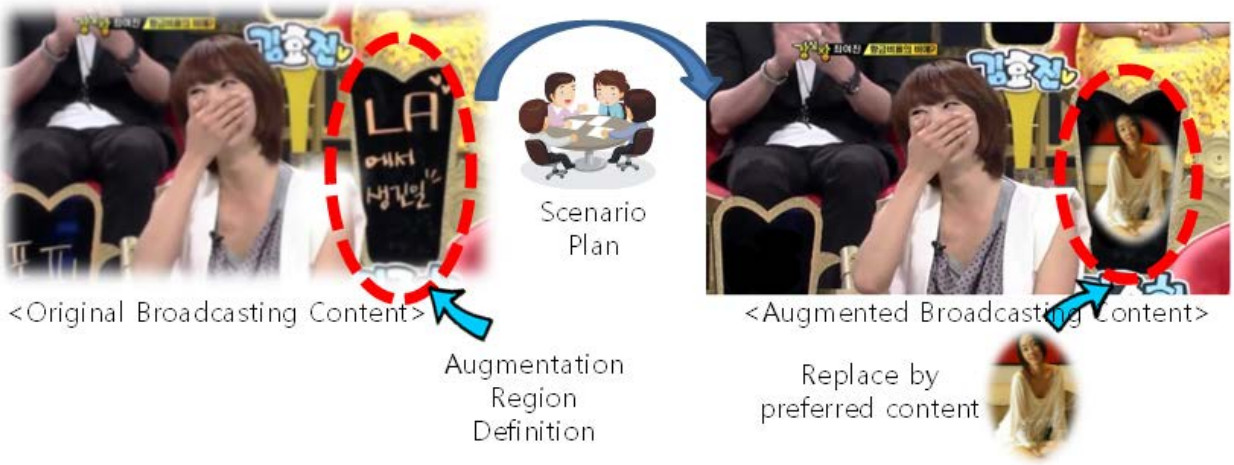


Figure 4-2 – Content replacement in augmentation region

2.1.2 Interactive application with manipulation of the 3D object

Enabling a user to manipulate a 3D object augmented over the background video will enrich the user experience. For example, a student is watching a TV programme about the organ of the human body. While the teacher is explaining about the functionality of each part of the human heart, a 3D model of the heart will show up and the student may manipulate the 3D object by handling a remote control equipped with a motion sensor. Another option to manipulate the 3D object is to run image recognition algorithms for the tracking of the marker image. This will be possible if the cost of the set-top box decreases and more calculation power and CPU speed are available to STB in the near future.

Figure 4-3 – Interactive broadcasting with manipulation of the 3D object

2.1.3 Location-based application

Location-based AR-services are very popular in mobile devices nowadays. Mobile devices usually have a location sensor and an orientation sensor. However, TV does not have such sensors and the video stream is not related to the location of the user's watching point. Then what if the video stream contains the location and orientation signal obtained from the camera? A TV camera equipped with a location sensor and an orientation sensor has already been used in AR-advertisement in sports game broadcasts. Not only the advertisement, but various useful information based on the location could be possible. For example, in the golf game broadcasts with location information, the AR service provider may give the users the ground shape of the field. Another service provider may give information about the golf club. Similarly in a tour broadcasts, the location information allow the user to have more useful information such as transportation guidance or the location of some restaurants nearby the place of the scene.

Figure 4-4 – Location-based broadcasts

2.2 Service conceptual model

Figure 4-5 shows the service model of augmented smart television broadcasting. The augmented broadcasting provider defines the augmented region from the audio/video content and information expressed in the region. The information is formatted as augmented broadcasting metadata and generated by an authoring tool. The metadata includes a unique name, an object type, a position, presentation/life time, resource location of augmented objects and rendering attributes for mixing augmented objects according to the augmented broadcasting scenario. A service scenario could be planned in a process of content production. Content providers produce augmented content database harmonized with the scenario. A broadcasting programme is transmitted together with metadata to set-top boxes or smart TVs. When viewers want augmented broadcasting service in the middle of watching TV, they can enjoy it by clicking a service button. Therefore, viewers can watch the mixed broadcasting contents when they want to watch that service only and watch the original broadcasting content when they do not. In addition, the object rendering technology on the receiving terminal allows every viewer to choose purchasing the contents or control them via a user interface/user experience (UI/UX). Moreover, viewers can select a preferred provider from several content providers, and they might consume the same video content newly even when re-watching by selecting another content provider.

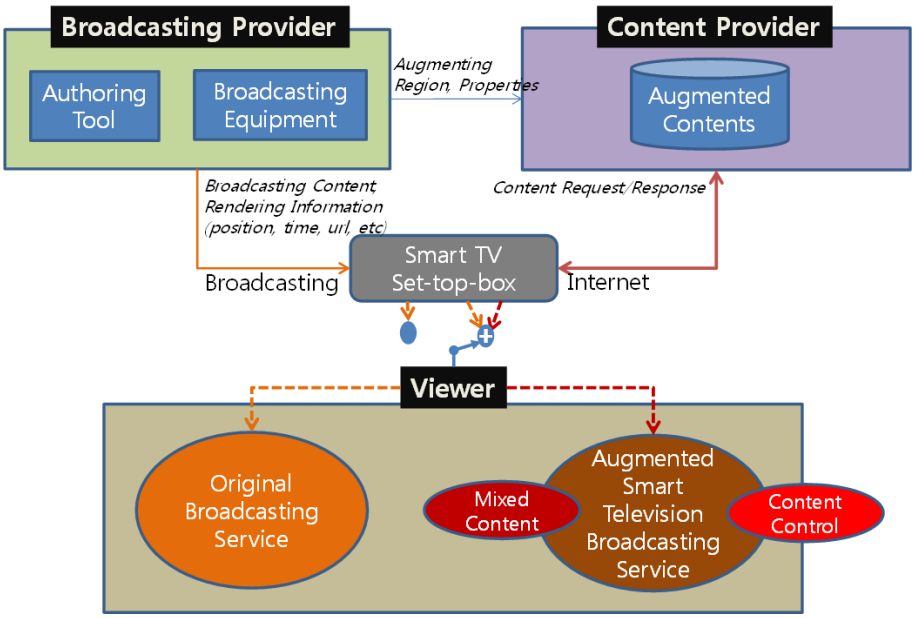


Figure 4-5 – Service model of augmented smart television broadcasting service

2.3 Current status for AR-broadcasting in MPEG standards

This clause introduces the relevant standards of "Augmented Smart Television Service based on Augmented Reality (AR) Technology" that have been developed by MPEG.

2.3.1 AR-broadcasting in MPEG

MPEG started to standardize AR-technologies under the project name of augmented reality application format (ARAF) [ISO 23000-13] in 2011. ARAF is a collection of a subset of the [ISO 14496-11] (MPEG-4 Part 11) Scene Description and Application Engine standard, combined with other relevant MPEG standards (e.g., [ISO 23005-5] – MPEG-V Part 5). Requirements have been collected from the use cases proposed by interested companies, research institutes and other standards organizations. The targeting service areas are broadcast, games, tour guides, education, simulation, medical training, etc.

MPEG ARAF's standardization is fulfilled as follows:

- Goal:
  - Compile existing MPEG technologies and add new tools that will enable applications and services for augmented reality.
- Related standards:
  - MPEG-4 BIFS (Binary Format for Scenes);
  - MPEG-V Part 5 (Sensor descriptions);
  - MPEG-U (User Description);
  - MPEG-CDVS (Compact Descriptor Visual Search).
- Schedule:
  - Working Draft (WD): 2012-02 ~ 2012-05, 99th /100th meeting;
  - Committee Draft (CD): 2012-07, 101th meeting;
  - Draft International Standard (DIS): 2012-102013-01, 102th103th meeting;
  - Study of DIS (SoDIS): 2013-04, 104th meeting (current);

  - Final DIS (FDIS): 2013-07, 105th meeting (expected).
- Requirements: see Table 4-1

Table 4-1 – Requirements of ARAF

Requirements	Description
Scene description	ARAF should support scene description: • Representation of the scene graph as a hierarchical collection of nodes. • Representation of nodes for the following types of information: – static and dynamic regions to be augmented, – approximation of the geometry of the real scenes, – approximation of the illumination of the real scene, – elementary media and their spatial and temporal properties, – programming information such as scripts, – user interactivity, – data obtained from sensors and data to control actuators, – maps and associated data, – metadata.
Media	ARAF should support a broad range of media data: • text with a large set of fonts, • 2D/3D image: single image, stereo images, multi-view images, colour plus depth images, • 2D/3D audio: natural and synthetic audio, spatial audio, • 2D/3D video: single video, stereo video, multi-view videos, colour plus depth videos, • 2D/3D Graphics (static and animated): simple geometric primitives (lines, curves, sphere, cylinder, etc.), complex geometric primitives (free form surfaces, volumes, etc.)
Metadata	ARAF should support a broad range of metadata: • scene metadata, • media metadata, • sensors and actuator metadata, – augmentation service-related metadata (e.g., an augmentation service can provide information for restaurants).
Remote access	ARAF should provide means to access remote media resources. ARAF should provide means to access remote sensors and actuators.
Compression	ARAF should support compression of the different media types: • 2D/3D graphics object (static and animated) compression, • image compression, • video compression, • audio compression, • scene compression.
Management and protection	ARAF should support management and protection of augmented content, both at the format level and at the individual object level.

Table 4-1 – Requirements of ARAF

Requirements	Description
Integration and communication	ARAF should provide means to access local/remote sensors: • ARAF should support the representation of data captured by one or several (front, back, etc.) local cameras, • ARAF should support representation of data captured by the acceleration, orientation, angular velocity, global positioning, and altitude sensors, • ARAF should support the representation of environment parameters such as light sources and reflectance properties of real objects. ARAF should provide means to identify and analyse real and/or virtual objects and signals: • ARAF should support the representation of the reference signal (e.g., bar code, image, representative sound) or a model characterizing it, • An ARAF device should be able to execute signal analysis by using the reference signal and/or its model and implementing third-party identification and tracking methods. ARAF should support communication with external components and services: • ARAF should support the communication with maps service providers, • ARAF should support the communication with dedicated providers that execute signal analysis, • ARAF should support the identification of the augmentation region and the definition of how the augmentation will be performed.

2.3.2 Related working activities in MPEG

The use cases for the augmented broadcast service as well as additional scene-nodes describing the augmentation region and reference signal have been described in the following documents [W13605], [W13609] and [W12585]. The augmentation region provides the parameters of a static or animated 2D region related to a natural media. A virtual object can therefore be composed with the natural media and contained inside the region. The reference signal provides signal detection capabilities in a scene. ARAF has phased the work plan from version 1 to 4 and the 1st version of technical specification was approved as DIS in January 2013 and will be finalized in January 2014.

2.4 Summary

Clause 2 introduces the augmented smart television service. It is believed that this service will be more useful for education, sports, and advertisement channels and will appeal to broadcasters and content providers. Moreover, TV viewers can enjoy the broadcasting programme realistically and focus on watching TV.

3 Cable DRM

A rapid deployment of smart phones and tablet devices has changed people's style in watching TV, be it at home or outdoors. Bringing out recorded content in mobile devices increases the traffic of media streaming and download over an IP two-way communication. In such a case, DRM technology rather than conditional access system (CAS) is required for content protection based on device authentication. DRM means not only digital content right protection but also its usage and re-production. In this FG Technical Report, DRM is defined to be a method of control and protection of digital contents among the authenticated devices situated in the IP communication environment.

3.1 DRM outline

DRM allows a personal authentication which consists of personal ID and password for rather lighter content protection. However, in this FG Technical Report, DRM must have a device authentication function. Figure 4-6 shows one aspect of DRM.

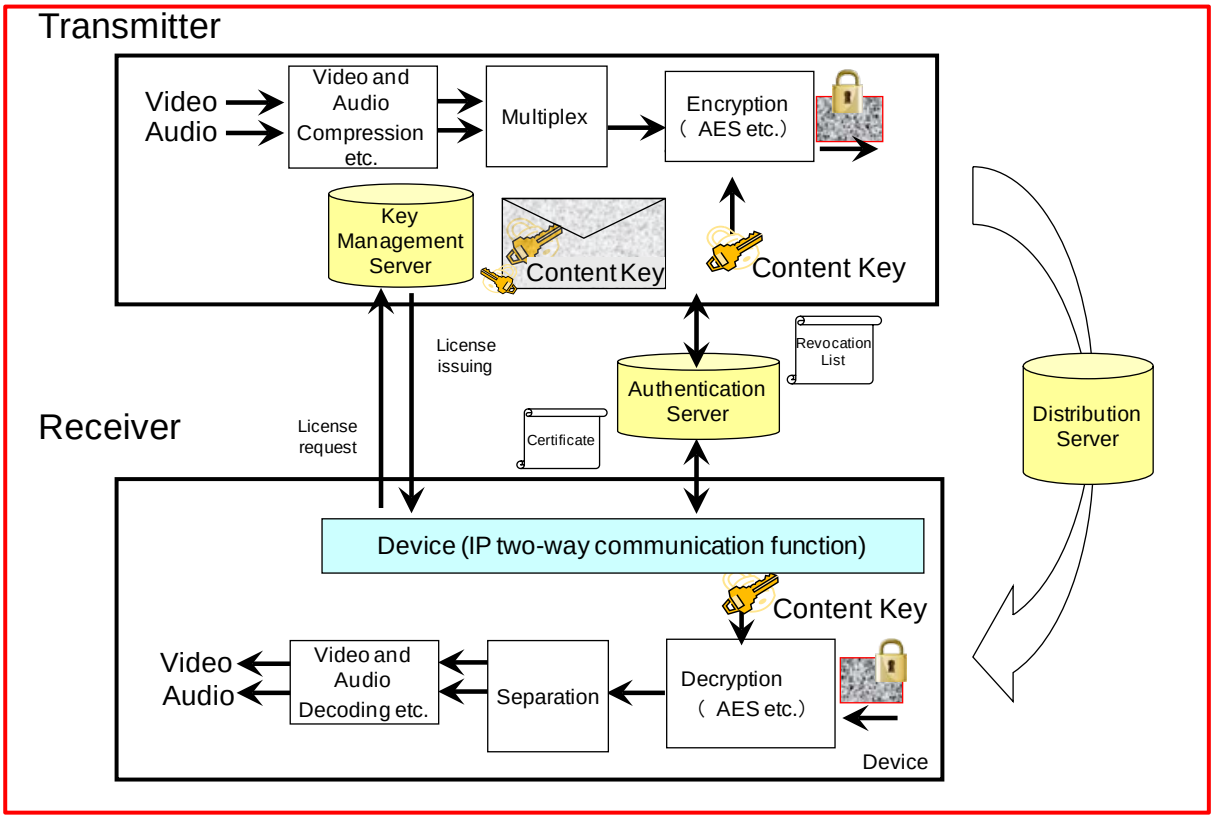


Figure 4-6 – One aspect of DRM

The encrypted content is put on a distribution server. The content key is stored separately in a key management server. The device which needs the content must get device authentication beforehand. After authentication, the device requests a license from the key management server and obtains it. A license means an envelope (i.e., encryption by public key of device) having content key which is encrypted by another key. In the receiver, the content key can be recovered by unsealing an envelope (i.e., decryption by personal key), and the content can be obtained after decryption by this content key.

3.2 Current DRM technology

3.2.1 Digital content protection methods for multi-screen services

Multi-screen services are one of the services that are defined in FG SmartCable. There is no doubt that the trends of the distribution of premium contents among mobile smart devices at home are increasing alongside with the growth of smart TV markets. These trends necessitate the development of new types of content protection methods, and many companies and organizations develop their own proprietary methods.

This clause describes the survey results regarding digital content protection methods for multi-screen services.

3.2.1.1 Categorizing content protection method/service based on DRM

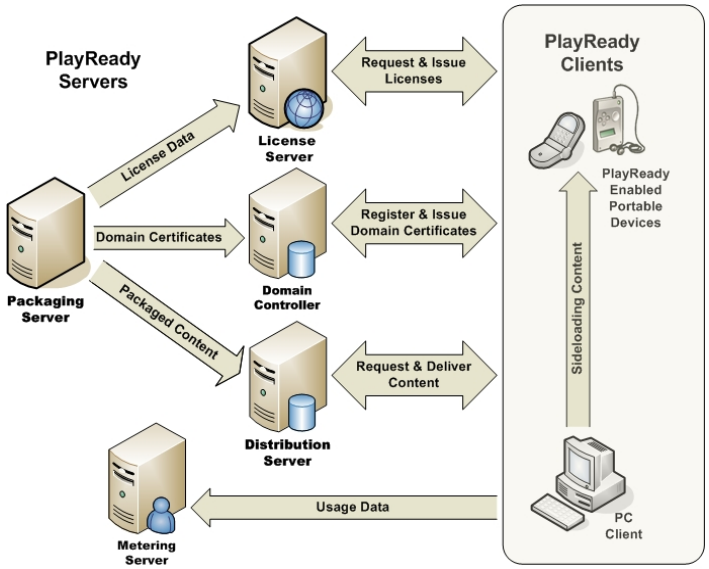
DRM is the preferred method for content protection in multi-screen services. It is possible to categorize DRM services into four types as shown below.

