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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS, NEXT-GENERATION NETWORKS, INTERNET OF THINGS AND SMART CITIES

ITU-T Y.2000-series – Device independent screen-free service models and scenarios

ITU-T Y-series Recommendations – Supplement 51

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Supplement 51 to ITU-T Y-series Recommendations

ITU-T Y.2000-series – Device independent screen-free service models and scenarios

Summary

Supplement 51 to ITU-T Y.2000-series Recommendations describes service models and scenarios for device independent screen-free service based on fixed mobile convergence (FMC). This Supplement uses the features defined in ITU-T Y-Sup.14, (Supplementary service scenarios for fixed-mobile convergence).

History

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ITU-T Y.2000-series – Device independent screen-free service models and scenarios

1 Scope

The objective of this Supplement is to describe the device independent screen-free service models and scenarios to provide high-quality media service using device independent screen-free services in server environments where the main programs are executed in the server and the client's role is displaying results only.

More specifically, this Supplement identifies service deployment models and service scenarios to support device independent screen-free services in the server environment.

The scope of this Supplement covers:

- the general overview for device independent screen-free service;
- device independent screen-free service model and its scenarios in the server environment;
- device independent screen-free service deployment models for FMC.

2 References

[ITU-T Q.1706] Recommendation ITU-T Q.1706/Y.2801 (2006), *Mobility management requirements for NGN*.

[ITU-T Q.1762] Recommendation ITU-T Q.1762/Y.2802 (2007), *Fixed-mobile convergence general requirements*.

[ITU-T Y.1901] Recommendation ITU-T Y.1901 (2009), *Requirements for the support of IPTV services*.

[ITU-T Y.1910] Recommendation ITU-T Y.1910 (2008), *IPTV functional architecture*.

[ITU-T Y.2001] Recommendation ITU-T Y.2001 (2004), *General overview of NGN*.

[ITU-T Y.2002] Recommendation ITU-T Y.2002 (2009), *Overview of ubiquitous networking and of its support in NGN*.

[ITU-T Y.2011] Recommendation ITU-T Y.2011 (2004), *General principles and general reference model for Next Generation Networks*.

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2010), *Functional requirements and architecture of the next generation networks*.

[ITU-T Y.4400] Recommendation ITU-T Y.4400/Y.2063 (2012), *Framework of the web of things*.

[ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.

[ITU-T Y-Sup.14] ITU-T Y-series Recommendations – Supplement 14 (2011), ITU-T Y.2000-series – *Supplementary service scenarios for fixed-mobile convergence*.

3 Definitions

3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

3.1.1 fixed mobile convergence [ITU-T Q.1762]: In a given network configuration, the capabilities that provide services and application to the end user defined in [ITU-T Y.2091] regardless of the fixed or mobile access technologies being used and independent of the user's location. In the NGN environment [ITU-T Y.2011], it means to provide NGN services to end users regardless of the fixed or mobile access technologies being used.

3.1.2 fixed network [ITU-T Q.1762]: A network that provides wire-based (e.g., copper, fibre) or wireless access to its services. The fixed network may support nomadism, but does not support mobility.

3.1.3 mobile network [ITU-T Q.1762]: A network that provides wireless access to its services and supports mobility.

3.1.4 client [ITU-T Y.4400]: The role adopted by an application when it is retrieving and/or rendering resources or resource manifestations.

3.1.5 device [ITU-T Y. 4400]: An apparatus through which a user can perceive and interact with the web.

NOTE – In the IoT, a piece of equipment with the mandatory capabilities of communication and the optional capabilities of sensing, actuation, data capture, data storage and data processing [ITU-T Y.2060].

3.1.6 resource [ITU-T Y. 4400]: The term "resource" is used in a general sense for whatever might be identified by a URI.

NOTE – Familiar examples include an electronic document, an image, a source of information with a consistent purpose (e.g., "today's weather report for Los Angeles"), a service (e.g., an HTTP-to-SMS gateway), and a collection of other resources. A resource is not necessarily accessible via the Internet; e.g., human beings, corporations, and bound books in a library can also be resources. Likewise, abstract concepts can be resources, such as the operators and operands of a mathematical equation, the types of a relationship (e.g., "parent" or "employee"), or numeric values (e.g., zero, one, and infinity).