3.2.1.1.1 Single DRM on a service

This is a conventional type of DRM service. In this type of DRM, only one DRM method is used in one service. Many proprietary multi-screen services such as iCloud or Netflix adopt this type of DRM method.

One of the popularly used types of DRM is Microsoft's PlayReady DRM which was announced in 2007. The distinguished feature compared to the previous DRM is domain concept which allows users who are in the same domain to share the same license. PlayReady DRM is a platform independent solution, so it can be ported to any kind of portable device, even if it uses non-Microsoft technologies (e.g., an operating system (OS), codecs, media player, etc.) except Linux.

iCloud services do not provide video contents with DRM, but if Apple wants to apply DRM to the iCloud services, they will possibly use Fairplay DRM since it is already embedded in all Apple devices.



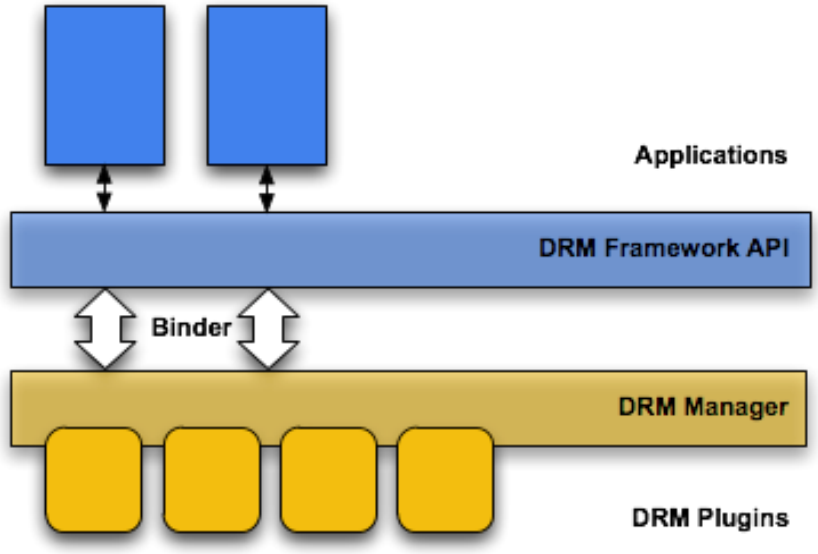
This figure reproduced from [Microsoft-2008].

Figure 4-7 – Microsoft PlayReady DRM

3.2.1.1.2 Embedding multiple DRM clients on a device

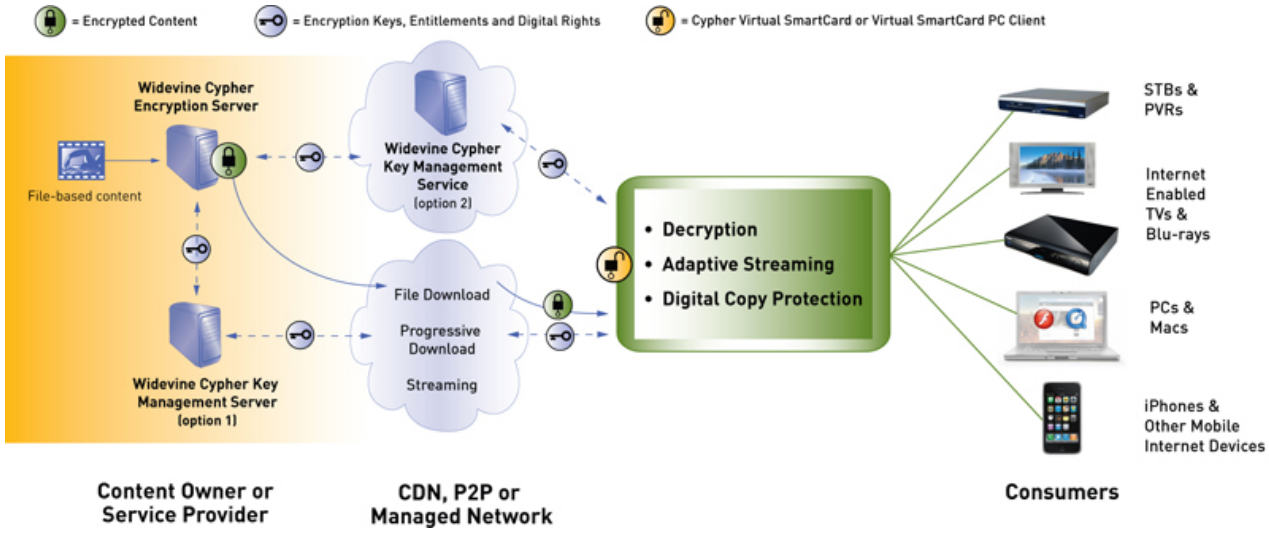
This type of DRM is one of the popular methods which are provided by several vendors such as Google, Widevine, and Verimatrix. In this type of DRM, one DRM framework is provided to DRM vendors, who are allowed to develop their own DRM applications based on unified APIs of the DRM framework.

In case of Google DRM Framework, Android applications acquire DRM plug-in information through the DRM Framework API, and confirm that their contents can be played by DRM Agent. In addition, Android applications can inquire and manage DRM licenses for Display, Execute, or Print. If Android applications have a license, DRM protected contents can be serviced with StageFright which is an Android Multimedia Framework. In Google DRM Framework, DRM Plug-ins, which is supposed to be developed by each DRM vendor, should be ported in the devices when they are manufactured.



This figure is reproduced from work created and shared by the Android Open Source Project and used according to terms described in the Creative Commons 2.5 Attribution License. (http://developer.android.com/reference/android/drm/package-summary.html)

Figure 4-8 – Google DRM Framework



(http://www.widevine.com/wv_drm.html)

Figure 4-9 – Widevine's multiplatform DRM

3.2.1.1.3 DRM interoperability based on common file format

This type of DRM method provides interoperability among proprietary DRMs by defining a common file format (CFF). The representative method is Ultraviolet service which is announced in 2010 by the Digital Entertainment Content Ecosystem (DECE) consortium.

Ultraviolet service provides a family account management to 12 devices at maximum for convenient content sharing among family-owned devices. Ultraviolet also defines a concept of Digital Locker to control family purchased contents by storing Rights in the cloud server.

(http://www.uvvu.com/)

Figure 4-10 – Ultraviolet

3.2.1.1.4 DRM interoperability based on format transform

In this type of DRM methods, the format transform scheme is used for DRM interoperability. The representative DRMs are Coral DRM and Export/Import (EXIM). However, these kinds of DRM types are not successfully deployed in the market.

3.2.1.2 Summary

The content protection methods which are described in this clause are summarized in Table 4-2.

3.2.2 Major functional elements of DRM

Figure 4-11 shows major functional elements of DRM.

As shown in Figure 4-11, content is encrypted through the transcoder process. The key is kept in the key management server. The encrypted content, stored in the distribution server, requests the content key from the key management server. The key management server sends the content key which is encrypted by the distribution key. The device decrypts content by this content key which is transmitted with content.

3.2.3 Encryption algorithm

There are two DRM algorithms; one is for content encryption and the other for the distribution of content key from the key management server. Most of DRM systems use AES as encryption algorithm, as shown in Table 4-3.

Table 4-2 – Summary of the content protection methods

Service/Product (Company)	Type	Content protection method
iCloud (Apple)	Single DRM on a service	N/A ('FairPlay DRM' is a possible one)
Google DRM Framework (Google)	Embedding multiple DRM clients on a device	Multiple DRMs
Hoppin (SKT (Korea))	Single DRM on a service	Playready DRM
uCloud (KT (Korea))	Single DRM on a service	N/A
UtraViolet (Consortium)	DRM interoperability based on common file format	Widevine DRM, Marlin DRM, OMA DRM, Playready, Adobe Flash Access
Netflix (Netflix)	Single DRM on a service	Playready DRM
Hulu (Hulu)	Single DRM on a service	N/A or HTML encoding method
Multiplatform DRM (Widevine)	Embedding multiple DRM clients on a device	Widevine Multiplatform DRM
MutiRight (Verimatrix)	Embedding multiple DRM clients on a device	Multiple DRMs
EXIM (ETRI)	DRM interoperability based on format transform	Multiple DRMs
AllShare (Samsung) /SmartShare (LG)	Single DRM on a service	N/A (Content sharing between Digital Living Network Alliance (DLNA) terminals)

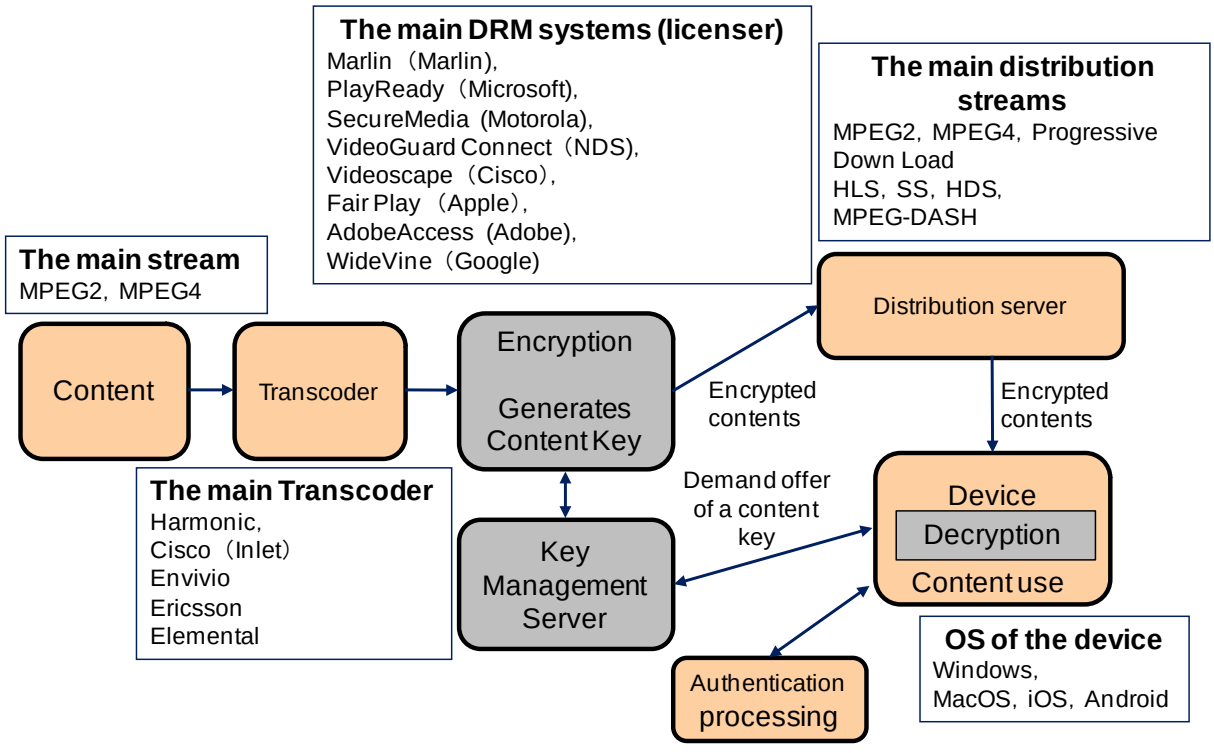


Figure 4-11 – Major functional elements of DRM

3.2.4 Domain function

Domain function enforces DRM for multiple device usage. The domain function belongs to a single person who shares multiple devices, as shown in Figure 4-12.

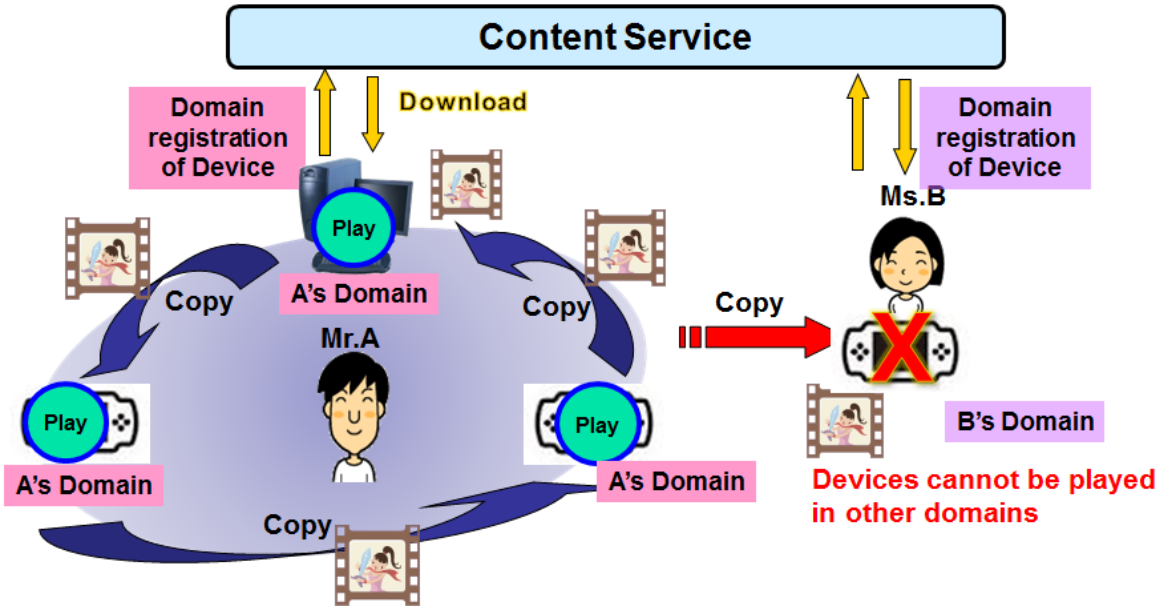


Figure 4-12 – Domain function belonging to a single person

A person (Mr. A) registers multiple devices first in the same domain, thus copying and re-playing of content can be available. This means registering himself and his devices as a user in the domain server. The server generates the domain key for the user, issues it to the devices and the device keeps the key safely. The relationship of keys, in case of OMA DRM [OMA-RD-DRM] and [OMA-TS-DRM], is shown in Figure 4-13.

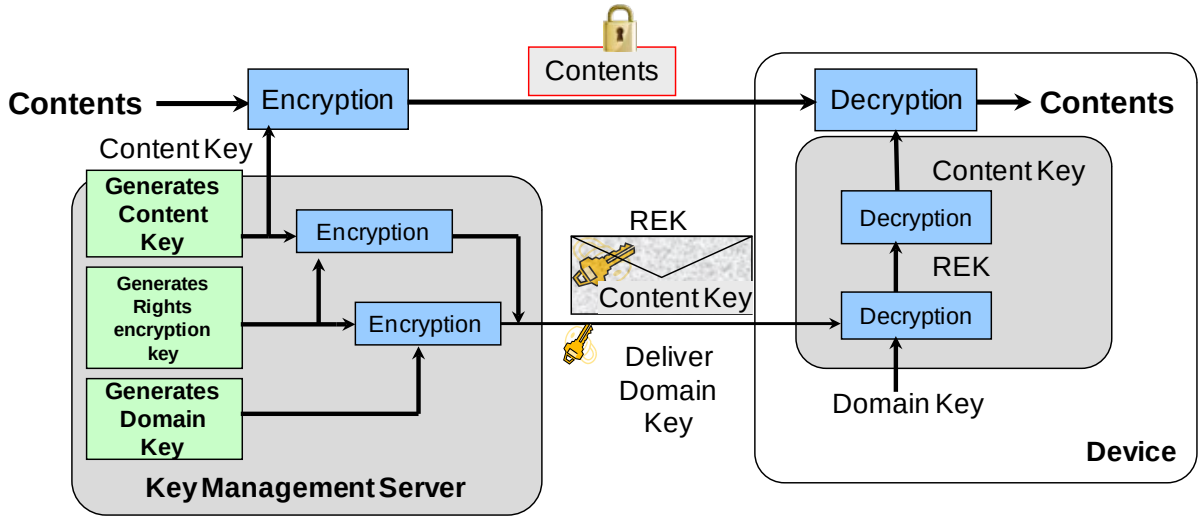


Figure 4-13 – Relationship of keys

A content key is encrypted by the right encryption key (REK), the domain key encrypts REK. Each device uses the domain key for decryption of REK, REK decrypts the content key. If other devices have the same domain key, copying the content is allowed among devices.

As shown in Table 4-3, each DRM of Marlin, PlayReady, SecureMedia, VideoGuard Connect adopts a domain function.

3.2.5 Multi-DRMs

An aspect of multi-DRM is shown in Figure 43Figure 20. As shown in the figure, content from the transcoder is encrypted by the content key; the content key is stored in the key management server (KMS). The content key can be controlled and delivered by multi-DRM systems (DRM-A and DRM-B). A content requesting a device (DRM-A device in the figure) requires the key from KMS. KMS delivers the content key after encryption of content key by the delivering key of DRM-A. The content key can decrypt the encrypted content at DRM-A device, and finally the content can be ready for service. In this case, a unique content key is assigned for a content, which does not depend on a specific DRM. Multiple DRMs can use this unique key in common for key management as well as for key delivery.

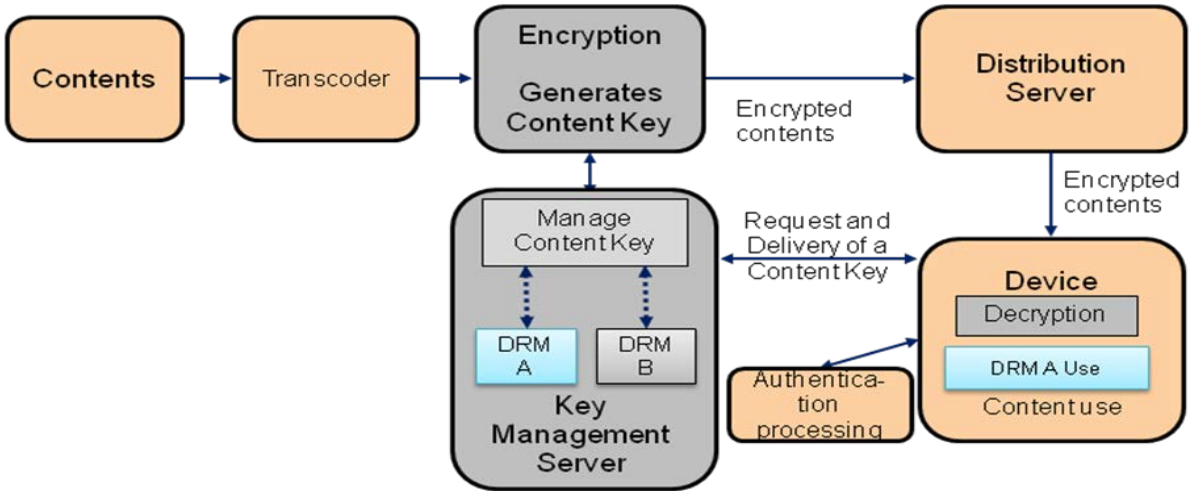


Figure 4-12 – One aspect of multi-DRMs

Tables 4-3 and 4-4 list features of current DRMs. As shown in the tables, Marlin and PlayReady are for single use of DRM, which needs a cooperation of solution vendors for multi-DRM system. SecureMedia, VideoGuard Connect supply single and multi- DRMs.

Table 4-3 – Features of current DRMs

DRM name Item	Marlin	PlayReady	SecureMedia	VideoGuard Connect
Licensor	MTMO	Microsoft	Motorola	NDS（Cisco merged NDS）
Standardization of DRM system	MTMO	Original	Original	Original
Encryption algorithm	AES, RSA, ECC	AES, ECC, Cocktail	AES, RC4	AES, CBC, ECB, NSA
Supported platforms	Windows, iOS, Android, Linux, other OS	Windows, iOS, Android, Linux, other OS	Windows, iOS, Android, Linux, other OS	Windows, Mac OS, iOS, Android, other OS
Supported devices	TV, BDR, BDP, STB, iOS system device, Android system device,	TV, SmartTV, BD, HDR, STB, iOS system device, Android system device, Linux device, Windows	STB, PC, Mac, iOS system device	STB, PC, Mac, iOS system

Table 4-3 – Features of current DRMs

DRM name Item	Marlin	PlayReady	SecureMedia	VideoGuard Connect
	Linux device, Windows device, Game device, Application and others (including domestic)	device, Application and others (including domestic)	, Android system device , TV, BDR, Game device (e.g., play station)	device, Android system device , Game device(e.g.,PS3, Xbox)
Applied services	Hikari TV, acTVila, TSUTAYA TV etc., Domestic and international music, video, and book service company	Domestic music and video service company Asia, Europe, United States and many others, related to Ultraviolet http://www.microsoft.com/PlayReady /Licensing/licensees.mspx	Time Warner , Verizon, Echostar, Blockbuster, Avail-TVN, Comstar, etc.	BSkyB(UK DTH Operator), Cox Communications (US Cable MSO) , DIRECTV(US DTH Operator), other TV operator companies
Content suppliers	Many, such as Hollywood studios	Asia (including domestic) , United States (Hollywood) , Europe Studio , Music Channel	Hollywood studio, U.S. major broadcasting station (MerdanSecurity audit)	Hollywood major studio: Fox, Warner , NBCU, Sony, Disney , HBO, Paramount, Turner and Starz, Audit of Telcordia, recognized audit company
Adaptive streaming	○	○	○	○*1
Domain function	○	○	○	○
Applicable different DRM on server side	Accepts solution vendor' s system	Accepts solution vendor' s system	Motorola Connect SR™ Accepts multi-DRM-CAS / domain.	VideoGuard accepts Different DRM, mutual operation with a DTCP protocol, access to shared content libraries by SimulCryp

Table 4-3 – Features of current DRMs

DRM name Item	Marlin	PlayReady	SecureMedia	VideoGuard Connect
Download content	○	○	○	○
Support of in-house distribution from STB/GW	○*2	○	○*3	○
1) HD Content	○	○	○	○
2) Grant of replay period control	○	○	○	○
3) Streaming / download	Available both	Available both	Available both	Available both
4) Subscription	○	○	○	○
5) Device bind condition	○	○	○	○
6) Restriction of maximum usage number	○	○	○	○
7) MPEG 2-TS/MP4 support	Available both	Available both	Available both	Available both
8) Key rotate function	○	○	○	○

NOTE 1 – Points 1) to 8) in Table 4-3 are items to be studied by the cable operator for the selection of DRM.

*1：Applied by HLS, NDS ABR, Smooth Streaming, MPEG-DASH [ISO/IEC 23009-1].

*2：Approved as by Persistent protected storage of DTCP-IP.

*3: Applied by SecureMedia IPRM-HR, Approved by US CableLabs and DTLA.

NOTE 2 – The following documents should be conferred: Persistent protected storage of DTLA for DTCP protected content (http://www.dtcp.com/approvedtechnologies.aspx)

Table 4-4 – Features of other DRMs

DRM name / Item	Fair play[1]	Flash access[2]	Widevine[3]
Licensor	Apple	Adobe	Google
Standardization	Original	Original	Original
Encryption algorithm	AES+MD5 hash	Non-disclosure	Non-disclosure
Supported Platforms	Mac OS, iOS	OS for Windows, Mac, Android and Linux	Android OS
Supported devices	iPhone, iPod, iPad	PC, Android device, iPhone	TV, STB, PC, Smart phone, tablet device
Applied Services	iTunes Store	Flash Player Flash AIR	Google Play

[1] Flash access:

- http://www.adobe.com/products/flashaccess/faq/
- http://www.adobe.com/products/flashaccess/systemreqs/
- http://www.adobe.com/products/flashmediaserver/pdfs/flashaccess2_0_whitepaper.pdf

[2] Fair play:

- http://www.wikipedia.org/wiki/FairPlay

[3] Widevine:

- http://www.widevine.com/drm.html
- http://www.widevine.com/available_platforms.html

Chapter 5 – Smart cable television usability and accessibility

Chapter 5 Summary

Chapter 5 reports the summary of user interface issues identified in the smart TV Focus Group, and it also proposes participation taxonomy and a format of user profile for standardization. The participation taxonomy can be used as a tool to analyse usability and accessibility issues with respect to the different use cases of digital TV. The user profile aims to adapt user interfaces to facilitate man-to-machine interaction.

1 Scope

With the advent of technology, television has turned from only a viewing media to an interactive media which not only broadcasts programmes but also offers a plethora of functionalities including teleshopping, home automation, energy monitoring, and online games, etc. However, it is still different from other electronic media in terms of social viewing as multiple users use the same set. Addressing the needs and preferences of different users remain a challenge. Chapter 5 aims to standardize a framework to analyse usability and accessibility issues of digital TV applications and define a common user profile to adapt or personalize user interfaces based on preferences and range of abilities of users.

2 Summary of input documents and liaison statements

The Focus Group received a plethora of applications of smart TV systems, and WG1 prepared a consolidated report on these use cases. WG4 noted the changing role of television from a shared viewing media to a multi-purpose device that can display augmented reality content and that can be used as an energy monitor or controller of home appliances. In light of this changing role, Chapter 5 proposes taxonomy of users' participation with smart TV and discusses the roles of existing access services and the usability criteria with respect to that taxonomy.

WG4 also noted the relevance of user modelling and user profile-based personalization for various smart TV applications, which have a more complex graphical user interface than the standard electronic programme guides. In particular, the input document from the EU gentle user interfaces for disabled and elderly citizens (GUIDE) project presents results from a user trial confirming the usefulness of user modelling-based interface personalization for users with age-related and physical impairment. Figure 5-1 below shows the effects of adaptation on a smart home application for different profiles in a GUIDE application. It shows different colour contrasts, font sizes and button sizes used for different users.

Non-Adapted

Adapted

Adapted

Adapted

Figure 5-1 – Adaptation in GUIDE application

User modelling-based interface personalization was previously explored in the domain of human computer interaction but was not well investigated in the domain of digital TV, apart from content discovery applications. A detailed literature survey on user modelling can be found in [Biswas]. The input document from the EU Virtual User Modelling and Simulation cluster (VUMS) was an attempt to standardize the concept of user modelling. This FG Technical Report proposes to standardize a subset of VUMS profiles relevant to digital TV applications.

Finally, the input documents from ITU-T FG AVA point out the importance of access services in developing accessible digital TV interfaces.

A summary of the issues is included in a recent FG AVA presentation at the Poznan Media Fair in Poland: In particular, the FG AVA documents focussed on:

1. Offering improved customization of closed captioning/subtitles for the deaf and hard-of-hearing;
2. Offering closed signing (i.e., sign language interpretation of TV programmes that the user can choose to view or not view).

The participation taxonomy described in clause 3 analyses different access services in the context of different types of use cases and scenarios.

3 Taxonomy of participation

In preparing the taxonomy, a set of participation scenarios (See Figure 5-2) was initially summarized, and in light of that, taxonomy was proposed to identify issues with existing accessibility products and services.

Based on these participation scenarios, the following questionnaire was prepared:

- How many people are watching: One, or more than one
- What are they watching: A single programme (and then switch off); More than one programme
  - If more than one programme, is it: A series of programmes viewed sequentially; More than one programme simultaneously
  - Are the programmes on now, but not "live" (e.g. the scheduled broadcast time for a series); On now and live (e.g., a football match); Previously recorded (e.g. on a DVR/DVD, etc.)
  - How is the user participating in the viewing: Watching only; Voting (e.g., X Factor); Shopping; Asking a question; Getting further information (e.g., via text); Selecting viewing options (e.g., camera angles for a football match)
- Where is the user: At home in the living room; At home in the kitchen; etc.
- What equipment is being used: Large screen TV; PC; mobile phone; iPlayer, etc.

The set of questions is visualized in Figure 5-3.

This taxonomy was used to analyse existing accessibility services and compare and contrast them. As a starting point, subtitles or captions, audio captions and visual screen modifications have been considered. The following clauses identify issues with these elements with respect to the taxonomy. In the future, other accessibility features can be considered and the analysis can be extended.

1. Viewer alone watching news in his drawing room
2. Viewer watching news with multiple viewers and one of them requires subtitles
3. Viewer changing settings of a digital TV to turn on audio caption
4. Viewer watching a live show and participating in a voting process with basic remote control
5. Viewer watching a live show and participating in a voting process with mobile phone and image recognition technology
6. Viewer watching a live show in a connected TV and shopping over Internet using basic remote
7. Viewer watching a live show in a connected TV and shopping over Internet using direct manipulation with a gyroscopic remote
8. Viewer watching a live show in a connected TV and tweeting about it over social media using a second screen
9. Viewer using an electronic program guide with hand gestures
10. Viewer using an electronic program guide using a second screen on a tablet
11. Viewer recording a program from a live TV show
12. Viewer watching a movie in 3-dimension
13. Viewer playing a game in a connected TV with augmented reality system
14. Viewer using a video conferencing application in a hybrid TV
15. Viewer discovering content in a connected TV
16. Viewer authoring content for a telelearning application to be run on a hybrid TV

Figure 5-2 – Participation scenarios

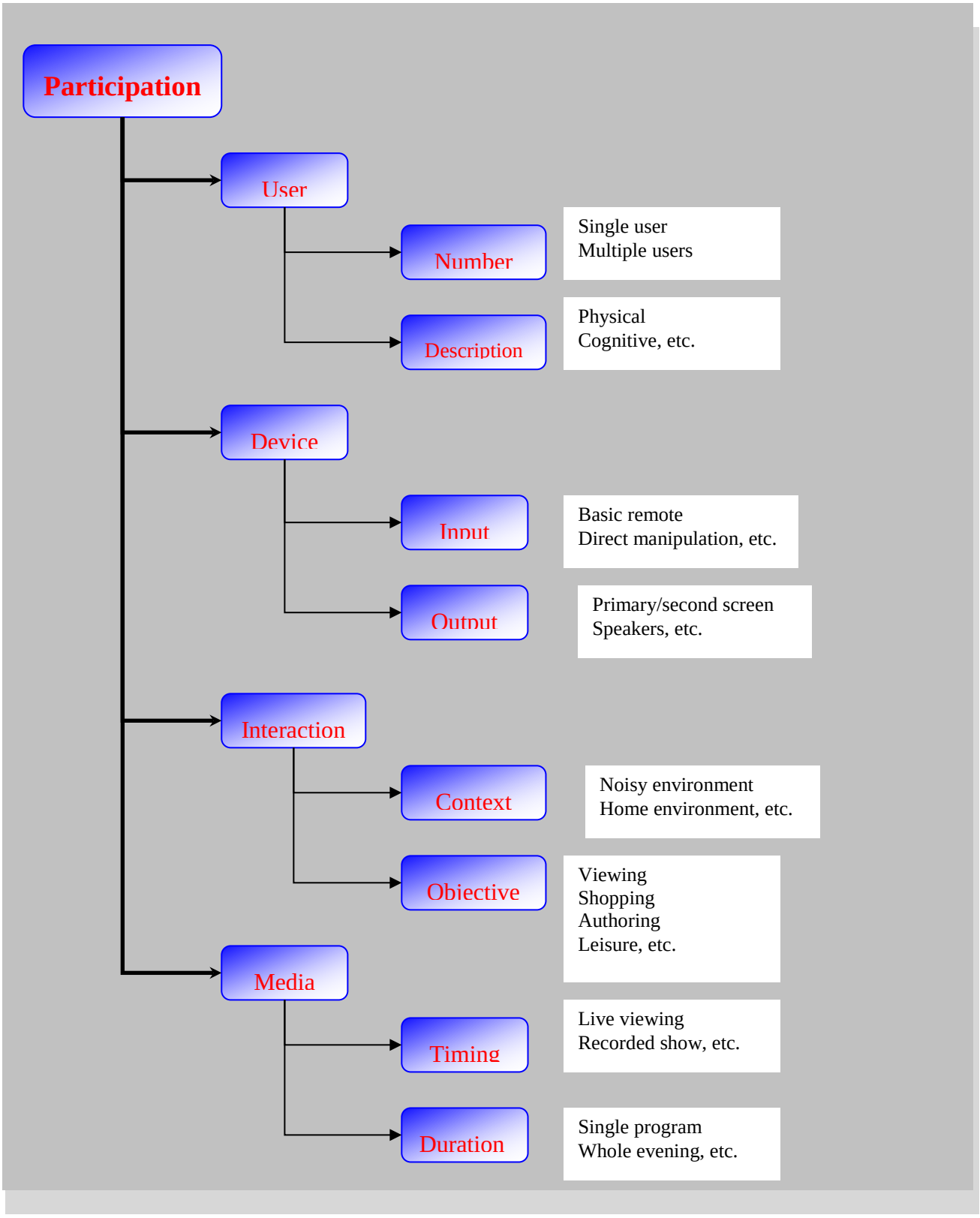


Figure 5-3 – Taxonomy of participation

3.1.1 Captioning

1. **Multiple users**: Captioning will be fine with multiple users even though someone does not need it. This depends on whether the viewers in a country where captioning is something with which they are familiar when there are foreign language programmes (this not the case

where dubbing is used in some countries). It depends also on the amount of text that has to be read, and the speed with which the captions are refreshed.