3.1.7 server [ITU-T Y. 4400]: The role adopted by an application when it is supplying resources or resource manifestations.

3.2 Terms defined in this Supplement

This Supplement defines the following terms:

3.2.1 screen-free: Screen-free refers to the hardware (HW) and software (SW) capability for providing the same services regardless of the different size of screens and type of services.

3.2.2 thin-client: A lightweight computer that has been optimized for remote execution into a server-based computing environment. The server does most of the work, which can include launching software programs, crunching numbers, and storing data.

3.2.3 thick-client: A computer (client), in client–server architecture or networks that typically provides rich functionality independent of the central server.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

ACAP Application Configuration Access Protocol

AR Augmented Reality

ARPU	Average Revenue per User
DISF	Device Independent Screen-free
EPG	Electronic Program Guide
ES	Elementary Stream
FMC	Fixed Mobile Convergence
HW	Hardware
IPTV	Internet Protocol TV
MPEG2	Moving Picture Expert Group 2
MPEG4	Moving Picture Expert Group 4
OS	Operating system
SoC	System on a Chip
STB	Set Top Box
SW	Software
VoD	Video on Demand

5 Conventions

In this Supplement:

The keywords "is prohibited from" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Supplement is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

The keywords "is not recommended" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this Supplement can still be claimed even if this requirement is present.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option, and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Supplement.

6 Overview of device independent screen-free services

The recent technological development have changed customer preferences and customers want to use different kinds of devices and high-end services regardless of the type of devices. With the rapid dissemination of high-speed Internet and smart devices such as smart phone and pad, customers want to use high quality multimedia services in their device without any inconveniences.

As a result of the lack of device capability, it is problematic to deliver high quality services to small customer terminals or devices such as a smart screen on home appliances, a low-quality Internet protocol TV set top box (IPTV STB) and a digital cable TV, smart watches and small wearable devices. Even the smartphone cannot execute high quality service and high quality console game easily.

In order to provide high quality services to various terminals, the likelihood of the increase of price of the terminal is eminent; therefore, a method for solving such a problem is required.

This Supplement provides the method for solving this problem and suggests deployment models and service scenarios.