2. **Impaired user**: If a user has visual impairment, the font size and colour contrast needs to be adjusted. If a user is a slow processor of information or a speaker of a foreign language, the delay in providing captioning needs to be predictable. Captioning should also remain on the screen for a longer time. There are already well-established norms based on empirical studies that govern this. The norms vary from one country to another, and also from one medium (TV) to another (movies).
3. **Input device**: It would be good if the input device like a TV remote can be used to change the font size.
4. **Output device**: Captioning is suitable for large screen displays; the font size needs to be adjusted for small screen displays such as a portable TV or a laptop screen based on the viewing angle, screen size and resolution.
5. **Context**: Colour contrast may need adjustment if the ambient light is too bright or may be bright such as a public display facing sunlight.
6. **Objective**: If the captioning bears important information, it should be implemented either by using a bigger font or by using a different colour to attract attention. While the user is participating in a particular activity such as online shopping or checking the weather through captioning, highlighting or different colour contrasts should be used as in written media for important features and steps (as when confirming an electronic transaction or alerting about a natural disaster, and so on).
7. **Timing**: The delay should be predictable and short during live viewing.
8. **Duration**: It should not be affected if the delay is predictable overall.

3.1.2 Audio captioning

1. **Multiple users**: Studies have shown that non-deaf family members do not feel disturbed with audio captioning while watching TV with a deaf member. Audio captioning is often also helpful for people with cognitive impairment besides visual impairment.
2. **Impaired user**: It is suitable for blind users, but if they also have age-related or other forms of hearing impairment, they may not listen to certain words properly. The speaker or the producer of the audio captioning may need digital signal processing for digital compression and/or spectral contrast enhancement.
3. **Input device**: Users needing audio captioning may not use a keypad (keyboard or remote control) or direct manipulation devices (mouse, trackball, gesture controller, etc.) due to the visual impairment. As a result, audio captioning should be accompanied by a voice input system with good speech recognition capability, if possible, in the users' native language.
4. **Output device**: Speakers with some in-built digital signal processor for noise cancellation. Transmitting the main signal and background signal in different channels (e.g., Swedish public radio) may be useful as users can adjust the signal-to-noise ratio (SNR) themselves.
5. **Context**: The speaker volume needs to be adjusted in noisy environments. The volume should not always be higher, which may create a worse hearing experience due to loudness recruitment, good noise cancellation and multi-channel compression algorithms should be used instead (e.g., EBU recommendation for Loudness R 128 normalization for public and private broadcasters).
6. **Objective**: If captioning bears important information, it should be repeated or spoken slowly. While the user is participating in a particular activity such as online shopping or checking the weather using audio captioning, special features such as slow or repeated messages or audio icons should be used for important features and steps (as when confirming an electronic transaction or alerting about a natural disaster and so on). If the speaker has in-built digital signal processors, those should be adjusted based on the purpose;

for example, a noise cancellation system will create a worse experience while listening to music.

7. **Timing**: The delay should be predictable and short during live viewing.
8. **Duration**: It should not be affected if the delay is predictable overall.

3.1.3 Screen modifications (font size, colour contrast adjustment, visual magnifier)

1. **Multiple users**: While multiple users have different requirements, this necessitates careful adjustment of the font size, the colour contrast, types of input and output modalities, sizes of menus and buttons on the screen. An algorithm for merging user profiles based on user models should be used to resolve conflicts in requirements. The resolution also depends on the purpose of viewing – for example, profile merging will be attained in different ways for public displays and home entertainment systems.
2. **Impaired users**: Visual adjustments are mainly suitable for partially sighted users. However, certain visual adjustments may be avoided by carefully designing the screen, for example, using bigger font, suitable colour contrasts and so on. Simulation of visual impairment and adjusting font size and colour contrast for mild to moderate visual impairment will be useful and should be used during the development of application interfaces.
3. **Input device**: If the user uses a direct manipulation device (mouse, trackball or gyroscopic remote), the pointer size, colour and speed should be adjusted based on the visual adjustment required by the user.
4. **Output device**: For small screen devices, visual adjustment may be difficult for lack of screen space. Alternate modalities such as voice output or tactile feedback can be invoked in similar situations.

4 User profile

Modern smart TV systems already offer customization of program schedule [Samsung Smart TV] and more recently, personalization of interface layout [EU GUIDE system] as well. Interface personalization requires a user profile and a user model that can translate the users' needs and preferences to parameters controlling the rendering of interfaces and electronic content.

User models [VUMS] and [Biswas] can be considered explicit representations of the properties of an individual user including user's needs, preferences as well as physical, cognitive and behavioural characteristics. Due to the wide range of applications, it is often difficult to have a common format or even definition of user models. The lack of a common definition also makes different user models developed for the same purpose to be incompatible to each other. It does not only reduce portability of user models but also restrict new models to leverage benefit from earlier research in similar fields. This FG Technical Report proposes a common format of user profile considering the use cases discussed in other smart TV documents. The purposes of the user profile are:

1. Personalizing interface layout for smart TV applications.
2. Adapting electronic content based on users' preferences.
3. Choosing appropriate access services based on users' needs.
4. Simulating users' interaction pattern while designing user interfaces.

4.1 Structure of user profile

4.1.1 Mandatory for adapting interface

Variable name	Description	Data Type
Username	A unique id of user	String
Password	Log-in credential	String
Age	Age of user in years	Integer
Sex	Sex of user	Integer
Height	Standing height of user	Integer
Volume	Preferred volume of speakers	Double
Font size	Minimum font size of interface captions	Integer
Font colour	Preferred colour of buttons	String
Cursor size	Size of cursor	Double
Cursor colour	Colour of cursor	String
Colour blindness	Presence and type of colour blindness, used to predict colour contrast of interface	Integer
Tremor	Presence of tremor or spasm in hand	Integer

4.1.2 Optional parameters for advanced user modelling

Variable name	Description	Data Type
Username	A unique id of user	String
Password	Log-in credential	String
Age	Age of user in years	Integer
Sex	Sex of user	Integer
Height	Standing height of user	Integer
Volume	Preferred volume of speakers	Double
Font size	Minimum font size of interface captions	Integer
Font colour	Preferred colour of buttons	String
Cursor size	Size of cursor	Double
Cursor colour	Colour of cursor	String
Visual acuity	Visual acuity of user, used to predict minimum font size	Acuity
Contrast sensitivity	Contrast sensitivity of user, used to predict minimum font size	Integer
Scotoma	Number of scotoma in visual field, used to predict minimum font size and appropriate modality of interaction	Integer
FieldLossP	Amount of peripheral visual field, used to predict minimum font size and appropriate modality of interaction	Integer
FieldLossC	Amount of central visual field, used to predict minimum font size and appropriate modality of interaction	Integer
Colour blindness	Presence and type of colour blindness, used to predict colour contrast of interface	Integer
Maccular degeneration	Presence of Maccular Degeneration, used to predict minimum font size and appropriate modality of interaction	Integer
halfK	Minimum hearing level in dB at 500 Hz	Integer
oneK	Minimum hearing level in dB at 1 kHz	Integer
twoK	Minimum hearing level in dB at 2 kHz	Integer

Variable name	Description	Data Type
fourK	Minimum hearing level in dB at 4 kHz	Integer
eightK	Minimum hearing level in dB at 8 kHz	Integer
TMT	Time taken to complete trail making test	Integer
DIGSYM	Score in Digit Symbol Test	Integer
Grip strength	Maximum grip strength of dominant hand	Integer
Tremor	Presence of tremor or spasm in hand	Integer
ROMW	Active range of motion of wrist	Double

5 Relation to other working groups

This working group has also coordinated and contributed to other working groups. In particular, WG 4 proposed user requirements for adaptive multimodal user interfaces to WG 1. It also proposed the needs of adapting layout of second screen based on a common user profile shared with main screen to WG 5.

Chapter 6 – Smart cable television multi-screen

Chapter 6 Summary

Consumers expect everything and everywhere – driven by high performance mobile platforms. To enhance their satisfaction, multi-service operators (MSOs) have rapidly merged the services between TV, PC and mobile devices. This attempt is called a multi-screen service. Chapter 6 describes three modes of multi-screen services, compares network topology and service flow in four basic patterns, analyses function modules and presents standardization proposal.

Keywords

Basic pattern, gateway, multi-screen

1 Scope

Chapter 6 provides analysis of multi-screen services, describes network topology, service flow, and function modules.

The multi-screen service is very intriguing to multi-service operators (MSOs). Based upon the study, the following items are considered to be standardized, but are not limited to:

- Functional requirements of the multi-screen services;
- Service architecture;
- Multi-screen service gateway functions and interfaces with other devices.

2 Service modes and service flows analysis

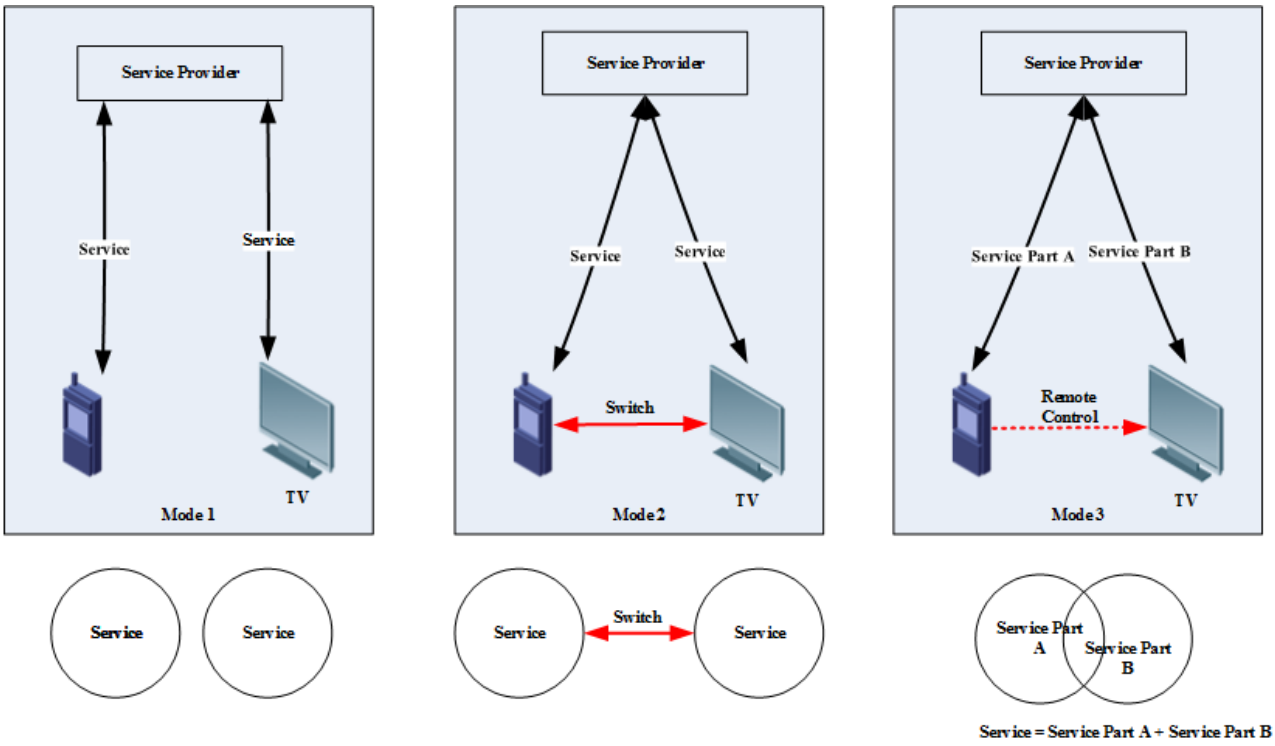
2.1 Various multi-screen service modes

According to the same service, there are three multi-screen service modes as shown in Figure 6-1.

2.2 Service flow patterns

To simplify the analysis, three units have been defined: a gateway, a decoder, and an access point. The gateway and decoder are functional definitions, and not necessarily a device entity. They may be an integrated device, or they may be a functional module integrated in the device.

The gateway should mainly support the following functions: network adaptation, message process, data rights management, data storage, and transcode.



Mode 1: The service provider (SP) delivers identical services to different devices, and the services are displayed on different screens.

Mode 2: The service Provider (SP) delivers identical services to different devices, and the service is switched between different devices to be displayed.

Mode 3: Various mobile devices and TV cooperate to complete a service, and specific service parts are displayed on related screens. In some cases, the mobile devices may be used as a remote control.

Figure 6-1 – Service modes

2.2.1 Service flow pattern 1

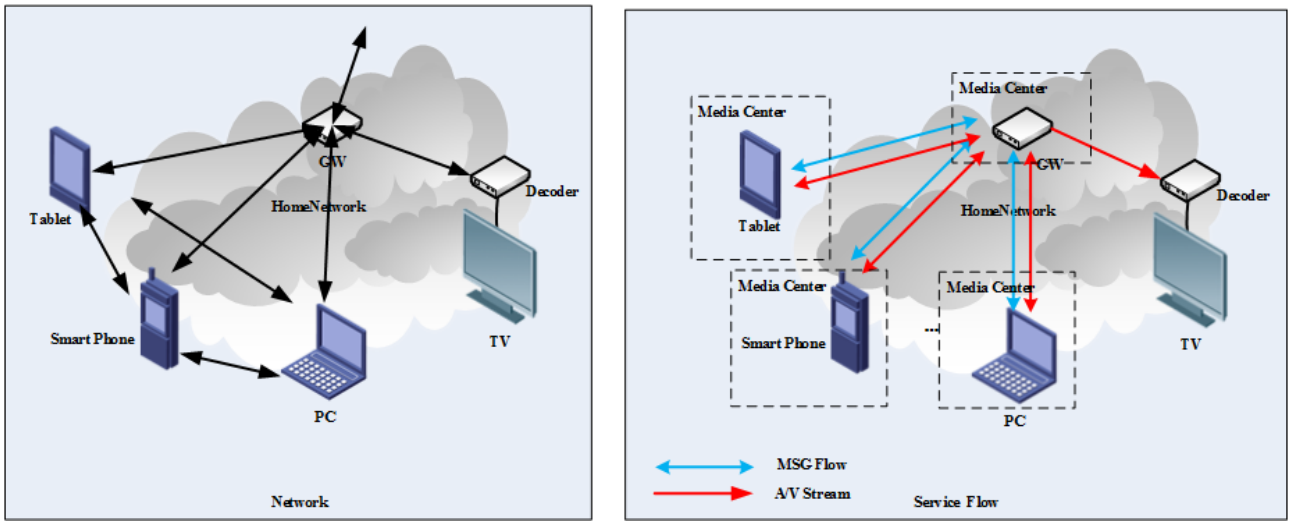


Figure 6-2 – Service flow pattern 1

In this service flow pattern, all devices such as smart phone, tablet, PC and gateway are connected through peer-to-peer home network, and they only operate in the home network domain. These connections can be supported by Ethernet, MoCA, [ITU-T G.9960] WLAN, Bluetooth and other related technologies.

As shown in Figure 6-2, the multi-screen service is implemented by the media centre as well as by other devices with a "server-client" structure. The media centre operates as the server and the other devices as the client and each device can be assigned a server/media centre. The device assigned a server/media centre provides offline audio and video contents in different formats, as required by the other devices. The devices assigned a client will get the corresponding contents in the appropriate format.

The interaction messages and data flows are all transmitted in the home network domain.

This home network sharing mode has been studied, and related specifications are on schedule by the consumer electronics standards associations.

2.2.2 Service flow pattern 2

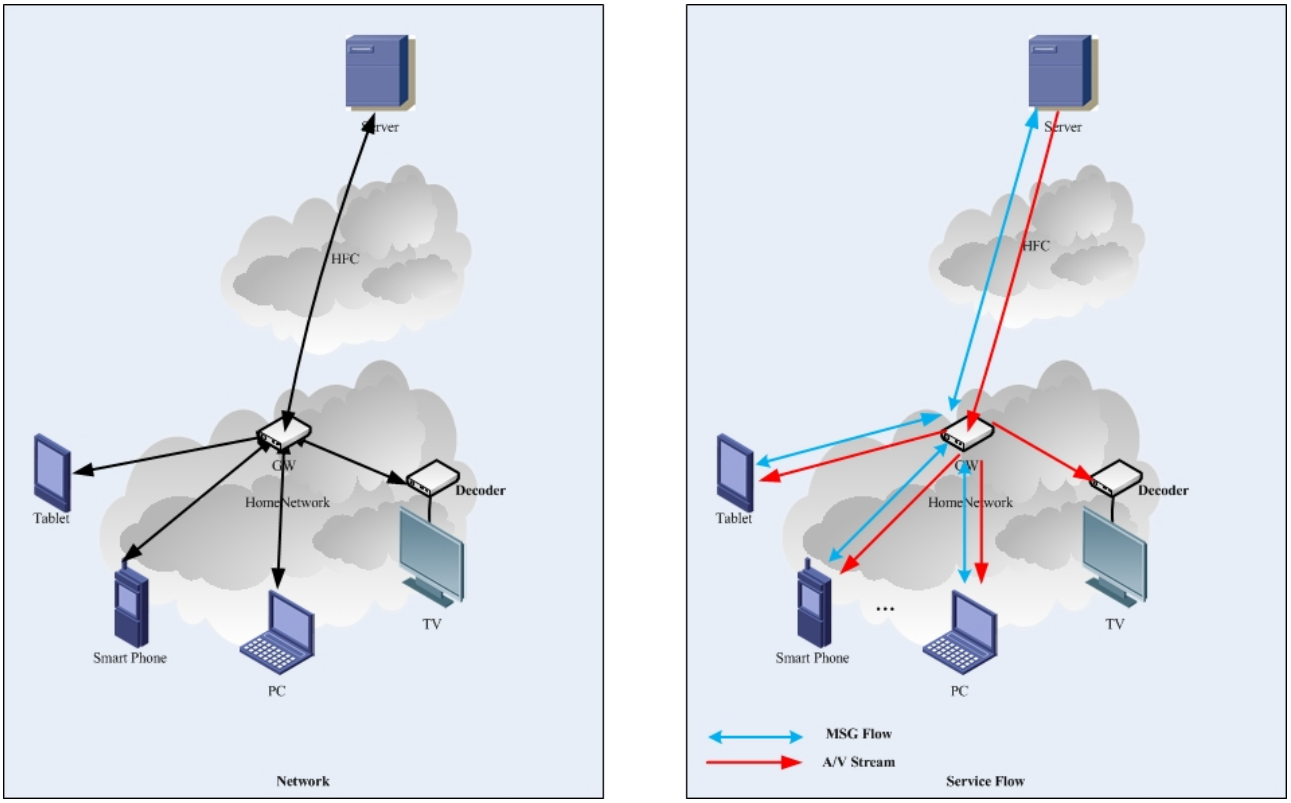


Figure 6-3 – Service flow pattern 2

In this service flow pattern, each device is connected to the home gateway through the home network. The home gateway is connected to the service platform through the HFC network. All other devices operate in the home network domain.