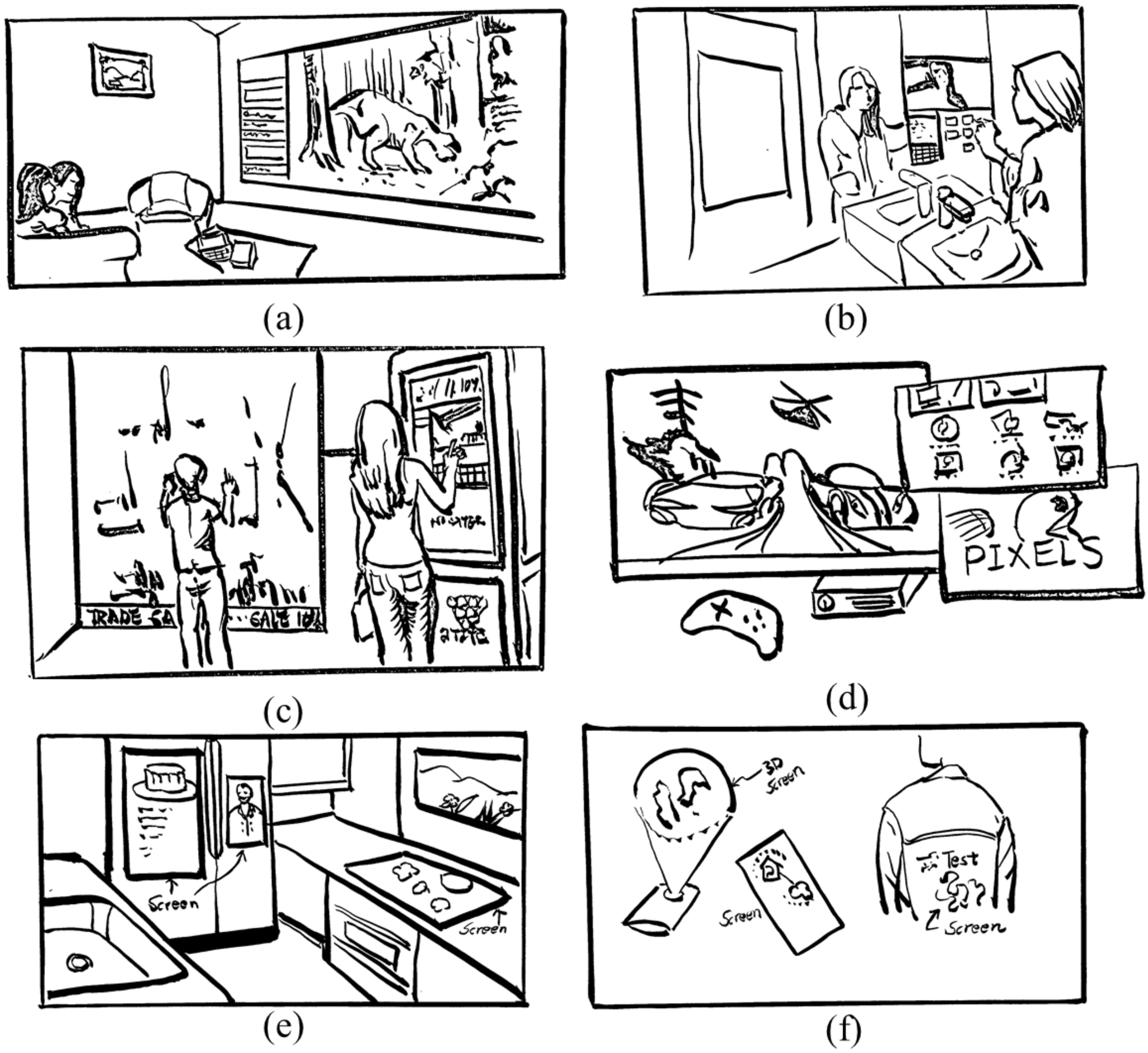

Figure 6-1 – High quality services examples

Streaming based delivery is the most appropriate method to deliver fast moving high quality services. Figure 6-1 shows examples of high quality services. Figure 6-1 (a) is the example of a wall mount screen. On the wall, there are big screens that show various kinds of media oriented services such as an ultra-high definition TV, a high-quality console game and a movie. Figure 6-1 (b) shows high-quality services provided through bathroom mounted mirror. Figure 6-1 (c) shows a smart signage service with high quality contents. Figure 6-1 (d) shows a high quality 3D game service through lower-*spec* IPTV STB. Figure 6-1 (e) is a 3D virtual reality service using hologram on home appliances. Figure 6-1 (f) shows service screens displayed in small devices or a *cloth*.

With the adaptation of the screen-free service, the specific roles of various screen devices will disappear because of the convergence of contents and services. The PC services can be used in a TV screen, a tablet and a smartphone. Also, the user can see a channel service on a PC, a tablet and a smartphone. So the device cannot have any specific roles.

The right side of Figure 6-2 shows that the system can be used for a media service provision running remotely on home appliances with screen of various sizes.

According to the screen size, proper adaptation is made for the same service. There is no need for an operating system (OS) or middleware in screen devices. The services are provided from the service server.