As shown in Figure 6-3, the gateway operates as a message relay point, through which the interaction messages are transmitted between the terminal devices and the remote service server. The remote service server interprets the received messages and provides real-time audio and video contents in different formats matching the device requirements. The devices can get the corresponding contents in the appropriate format through the gateway.

2.2.3 Service flow pattern 3

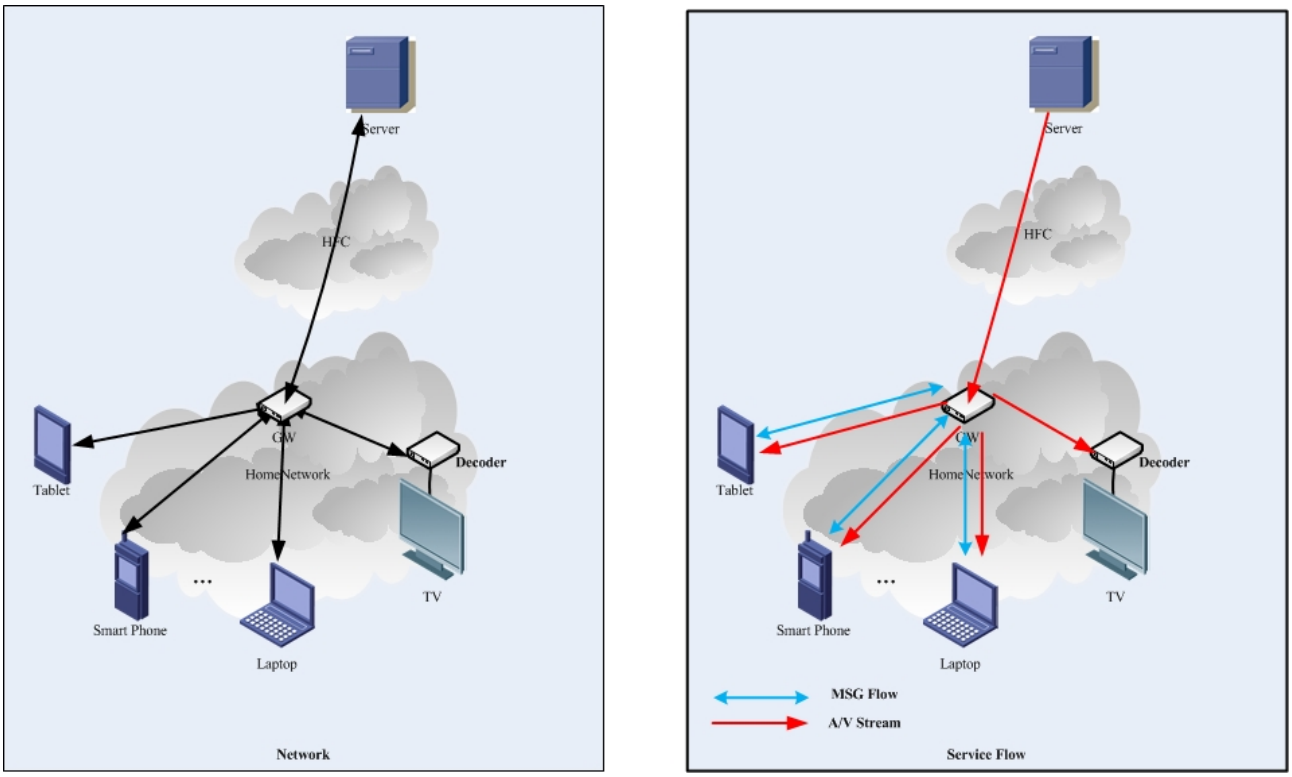


Figure 6-4 – Service flow pattern 3

In this service flow pattern, each device is connected to the home gateway through the home network. The home gateway is connected to the service platform through the HFC network, which may be a one-way or interactive network. All other devices work in the home network domain.

As shown in Figure 6-4, the gateway works as virtual service provider, and the interaction messages are transmitted within the home network domain. To launch a multi-screen service between the devices, the devices communicate with the gateway. The gateway interprets the received messages, transcodes the corresponding contents in real time, and delivers the output to the specific device.

2.2.4 Service flow pattern 4

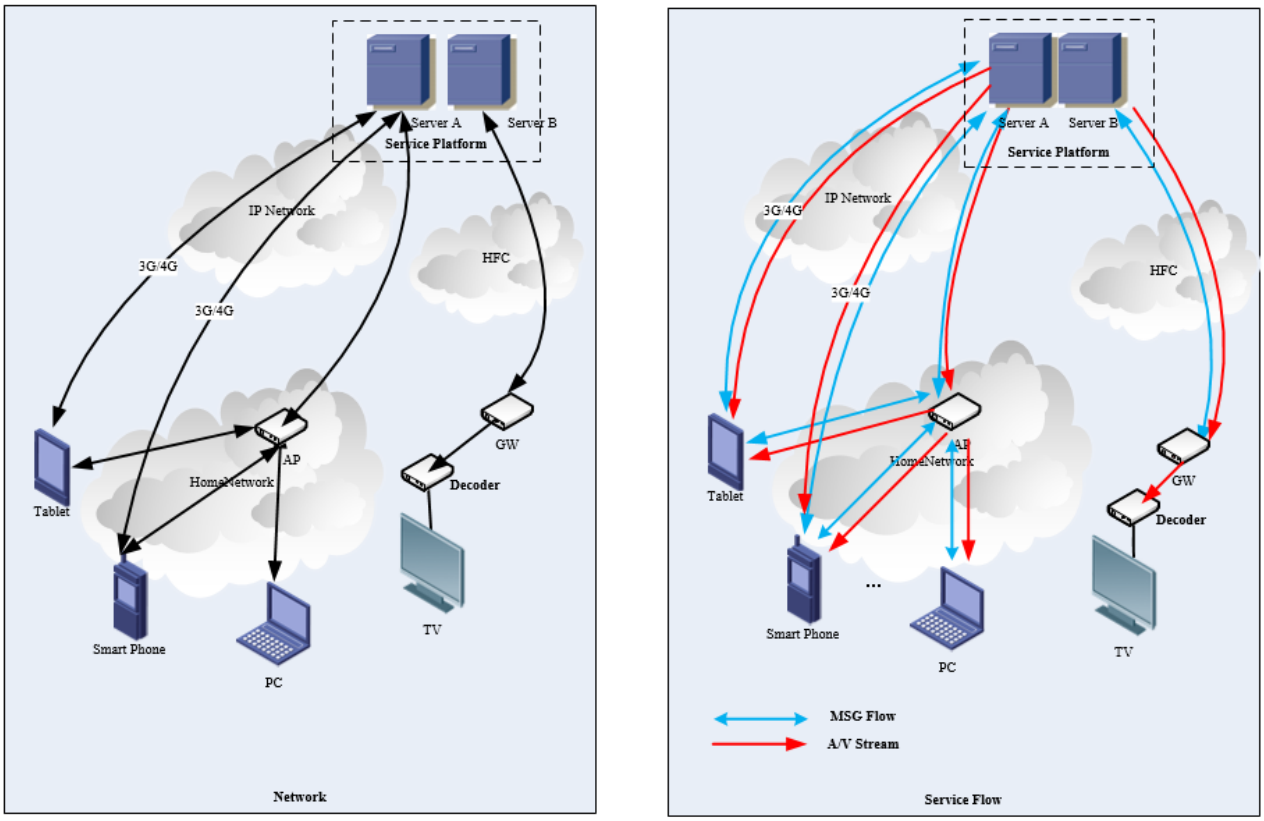


Figure 6-5 – Service flow pattern 4

In this service flow pattern, the gateway (Type I device) is connected with the remote service server through the HFC network. All other devices such as the tablet, the smart phone and PC (Type II devices) are connected to the IP network through the home network access point (AP), and devices such as the smart phone and the tablet could also be connected to the IP network through 3G/4G networks.

The mechanism for multi-screen service between Type II devices is similar to service flow pattern 2. For the multi-screen service between Type I devices and Type II devices, the remote service server interprets the received messages, completes message and service mapping, and provides service content matching device requirements. One example for this pattern is OTT service.

2.3 Applications based on service modes and service flow patterns

1. According to 1.7.4 of Chapter 1, which shows a high-level architecture of STB-tablet cooperative service, the service is based on service mode 3 and service flow pattern 1 (See clauses 2.1 and 2.2.1). If a user wants to play cards with remote players, service flow pattern 2 should be added in this application scenario.
2. In Appendix I, a UI adaptation example service based on service mode 3 and service flow pattern 1 is shown, this could help users adjust their screens configurations very conveniently.
3. In Appendix II, an example of multi-screen service architecture, which is based on service mode 2 and service flow pattern 2, the customer may send a request from mobile devices and get the corresponding service on the TV screen.

In conclusion, many combinations, based on these four service flow patterns, are possible to realize a multi-screen service.

3 Functional module analysis

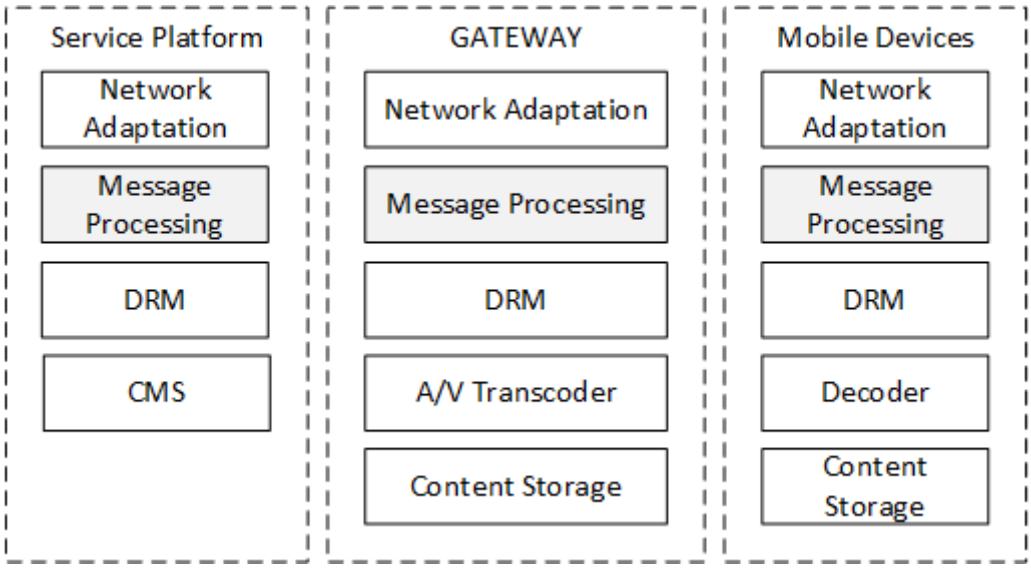


Figure 6-6 – Functional modules

From head-end to terminals, a multi-screen service needs the functional modules mentioned in Figure 6-6.

- Network adaptation can connect devices based on different network environments.
- Message processing can parse and deal with multi-screen requests, service control instructions and result messages.
- DRM is for digital rights management.
- CMS is content management system, which is responsible for content management, multi-screen content integration and pre-processing.
- A/V transcoder operates in the gateway to complete real-time audio and video content transcoding.
- In content storage, there is space to save audio and video contents.

According to the four mentioned service flow patterns, message processing is the fundamental function for the gateway. In addition, the gateway has other functions. According to the different mentioned patterns, different functional module combinations are needed.

For service flow pattern 1, the gateway has a storage functional module and can adapt different mobile device requests, and provide or transmit proper contents to achieve a multi-screen service.

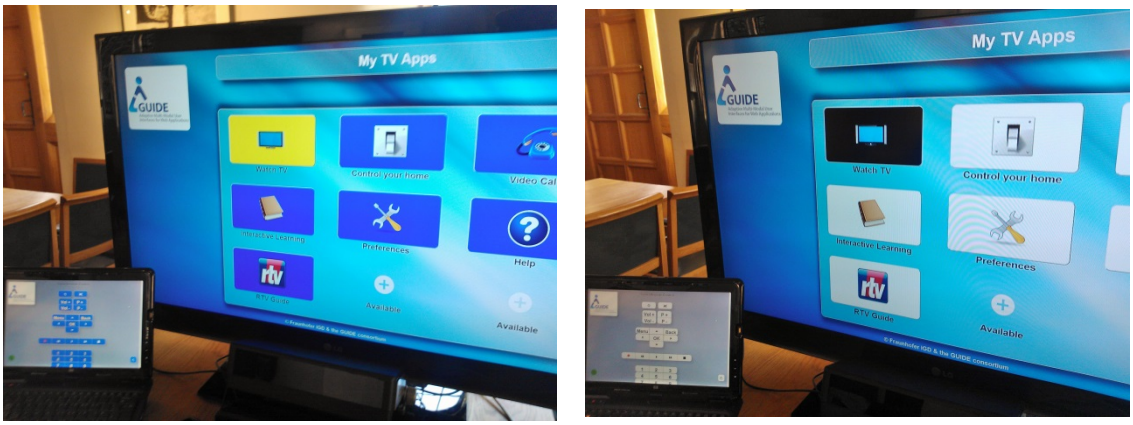
For service flow pattern 2, the gateway deals with mobile device request messages, and obtains the appropriate contents transcoded from the service platform to match the different requests.

For service flow pattern 3, the gateway needs audio and video transcode module. Depending on the different request messages from different mobile devices, the gateway can provide the same content in proper formats to fit them.

For service flow pattern 4, the gateway only needs fundamental functions – transmitting messages and media contents to the decoder device, which can display the appropriate contents on the TV screen.

Appendix I
User centred design in EU GUIDE project for multi-screen services

Smart TV systems offer a plethora of new applications for users who often need to customize interfaces and interaction to the needs and preferences of individual users. WG1 deliverable on use cases already presents a list of diverse applications on smart TV. Interface personalization becomes more important for second screen devices. The typical one-to-many interaction paradigm of a television is different for a tablet or smartphone as these devices are designed for a one-to-one interaction paradigm. Chapter 6 already addressed ways to synchronize the main screen content with the second screen content. Appendix I proposes to extend this synchronization to interface adaptation as well. For example, if the font size or colour contrast of the main screen is adjusted, a similar setting should be propagated to the second screen as well. For example, if a user wants a bigger font size due to short sightedness or wants a high contrast display for colour blindness, similar settings should be automatically applied to the second screen device and vice versa. Figure I.1 below shows an example of such synchronous adaptation performed in the EU GUIDE system (www.guide-project.eu).



Blue-yellow contrast **Black-white contrast and bigger fonts**

Figure I.1 – Propagation of adaption to second screen

Figure I.1 demonstrates how the font size and colour contrast is synchronously maintained on both screens through a user model. WG4 deliverable on user interfaces presents a user profile that can be stored on a cloud and can be used to provide automatic adaptation to both the main and second screen.

Appendix II
Example of multi-screen service architecture

The system architecture for a multiple screen application platform would be the service delivery platform type. This system is called the video cloud system, which is designed in an open architecture to convergence all kinds of video service infrastructures to the customers. The core module is a unified message system, a service coordination support system, a device management system, a personal search engine, and smart recommendation plug-ins. All multiple screen applications will deploy and run over these systems.

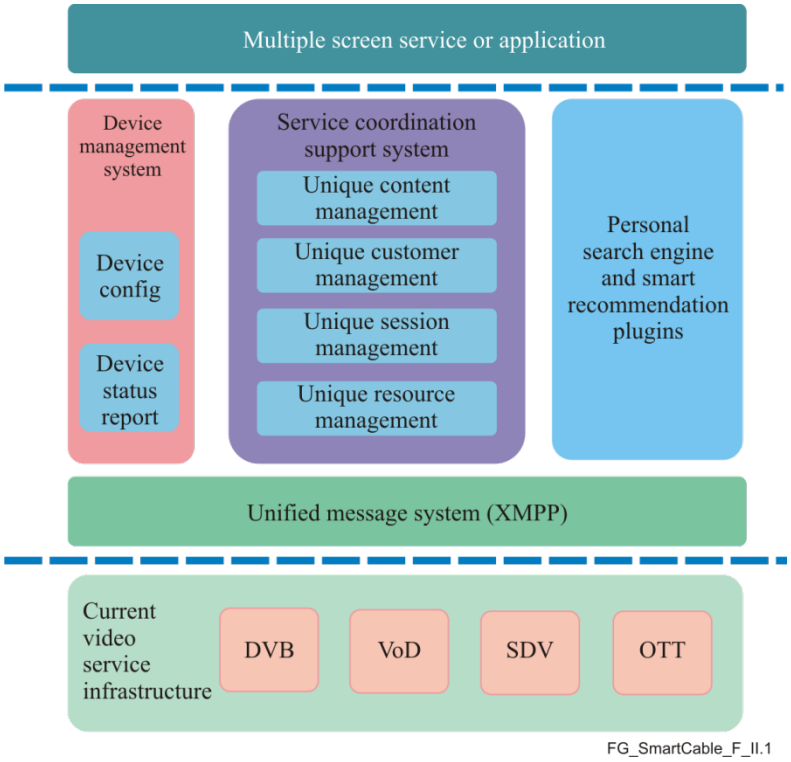


Figure II.1 – System architecture of a multiple screen application platform

The lower level of the video cloud system are the current video service infrastructures, such as the DVB live broadcast system, the video on demand system, the switched digital video (SDV) system, and over-the-top video system. All these infrastructures will run correspondingly, but the customer will not know where the video stream is coming from. All resources will converge on the video cloud system. Then the video cloud system will select the suitable video service path for best QoS and quality of experience (QoE).

II.1 Unified message system

The unified message system will build on the XMPP protocol. XMPP is a common international message protocol. It is supported by many devices such as Android phone, Apple iPhone and iPad. For legacy STBs and XMPP, the gateway should translate the proprietary message to the XMPP code so that the multiple screen applications can be deployed at these boxes.

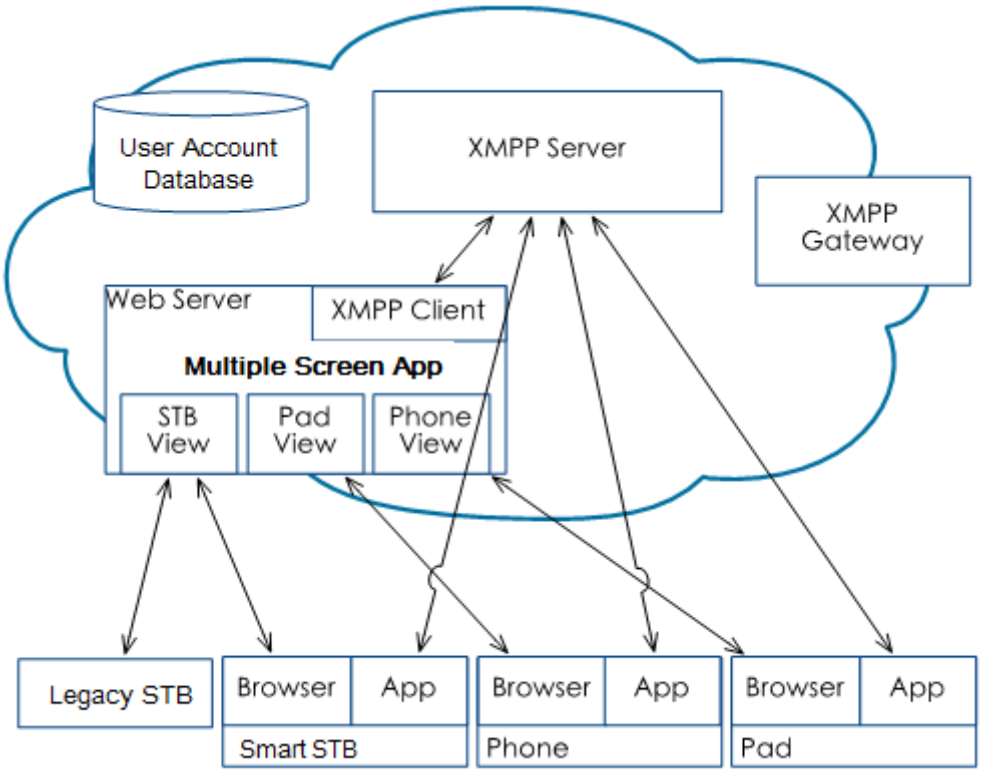


Figure II.2 – Unified message system model based on XMPP

II.2 Service-coordination-support system

A service-coordination-support system just focuses on a unique content management, a unique customer management, a unique resource management, and a unique session management for the multiple-screen.

The unique content management means that when the content comes into the video cloud system, it will automatically fit for multiple devices, such as video format, bit-rate, resolution and content metadata. As a result, the customer can have a seamless watching experience between devices for the same content.

The unique customer management means that whatever service the customer uses, the system should determine one person for device type, the consumed product, the access network, so that whenever they open the screen, the system can provide undifferentiated user interface for best experience.

The unique resource management means that the system can manage the right way to transport video stream to the customer for best quality of service and experience. For example, when a network is free, high resolution video can be pushed to the customer However, when the network is busy at night, only the customer who paid a fee can get high quality video, and those trail users just get the general quality so that they can continue to watch the video.

The unique session management means that the video cloud system will know any viewing breakpoint information to any content by gathering the session history data, so that any user can play content from last exiting time if this user want to push this content to another device. The unique session management also controls the stream allocation based on the unique resource management policy so that most of the network bandwidth is saved for high priority users.

II.3 Device management system

The device management system can gather device information and running status for all kinds of devices, and it also includes the configuration to devices. It includes two kinds of interfaces.

II.3.1 Device configuration interface

The device configuration interface will use the XMPP protocol. After the device receives the command, it needs to execute it immediately.

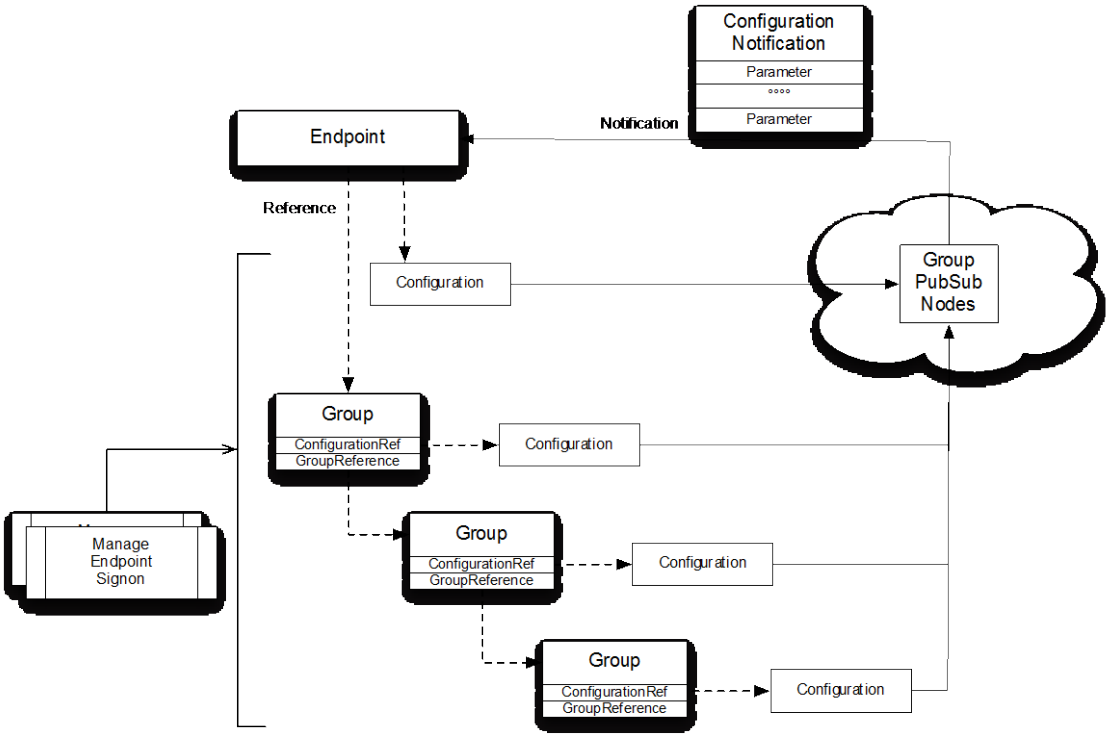


Figure II.3 – Device configuration interface

II.3.2 Information report interface

The information report interface can be running over XMPP or TR-069 protocol. The main task is to gather the report data sent from devices periodically so that the video cloud system can carry out a detailed analysis or prevent failure before it happens.

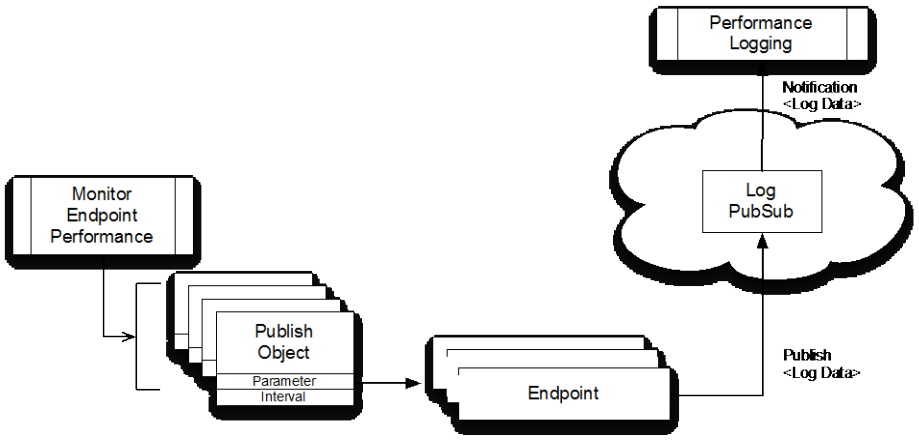


Figure II.4 – Device information report interface

II.4 Personal search engine and smart recommendation plug-ins

The personal search engine and the smart recommendation module are plug-ins that have been installed over the video cloud system. This means that these plug-ins can be easily deployed and updated. Without these plug-ins, the video cloud system can also provide common service to everyone, but if these plug-ins are installed and running, a personal portal menu for individual customers can be provided. Customers can also see the optimized search result based on their private interest so that cable MSO can continue to provide personal content and service recommendation under a multiple-screen environment.

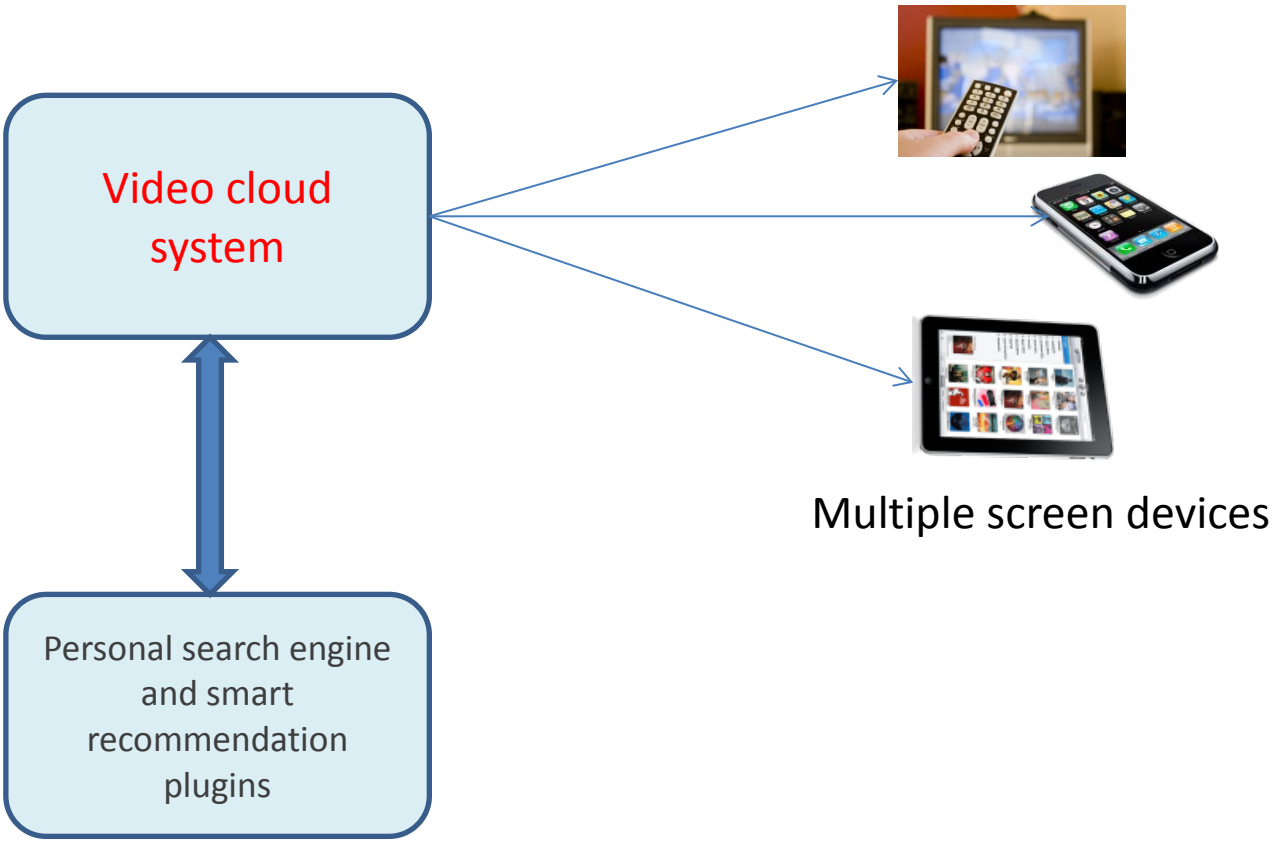


Figure II.5 – System model of personal search engine and smart recommendation plug-ins

Appendix III
Living list of SmartCable pertinent organizations

III.1 International Organizations

ITU-T SG9

ITU-T FG DR&NRR, for preferential telecommunication over cable

ITU-T FG AVA, for adaptive user interface for persons with disabilities

ITU-R SG6

IEC TC 100 TA5

ISO/IEC JTC1/SC 29

III.2 National and Regional SDOs, Forums, Consortia

ANATEL

ATIS

ATSC

CableLabs

CCSA (China Communications Standards Association)

CENELEC TC 209

Consumer Electronics Association (USA)

Digital Video Broadcasting Project (DVB)

ETSI TC-CABLE

GISFI

HbbTV

Japan Cable Laboratory

JCTEA

KLabs

SARFT National TC 239

SCTE

SMPTE

TTA

Appendix IV
Terms and definitions

IV.1 Terms defined elsewhere

This FG Technical Report uses the following definitions defined elsewhere:

IV.1.1 access network [ITU-T K.44]: That part of the overall telecommunication network that is located between a telecommunication centre and the customer premises building. (Chapter 2)

IV.1.2 assistive technology device [ITU-T V.254]: Device used by a person with disabilities to prevent, compensate, relieve or neutralize any resulting handicap and that has the ability to interface to an ICT device.

NOTE – The term "external device" is used for either a mobile external device or an assistive technology device. (Chapter 5)

IV.1.3 closed captioning [ITU-T J.193]: Text scrolling on a television display that represents the audio portion of the program, typically provided for the hearing impaired. (Chapter 5)

IV.1.4 conditional access system [ITU-T X.1193]: A component of a service and content protection system, the purpose of which is to prevent unauthorized (unentitled) access to a service or to content. (Chapter 1)

IV.1.5 context modelling [ITU-T T.87]: Procedure estimating a probability distribution of prediction error from the context. (Chapter 5)

IV.1.6 denial-of-service (DoS) attacks [ITU-T J.191]: Denial-of-service attacks can occur when a 3rd party entity (attacker, disgruntled customer, etc.) disrupts the normal communication and delivery of services between operators and their subscribers. Offending data transmissions coming from what appears to be a valid device/source could be injected into the home network and severely degrade its normal functions. These offending data transmissions could also extend to the operator's HFC network causing performance problems there. (Chapter 2)

IV.1.7 digital rights management [ITU-T X.1193]: A synonym for service and content protection or content protection, depending upon the context of use. (Chapter 1)

IV.1.8 disability [ITU-T E.135]: Any restriction or lack, resulting from impairment of ability to perform an activity in the manner or within the range considered normal for a human being.