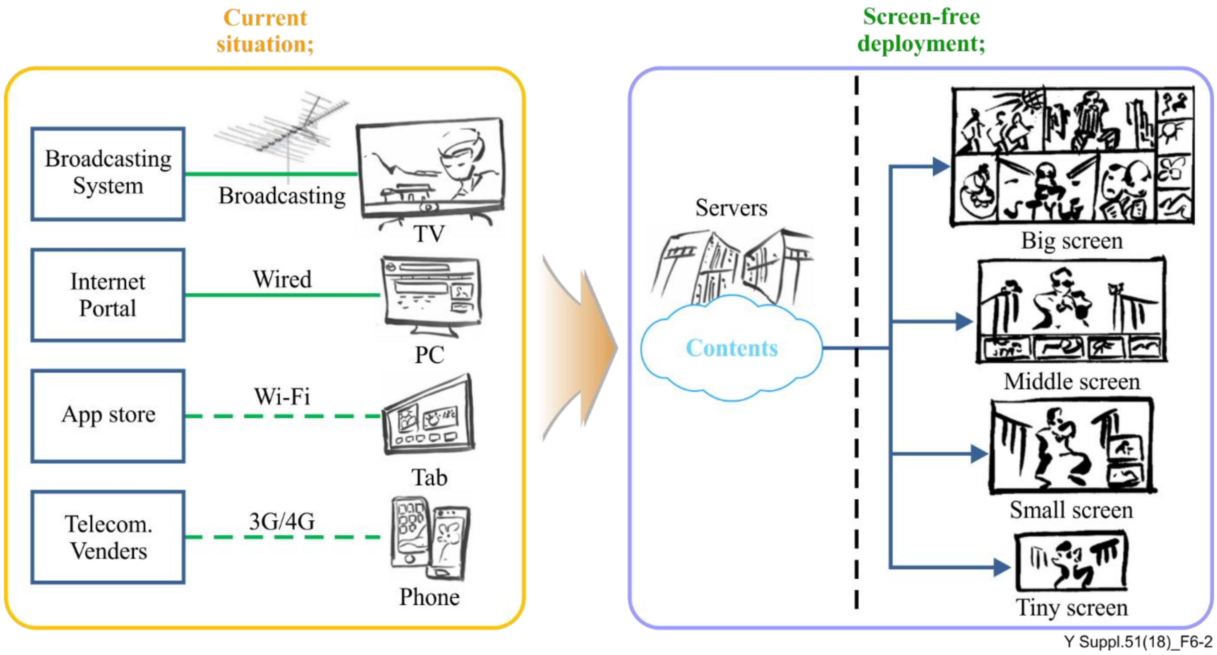

Figure 6-2 – Concept of screen-free environment change

If a user uses the device independent screen-free DISF) service system for a high quality service, the user can expect several advantages such as:

- Independency to device (device flexibility): When the capability of a service is upgraded, a service provider can provide it by changing server-side application and middleware only. It is very easy to provide new services without changing the device.
- Economical: Without exchanging devices, the service provider can provide a high-quality service to the customer. This feature extends a system life-cycle, increase an average revenue per user (ARPU). It is economical to a service provider if they can have the same service supply system for different kinds of screen devices. In the future environment such as Figure 6-2, there are many screens to be used in one household, so it is important to provide the screen devices at a low price.
- High-quality/High-capacity service provision: All services are executed in a server, which is provided into a device as a stream. The DISF service can provide high-quality application like a console game even in a low-quality device.
- Openness: By changing server middleware, the service provider can provide a cross-platform application. Even if the device's operating system is Linux; the service provider can provide a PC software, mobile apps, etc., without any changes in the device.

7 Device independent screen-free service deployment models in server environment

7.1 Thin-client type IPTV DISF service deployment model

Figure 7-1 is a thin-client type IPTV DISF service that is the screen-free deployment model, which is also called as a streaming-based IPTV service. Normally services for the TV such as IPTV are executed at customer device using terminal middleware platform such as application configuration access protocol (ACAP) after the application is downloaded.

In the streaming-based IPTV service, the middleware resides in the server, applications are executed in the server middleware, and then the resulting screen is captured, encoded, transferred to the customer device (Smart TV, STB, etc.), decoded and played.

The user input (remocon) is accepted from the customer device (thin-client), the user input signal is redirected to the server, then the meaning of the user input is processed, proper execution at the middleware residing in the server or applications is applied, and then the resulting screen is captured, encoded, transferred to the customer device (smart TV, STB, etc.), decoded and played.