In this context, we are concerned with the term as it is used in the in the Convention on the Rights of Persons with Disabilities (CRPD).

> "The Convention marks a 'paradigm shift' in attitudes and approaches to persons with disabilities. It takes to a new height the movement from viewing persons with disabilities as 'objects' of charity, medical treatment and social protection towards viewing persons with disabilities as 'subjects' with rights, who are capable of claiming those rights and making decisions for their lives based on their free and informed consent as well as being active members of society.
>
> "The Convention is intended as a human rights instrument with an explicit, social development dimension. It adopts a broad categorization of persons with disabilities and reaffirms that all persons with all types of disabilities must enjoy all human rights and fundamental freedoms. It clarifies and qualifies how all categories of rights apply to persons with disabilities and identifies areas where adaptations have to be made for persons with disabilities to effectively exercise their rights and areas where their rights have been violated and where protection of rights must be reinforced"[1].

[1] CRPD introduction on the UN website: http://www.un.org/disabilities/default.asp?navid=13&pid=150

> "Discrimination on the basis of disability' in the *Convention on the Rights of Persons with Disabilities* means any distinction, exclusion or restriction on the basis of disability which has the purpose or effect of impairing or nullifying the recognition, enjoyment or exercise, on an equal basis with others, of all human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field. It includes all forms of discrimination, including denial of reasonable accommodation".[2] (Chapter 5)

IV.1.9 electronic programme guide [ITU-T J.90]: A structured multimedia database, intended to provide information on programmes to be broadcast or cablecast. (Chapters 1, 5)

IV.1.10 home network [ITU-T J.190]: Short-range communications system designed for the residential environment, in which two or more devices exchange information under some sort of standard control. (Chapter 2)

IV.1.11 hybrid cable set-top box (STB) [ITU-T J.295]: An STB that satisfies the requirements defined in this Recommendation. (Chapter 2)

IV.1.12 impairment [ITU-T E.135]: Any loss or abnormality of psychological, physiological, or anatomical structure or function. (Chapter 5)

IV.1.13 integrated broadcast and broadband (IBB) applications [ITU-T J.205]: An Application that is meant to be handled and executed within an integrated broadcast and broadband (IBB) application control framework defined by this Recommendation. Such applications can have their application contents delivered using different application component delivery mechanisms. (Chapter 2)

IV.1.14 integrated broadcast and broadband (IBB) DTV service [ITU-T J.205]: A service that simultaneously provides an integrated experience of broadcasting and interactivity relating to media content, data and applications from multiple sources, where the interactivity is sometimes associated with broadcasting programmes. (Chapter 1)

IV.1.15 linear television (linear TV) [ITU-T Y.1910]: Also known as linear broadcast. A television service in which a continuous stream flows in real time from the service provider to the terminal device and where the user cannot control the temporal order in which contents are viewed. (Chapter 1)

IV.1.16 pay-per-view [ITU-T J.93]: A payment system whereby the subscriber can pay for an individual program or specified period of time. (Chapter 1)

IV.1.17 persistent storage [ITU-T J.200]: Memory available that can be read/written to by an application and may outlive the application's own life. Persistent storage may be volatile or non-volatile. (Chapter 2)

IV.1.18 residential gateway [ITU-T J.294]: A grouping of logical elements used to achieve access for home network(s). (Chapter 1)

IV.1.19 service provider [ITU-T M.1400]: A general reference to an operator that provides telecommunication services to customers and other users, either on a tariff or contract basis. A service provider may or may not operate a network. A service provider may or may not be a customer of another service provider. (Chapter 2)

IV.1.20 stakeholder [ITU-T Z.600]: A party that holds a business interest or concern in the telecommunications business. A stakeholder owns one or more business administrative domains.

NOTE – Within the discussion of FG AVA, a stakeholder is a person, group, organization, or system who affects or can be affected by an organization's actions. In the case of audiovisual media accessibility, the

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[2] CRPD Article 2: http://www.un.org/disabilities/default.asp?id=262

stakeholders are all those who have an impact on, or are influenced by the planning, production, exchange, delivery, use and enjoyment of audiovisual content. The FG AVA has focused on multi-stakeholder processes (non-normative ITU term). (Chapter 5)

IV.1.21 telecommunications accessibility [ITU-T F.790]: This is also known as accessibility. For the telecommunications area, the usability of a product, service, environment or facility by the widest possible range of users and especially users with disabilities. (Chapters 2, 5)

IV.1.22 video on demand [ITU-T Y.1910]: A service in which the end user can, on demand, select and view video content and where the end user can control the temporal order in which the video content is viewed (e.g., the ability to start the viewing, pause, fast forward, rewind, etc.). (Chapter 1)

IV.1.23 wide area network [ITU-T H.322]: A communication network which covers a wide geographical area and accommodates terminals and local area networks (LANs). (Chapter 2)

IV.2 Terms defined in this FG Technical Report

This FG Technical Report uses the following terms:

IV.2.1 access point: The customer device that provides the functionality required to connect the home network to the Internet protocol (IP) network provided by other Internet service provider (ISP) except cable operators. (Chapter 6)

IV.2.2 accessibility: See telecommunications accessibility in clause IV.1.22. (Chapters 2, 5)

IV.2.3 Action on Hearing Loss, previously known as **The Royal National Institute for Deaf People (RNID)** is a charitable organization working on behalf of the UK's 9 million people who are deaf or have hearing loss. (Chapter 5)

IV.2.4 adaptable user interfaces: Adaptable user interfaces are those which can be modified by one (or more) deliberate and conscious choice and action by the user. (Chapter 5)

IV.2.5 adaptive hypertext transfer protocol (HTTP) streaming: A technique used in streaming multimedia over hypertext transfer protocol (HTTP) networks. It works by detecting a user's bandwidth and central processing unit (CPU) capacity in real time and adjusting the quality of a video stream accordingly. It requires the use of an encoder which can encode a single source video at multiple bit rates. The player client switches between streaming the different encodings depending on available resources. This technique would result in very little buffering, fast start time and a good experience for both high-end and low-end connections. (Chapter 1)

IV.2.6 adaptive user interfaces: A user interface is adaptive if the interface can adapt its appearance and/or interaction behaviour to an individual user according to a user profile, device or context characteristic. (Chapter 5)

IV.2.7 agent service: A software module to provide common application programming interfaces (APIs) and their functional implementations for inter-device communication, e.g., between a set-top box and a tablet, running in each device in the background. (Chapter 2)

IV.2.8 application model: An application model is a representation of the states, transitions and functions of the application. (Chapter 5)

IV.2.9 assistive technology (AT): AT is an umbrella term that includes assistive, adaptive, and rehabilitative devices for persons with disabilities. It also includes the process used in selecting, locating, and using them. AT promotes greater independence by enabling people to perform tasks that they were formerly unable to accomplish, or had great difficulty accomplishing, by providing enhancements to or changed methods of interacting with the technology needed to accomplish such tasks. It provides “indirect access”, whereas *Universal Design* provides “direct access”. (Chapter 5)

IV.2.10 audio description: This is also known as "video description" and "described video". Additional audible narrative, interleaved with the dialogue, which describes the significant aspects of the visual content of audiovisual media that cannot be understood from the main sound track alone[3]. Audio description is the verbal depiction of key visual elements in media and live productions. The presentation of any description of media involves the interspersion of these depictions with the programme's original audio[4]. (Chapter 5)

IV.2.11 audiovisual content: These are all kinds of time-based content consisting of images and sounds. (Chapter 5)

IV.2.12 audiovisual media: Audiovisual media has several connotations, including audiovisual content and the distribution networks and storage media used to get the content from those who make it to those who want to use it. A distinction is often made between a *linear* audiovisual media service (audiovisual media service provided by a media service provider for simultaneous viewing of programmes on the basis of a programme schedule) and an *on-demand* audiovisual media service (i.e., a non-linear audiovisual media service) provided by a media service provider for the viewing of programmes at the moment chosen by the users and at their individual request on the basis of a catalogue of programmes selected by the media service provider)[5]. (Chapter 5)

IV.2.13 augmentation region: Targeted area to augment any object or region in a television (TV) scene. It provides the parameters of a static or animated 2D region related to natural media. (Chapter 4)

IV.2.14 augmented broadcasting: Broadcasting service to realize the mixed content such as a mobile's augmented reality (AR) service at targeted positions in real time on receiving terminals such as TV or set-top box. (Chapter 4)

IV.2.15 augmented broadcasting provider: An entity allowed to developing and providing augmented broadcasting service as a broadcast provider. (Chapter 4)

IV.2.16 augmented content: Added object to augmented region. It can be assets such as 2D image, 3D animated model, or audio/video. (Chapter 4)

IV.2.17 augmented reality (AR): A mixed reality where graphical elements are integrated with real-world video in order to enhance user experience and enrich information. (Chapters 1, 4)

IV.2.18 bandwidth cap: This is also known as a band cap. It limits the transfer of a specified amount of data over a period of time. Internet service providers commonly apply a cap when a channel intended to be shared by many users becomes overloaded, or may be overloaded, by a few users. (Chapter 2)

IV.2.19 cable network: An abbreviated form of cable television network. (Chapter 2)

IV.2.20 captioning (North America): This is also known as "same language subtitling", "intra-lingual subtitling" and "subtitling for the deaf and hard-of-hearing" in Europe. Subtitling in North America is restricted to foreign language programs. This is the equivalent of "foreign language subtitling" or "inter-lingual subtitling" in Europe. Captioning is the process of converting the audio content of a television broadcast, webcast, film, video, compact disk read-only memory (CD-ROM), digital versatile disk (DVD), live event, or other productions into text and displaying the

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[3] From Terms and Definitions Database Interactive (TEDDI), ETSI. http://webapp.etsi.org/Teddi/

[4] Based on definition in the Description Key, the Described and Captioned Media Program. http://www.dcmp.org/descriptionkey/

[5] From Terms and Definitions Database Interactive (TEDDI), ETSI. http://webapp.etsi.org/Teddi/

text on a screen or monitor. Captions not only display words as the textual equivalent of spoken dialogue or narration, but they may include speaker identification, sound effects, and music description. Captioning aims to include as much of the original language as possible. However, altering the original transcription may be necessary to provide time for the caption to be read and for it to be in synchronization with the audio[6].

Captioning may be presented as text or, in the case of foreign-language dialogue, read aloud in the form of *Audio Captioning* (North America) also known as *"Spoken"* or *"Audio Subtitles"* in Europe. The service may be something the viewer has to select (*Closed Captioning*) or may be an integral part of the image (*Open Captioning*). Where possible, *Intra-lingual Captioning* is *pre-prepared*. When produced live, this is done using some kind of *Stenography*, *Re-speaking* or, in certain limited content domains such as the weather, it is done directly with speech recognition. (Chapter 5)

IV.2.21 captioning, audio: This is also known as audio subtitles or spoken subtitles. Audio content of an audiovisual work or sequence in a foreign language is converted into captions or subtitles in the target language. These *inter-lingual captions* are then read aloud. This may be done at the source or in the user's device using *speech synthesis*. (Chapter 5)

IV.2.22 content provider: An entity allowed to developing and providing the augmented content. (Chapter 4)

IV.2.23 Control, Remote: It is also known as a remote, controller or sometimes channel changer. It is an electronic device used for the remote operation of a machine (television set, set-top box or PVR) often over very short distances within the home. The design of such devices needs to consider their usability and accessibility. Blind and partially sighted persons and those with other disabilities often encounter difficulties with remote controls that render them inaccessible. (Chapter 5)

IV.2.24 decoder: An embodiment of a decoding process, and optionally a colour transformation process. (Chapter 6)

IV.2.25 device model and profile: A device model is a formal machine-readable representation of the features and capabilities of one or several physical components involved in user interaction. A device profile is an instantiation of a device model representing either a specific real device or a stereotype of devices. (Chapter 5)

IV.2.26 environmental model and profile: An environmental model is a set of characteristics used to describe the environment where the user machine interaction is taking place. It includes all required contextual characteristics besides the user model, the interaction model, the device model, the product and related user tasks. An environmental profile is an instantiation of an environmental model representing either a specific real environment or a stereotype of environments. (Chapter 5)

IV.2.27 European Blind Union (EBU): It is a non-governmental, non-profit-making European organization founded in 1984. One of the six regional bodies of the World Blind Union, it is the only continent-wide organization representing the interests of blind and partially-sighted people in Europe. EBU aims to protect and promote the interests of all blind and partially-sighted people in Europe. (Chapter 5)

IV.2.28 European Broadcasting Union (EBU): It is the largest association of national broadcasters in the world. It has 74 Active Members, from 56 countries in and around Europe, and 36 Associate Members around the world. The association promotes cooperation between

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6 Based on definition in the Caption Key, the Described and Captioned Media Program. http://www.dcmp.org/captioningkey/

broadcasters and facilitates the exchange of audiovisual content. EBU works to ensure that the crucial role of public service broadcasters is recognized and taken into consideration by decision-makers. (Chapter 5)

IV.2.29 European Telecommunications Standards Institute (ETSI): ETSI produces globally-applicable standards for information and communication technologies (ICTs), including fixed, mobile, radio, converged, broadcast and internet technologies. ETSI is officially recognized by the European Union as a European Standards Organization. ETSI is a not-for-profit organization with more than 700 ETSI member organizations drawn from 62 countries across five continents world-wide. (Chapter 5)

IV.2.30 Federal Communications Commission (**FCC)**: FCC is an independent United States government agency. FCC was established by the Communications Act of 1934 and is charged with regulating interstate and international communications by radio, television, wire, satellite and cable. The FCC's jurisdiction covers the 50 states, the District of Columbia, and U.S. possessions. (Chapter 5)

IV.2.31 functional impairment: It refers to "a person's loss of functional capacity. Functional capacity is the ability or capability of an organ or system to perform its specified function. The existence of a medical condition /…/does not necessarily restrict functional capacity[7]". The UN definition is "Any loss or abnormality of psychological or anatomical structure or function". There is a good introduction to four different historical and social models of disability by Deborah Kaplan, Director of the World Institute on Disability[8]. (Chapter 5)

IV.2.32 gateway: A set of conceptual function modules including network adaptation, messages processing, digital rights management (DRM), audio and video (A/V) transcoder, and content storage. It is not a physical device but a functional definition in this FG Technical Report. (Chapter 6)

IV.2.33 home energy management: Planning and operation of energy-related production and consumption within a home. Objectives are resource conservation, climate protection and cost savings, while the users have permanent access to the energy they need. (Chapter 1)

IV.2.34 host network: A network originating content. (Chapter 2)

IV.2.35 hybrid broadcast broadband TV (HbbTV): HbbTV is a standard building on work in the Open IPTV Forum aimed at harmonizing the broadcast and broadband delivery of entertainment to the end consumer through connected TVs and set-top boxes. (Chapter 5)

IV.2.36 integrated broadcast-broadband system (IBB)[9]: In a media scenario where convergent TV receivers are able to handle not only the broadcast signal but also applications delivered by broadband Internet protocol (IP) telecommunication services, there are opportunities to drive user engagement and to maximize the end-user's satisfaction by offering a range of new services. A system which enables to offer such services is called integrated broadcast-broadband (IBB) system. Two examples of this are the HbbTV and the HybridCast standards explained in detail in the ITU-R report. (Chapter 5)

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7 Guide to Social Security Law. Australian Government. http://www.fahcsia.gov.au/guides_acts/ssg/ssguide-1/ssguide-1.1/ssguide-1.1.f/ssguide-1.1.f.270.html

8 http://www.accessiblesociety.org/topics/demographics-identity/dkaplanpaper.htm

9 Integrated broadcast-broadband systems. BT Series. Broadcasting service (television). REPORT ITU-R BT.2267 August 2013, ITU. Geneva, Switzerland. http://www.itu.int/pub/R-REP-BT.2267-2013

IV.2.37 impairment, age-related: It is a collection of sensory and cognitive impairments. In the general sense, it covers matters such as the deterioration of sight and hearing, memory impairment or memory loss. In FG AVA, we look not only at persons who are elderly but also at the challenges facing children whose intellectual maturity has an impact on their ability to read subtitles. In principle, there can be other impairments that are related to stages in the person's life. (Chapter 5)

IV.2.38 impairment, cognitive: This affects the individual's ability to think, concentrate, formulate ideas, reason and remember[10]. (Chapter 5)

IV.2.39 impairment, dexterity: It is a reduced function of arms and hands that makes activities related to moving, turning or pressing objects difficult or impossible. This does not influence speech communication itself but makes it hard to make a phone call or use a wide range of other equipment[11]. (Chapter 5)

IV.2.40 impairment, hearing: This is a generic term including both deaf and hard-of-hearing which refers to persons with any type or degree of hearing loss that causes difficulty working in a traditional way. It can affect the whole range or only part of the auditory spectrum which, for speech perception, the important region is between 250 and 4'000 Hz.[12]. (Chapter 5)

IV.2.41 impairment, visual: Visual impairment (or vision impairment) is vision loss (of a person) to such a degree as to qualify as an additional support need through a significant limitation of visual capability resulting from either disease, trauma, or congenital or degenerative conditions that cannot be corrected by conventional means, such as refractive correction, medication, or surgery. The loss may cover visual acuity, significant central or peripheral field defects or reduced contrast sensitivity[13]. (Chapter 5)

IV.2.42 inclusive design: The design of mainstream products and/or services that are accessible to, and usable by, as many people as reasonably possible ... without the need for special adaptation or specialized design. It is usually a synonym of *Universal Design*. (Chapter 5)

IV.2.43 International Organization for Standardization (ISO): ISO is an international standard-setting body composed of representatives from various national standards organizations.

A few examples of National Organizations are as follows: (Chapter 5)

Organization	Initials	Country
Bureau of Indian Standards	BIS	India
Brazilian National Standards Organization	ABNT	Brazil
Spanish Association for Standardization and Certification	AENOR	Spain
French association for Standardization	AFNOR	France
American National Standards Institute	ANSI	U.S.
British Standards Institution	BSI	U.K.
Dirección General de Normas	DGN	Mexico

10 Industry Canada. Assistive technology links: http://www.apt.gc.ca/wat/wb14200e.asp?dId=4

11 Industry Canada. Assistive technology links: http://www.apt.gc.ca/wat/wb14200e.asp?dId=123

12 Industry Canada. Assistive technology links: http://www.apt.gc.ca/wat/wb14200e.asp?did=5

13 Based on http://en.wikipedia.org/wiki/Visual_impairment

Organization	Initials	Country
Deutsches Institut für Normung	DIN	Germany
Instituto Argentino de Normalización y Certificación	IRAM	Argentina
Bureau of Standards of Jamaica	BSJ	Jamaica
Colombian Institute of Technical Standards and Certification	ICONTEC	Colombia
Japanese Industrial Standards Committee	JISC	Japan
Korean Agency for Technology and Standards	KATS	Korea (Republic)
Nederlandse Norm	NEN	Netherlands
South African Bureau of Standards	SABS	South Africa
Standardization Administration of China	SAC	China
Standards Council of Canada	SCC	Canada
Swedish Standards Institute	SIS	Sweden
Finnish Standards Association	SFS	Finland
Standards Norway	SN	Norway
Swiss Association for Standardization	SNV	Switzerland
Standards New Zealand	SNZ	New Zealand
Ente Nazionale Italiano di Unificazione	UNI	Italy

IV.2.44 internet protocol television (IPTV): A system through which Internet television services are delivered using the architecture and networking methods of the Internet protocol suite over a packet-switched network infrastructure, e.g., the Internet and broadband Internet access networks. IPTV is distinguished from general Internet-based or web-based multimedia services by its ongoing standardization process[14]. (Chapter 5)

IV.2.45 key performance indicator (KPI): KPI is a measure of performance. KPIs are commonly used by an organization to evaluate its success or the success of a particular activity in which it is engaged against some declared metric or metrics[15]. (Chapter 5)

IV.2.46 mission critical application: An application whose failure will result in the failure of business operations. That is, it is an application critical to the organization's mission. (Chapter 2)

IV.2.47 multi-modal adaptive system: A system that is equipped with an adaptive user interface that can be re-configured based on user's characteristics. (Chapter 2)

IV.2.48 multi-modal interaction: An interaction between a user and a device through a user interface that is capable of multiple types of input and presentation methods, e.g., touch, voice, gesture, etc. (Chapter 2)

IV.2.49 over-the-top video: A type of the broadband video delivery without a multiple system operator being involved in the control or distribution of the content. The provider may be aware of the contents of the IP packets but is not responsible for, nor able to control, the viewing abilities, copyrights, and/or other redistribution of the content. (Chapter 1)

14 Based on http://en.wikipedia.org/wiki/Internet_Protocol_Television

15 Based on http://en.wikipedia.org/wiki/Performance_indicator

IV.2.50 persistent protected storage: A persistent storage that is capable of content protection. (Chapter 2)

IV.2.51 programme guide, on-screeen: As distinct from programme listings and guides on other platforms such as the web, mobile phones and in print media. (Chapter 5)

IV.2.52 remote network: A network to which a subscriber is connected. (Chapter 2)

IV.2.53 sensor information: Information collected or detected by a sensor device such as motion detector, thermostat, electric current sensor, water level detector, blood pressure sensor, etc. (Chapter 2)

IV.2.54 server certification: A certificate for a server system created and assigned by certification authority. (Chapter 2)

IV.2.55 set-top box (STB): A hardware box that contains digital signal demodulator, de-multiplexer, decoder, and other functionalities and interfaces related to digital signal reception and presentation of the distributed programme at the subscriber's site. (Chapter 5)

IV.2.56 sign language: A sign language (also signed language or simply visual signing) is a language which, instead of acoustically conveyed sound patterns, uses manual communication and body language to convey meaning. This can involve simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to fluidly express a speaker's thoughts. (Chapter 5)

IV.2.57 simulation: Simulation is the process that enables the interaction of the virtual user with the application model within an artificial environment. The simulation can be real time or offline. Real-time simulation can be performed autonomously or manually, where the operator can interact with the environment from a 1st- or 3rd-person perspective. Accessibility assessment and evaluation can be performed automatically or subjectively by the operator. (Chapter 5)

IV.2.58 smart cable television: Advanced services and technologies for cable networks. (Chapter 2)

IV.2.59 smart phone: It is a mobile phone that offers more advanced computing ability and connectivity than a contemporary feature phone. (Chapter 5)

IV.2.60 social media: The means of interactions among people in which they create, share, and/or exchange information and ideas in virtual communities and networks. (Chapter 1)

IV.2.61 software-defined networking (SDN) (for the cable environment): An approach to computer networking where the network hardware is configurable by software that enhances network resiliency and enables advanced future services more efficiently. SDN also allows network administrators to manage network services through abstraction of lower level functionality. The basic concept is to decouple the system that makes decisions about where traffic is sent (the control plane) from the underlying systems that forwards traffic to the selected destination (the data plane). (Chapter 2)

IV.2.62 subtitles, audio: see clause IV.2.21 *Captioning, Audio.* (Chapter 5)

IV.2.63 subtitles, spoken: see clause IV.2.21 *Captioning, Audio.* (Chapter 5)

IV.2.64 subtitling: see clause IV.2.20 *Captioning*. (Chapter 5)

IV.2.65 tablet or tablet PC: It is a device equipped with a touchscreen as the primary input device and designed for personal use. (Chapter 5)

IV.2.66 TV everywhere service: It Provides customers of multichannel video programming distributors (MVPDs) watching content on mobile devices such as a tablet as well as the

verification system that allows MVPDs to authenticate those who wish to use their video on demand services as actual paying customers of cable television. (Chapter 2)

IV.2.67 user agent: A user agent is any end user software (such as a browser, or other user interface component) that can retrieve and render application content and invoke requests to the user agent capabilities model to modify the application content. (Chapter 5)

IV.2.68 user agent capabilities model: A user agent capabilities model is a formal machine-readable representation of the capabilities of the user agent related to user interaction. (Chapter 5)

IV.2.69 user initialization application: An application to be presented the first time a user interacts with the system to provide tutorials on new ways of interaction and create user profiles. (Chapter 2)

IV.2.70 user interaction model: The user interaction model is a representation of the user interaction behaviour with an application. The user interaction model is maintained UI-agnostic, which means it is independent of the concrete format of user interface output and input data. User interaction model is often also referred to as abstract user interface model as it describes usually user interface objects which will be used for the presentation of the instances of navigation and instances of which will be used for the presentation of the access elements. They are called abstract because these descriptions are independent of the implementation of the real user interfaces. (Chapter 5)

IV.2.71 user interface (UI) adaptation: Configuring and/or modifying the user interface adaptively according to the user's characteristics. (Chapter 2)

IV.2.72 user interface design pattern: This is an approved user interface solution to a recurring design problem. User interface design has a formalized description. For the use in adaptive user interfaces, design patterns have a representation in form of reusable software components which can be put together to complete user interfaces during runtime. (Chapter 5)

IV.2.73 user model and profile: A user model is a set of user characteristics required to describe the user of a product. The characteristics are represented by variables. The user model is established by the declaration of these variables. It is formally described in a machine-readable and human-readable format. (Chapter 5)

A user profile is an instantiation of a user model representing either a specific real user or a representative set of real users.

IV.2.74 user model/profile validation: Validation is the process to determine whether the model is an appropriate representation of the user for a specific application. If being mathematical, it would require a statistical validation process. If the model is non-mathematical, then it could be validated through qualitative processes. The type, process and metrics of validation should be standardized. (Chapter 5)

IV.2.75 virtual instance (user, environment, device, etc.): A virtual instance is a representation of a user, environment, device, etc., based on a profile. The virtual instance exists in a computer memory during the run time of an application. (Chapter 5)

IV.2.76 World Wide Web Consortium (W3C): W3C is an international community that develops standards to ensure the long-term growth of the Web. (Chapter 5)

Appendix V
Abbreviations and acronyms

This FG Technical Report uses the following abbreviations and acronyms:

AAA Authentication, Authorization and Accounting (Chapter 3)
ABR Adaptive Bit Rate (Chapter 2)
AES Advanced Encryption Standard (Chapters 2, 4)
AP Access Point (Chapter 6)
API Application Programming Interface (Chapter 1)
AR Augmented Reality (Chapters 1, 4)
ARAF Augmented Reality Application Format (Chapter 4)
ASP Application Service Provider (Chapter 1)
ASR Automatic Speech Recognition (Chapter 2)
AT Assistive Technology (Chapter 1)
A/V Audio and Visual (Chapter 1)
BD Blue-ray Disc (Chapter 4)
BDP Blue-ray Disc Player (Chapter 4)
BDR Blue-ray Disc Recorder (Chapter 4)
CAS Conditional Access System (Chapter 1)
CATV Cable Television (Chapter 1)
CBC Cipher Block Chaining (Chapter 4)
CCAP Converged Cable Access Platform architecture (Chapter 3)
CD-ROM Compact Disk – Read-Only Memory (Chapter 1)
CE Consumer Electronics (Chapter 1)
CFF Common File Format (Chapter 4)
CGN Carrier Grade Network (Chapter 3)
CM Cable Modem (Chapter 3)
CMS Content Management System (Chapter 6)
CMTS Cable Modem Termination System (Chapter 3)
CPU Central Processing Unit (Chapter 1)
CRPD Convention on the Rights of Persons with Disabilities (Chapter 1)
CSS Cascading Style Sheets (Chapter 2)
CSV Comma-Separated Values (Chapter 2)
CW Control Word (Chapter 1)
DASH Dynamic Adaptive Streaming over HTTP (Chapter 4)

DHCP	Dynamic Host Configuration Protocol (Chapter 3)
DLNA	Digital Living Network Alliance (Chapters 1, 4)
DoS	Denial-of-Service (Chapter 1)
DPI	Deep Packet Inspection (Chapter 3)
DRM	Digital Rights Management (Chapters 1, 2, 4, 6)
DTCP	Digital Transmission Content Protection (Chapters 2, 4)
DTLA	Digital Transmission Licensing Administrator (Chapters 2, 4)
DVB	Digital Video Broadcasting (Chapters 1, 6)
DVD	Digital Versatile Disk (Chapters 1, 5)
DVR	Digital Video Recorder (Chapters 1, 5)
ECB	Electronic Code Book (Chapter 4)
ECC	Elliptic Curve Cryptography (Chapter 4)
EPG	Electronic Program Guide (Chapter 1)
EPON	Ethernet Passive Optical Network (Chapters 1, 3)
EQAM	Edge QAM (Chapter 3)
EV	Electric Vehicle (Chapters 1, 2)
EXIM	Export and Import (Chapter 4)
GUI	Graphical User Interface (Chapter 2)
GUIDE	Gentle User Interfaces for Disabled and Elderly citizens (Chapter 5)
GW	Gateway (Chapter 2)
HBB	Hybrid Broadcast and Broadband (Chapter 1)
HD	High Definition (Chapters 1, 2)
HDR	Hard Disc Recorder (Chapter 4)
HFC	Hybrid Fibre-Coax (Chapters 3, 6)
HGW	Home Gateway (Chapter 2)
HLS	HTTP Live Streaming (Chapter 4)
HN	Home Network (Chapter 1)
HTML	HyperText Markup Language (Chapter 1)
HTML5	HyperText Markup Language Version 5 (Chapter 5)
HTTP	HyperText Transfer Protocol (Chapter 1)
IBB	Integrated Broadcast and Broadband (Chapter 1)
ICT	Information and Communication Technology (Chapter 2)
ID	Identifier (Chapters 1, 2)
IP	Internet Protocol (Chapter 1)
IPTV	Internet Protocol Television (Chapter 1)

IPv6	Internet Protocol version 6 (Chapter 2)
ISP	Internet Service Provider (Chapters 3, 6)
KMS	Key Management Server (Chapter 4)
KPI	Key Performance Indicator (Chapter 1)
LAN	Local Area Network (Chapter 2)
MAC	Media Access Control (Chapters 1, 2, 3)
MoCA	Multimedia over Coax Alliance (Chapter 6)
MPEG	Moving Picture Experts Group (Chapter 2)
MSO	Multi-Service Operator (Chapter 6)
MTU	Maximum Transmission Unit (Chapter 2)
MVPD	Multimedia Video Programming Distributors (Chapter 1)
NFC	Near Field Communication (Chapter 2)
NfV	Network Function Virtualization (Chapter 3)
NSA	National Security Agency (Chapter 4)
OEM	Original Equipment Manufacturer (Chapter 1)
OMA	Open Mobile Alliance (Chapter 4)
ONU	Optical Network Unit (Chapter 3)
OS	Operating System (Chapters 1, 4)
OSGi	Open Services Gateway initiative (Chapter 1)
OTT	Over the Top (Chapters 1, 6)
PC	Personal Computer (Chapters 1, 4, 5, 6)
PCMM	PacketCable Multimedia (Chapter 3)
PCS	Power Conditioning System (Chapters 1, 2)
PHV	Plug-in Hybrid Vehicle (Chapters 1, 2)
PMIPv6	Proxy Mobile IPv6 (Chapter 2)
PON	Passive Optical Network (Chapter 3)
PPMQ	Pay-Per-Maximum-Quality (Chapter 1)
PPV	Pay–Per-View (Chapter 1)
PW	Password (Chapter 2)
QAM	Quadrature Amplitude Modulation (Chapter 3)
QoE	Quality of Experience (Chapter 6)
QoS	Quality of Service (Chapters 3, 6)
QVGA	Quarter Video Graphics Array (Chapter 1)
RC	Remote Control (Chapter 2)
RCU	Remote Control Unit (Chapter 2)

REK	Rights Encryption Key (Chapter 4)
RF	Radio Frequency (Chapter 3)
RFoG	RF over Glass (Chapter 1)
RGW	Residential Gateway (Chapter 1)
RSA	Ron Rivest, Adi Shamir, Leonard Adleman (Chapter 4)
SD	Standard Definition (Chapter 1)
SDN	Software-Defined Networking (Chapters 2, 3)
SDP	Service Delivery Platform (Chapter 2)
SDV	Switched Digital Video (Chapter 6)
SLA	Service Level Agreement (Chapter 2)
SNR	Signal-to-Noise Ratio (Chapter 5)
SNS	Social Networking Service (Chapter 1)
SP	Service Provider (Chapter 6)
SSID	Service Set Identifier (Chapter 2)
STB	Set-Top Box (Chapters 1, 2, 4, 5, 6)
TCP	Transmission Control Protocol (Chapter 2)
TMT	Trail Making Test (Chapter 5)
TS	Transport Stream (Chapter 2)
TV	TeleVision (Chapters 1, 2, 5)
UI	User Interface (Chapters 1, 2, 4)
UIA	User Initialization Application (Chapter 2)
URL	Uniform Resource Locator (Chapter 1)
USB	Universal Serial Bus (Chapter 2)
UTF	Universal Transformation Format (Chapter 2)
UX	User eXperience (Chapters 1, 4)
VoD	Video on Demand (Chapters 1, 6)
WAN	Wide Area Network (Chapter 2)
WDM	Wavelength Division Multiplex (Chapter 1)
WG	Working Group (Chapters 1, 5)
WiFi	Wireless Fidelity (Chapters 1, 2, 3)
WLAN	Wireless LAN (Chapters 1, 6)
XMPP	eXtensible Messaging and Presence Protocol (Chapters 1, 6)

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