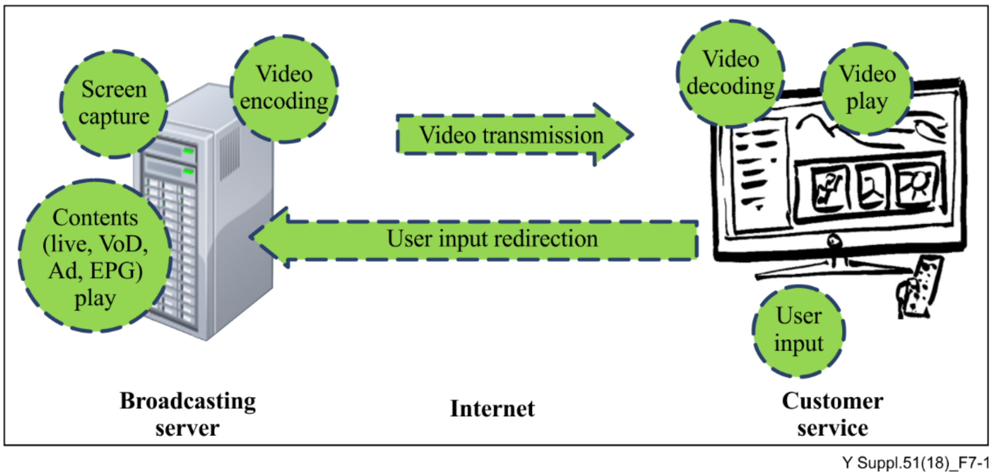

Figure 7-1 – Service flow of thin-client type IPTV DISF service

Figure 7-2 is a functional architecture of a thin-client type IPTV DISF service system. This architecture can be applied to an IPTV or a smart TV. For example, in IPTV, the video on demand (VOD) and a channel service is transferred to the terminal using moving picture expert group 2 (MPEG2).

This architecture can also be applied to a media convergence service provision for home appliances. For example, the customer can watch a YouTube video or a TV channel on a kitchen wall screen, can get food information on the refrigerator screen, and food recipe on the cook-top table screen, etc. Normally, the TV channel service is transferred to screens using MPEG2 and other value-added services including menu is downloaded and executed on the screen device. To provide those services, the screen device must be equipped with the proper HW and middleware.

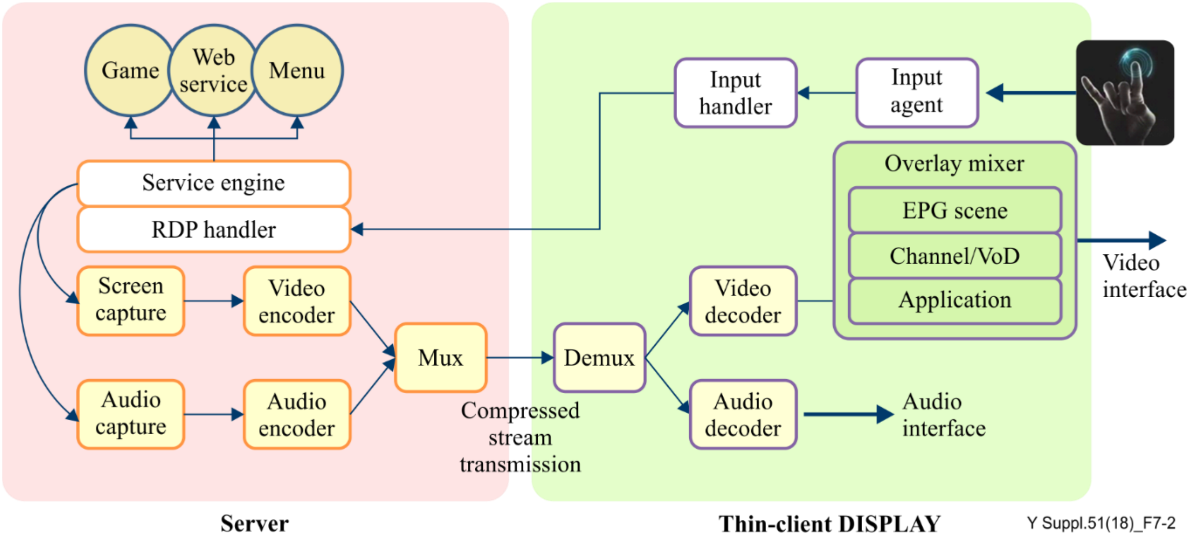

Figure 7-2 – Functional architecture of thin-client type IPTV DISF service

In the thin-client type IPTV DISF service system, all-those value-added services are executed in a server on the server-side middleware as a service engine as shown in Figure 7-2. The execution results are captured as a real-time stream data, compressed by a video encoder, and then mixed with an audio stream. The prepared stream is transmitted to the thin-client screen device. It is de-muxed and put into the HW overlay mixer to be displayed in the customer home appliance screen.

The service scenarios of a thin-client type IPTV DISF service are described using the [ITU-T Y-Sup.14] convention described in Appendix I.

The thin-client type IPTV DISF service is a service on which an end user can watch the high-quality media-oriented service on TV with a low specification STB, a smartphone or a laptop with a small-size client program.

Figure 7-3 is an overall configuration of a thin-client type IPTV DISF service using the [ITU-T Y-Sup.14] convention. Figure 7-4 is a service scenario diagram using the same convention.

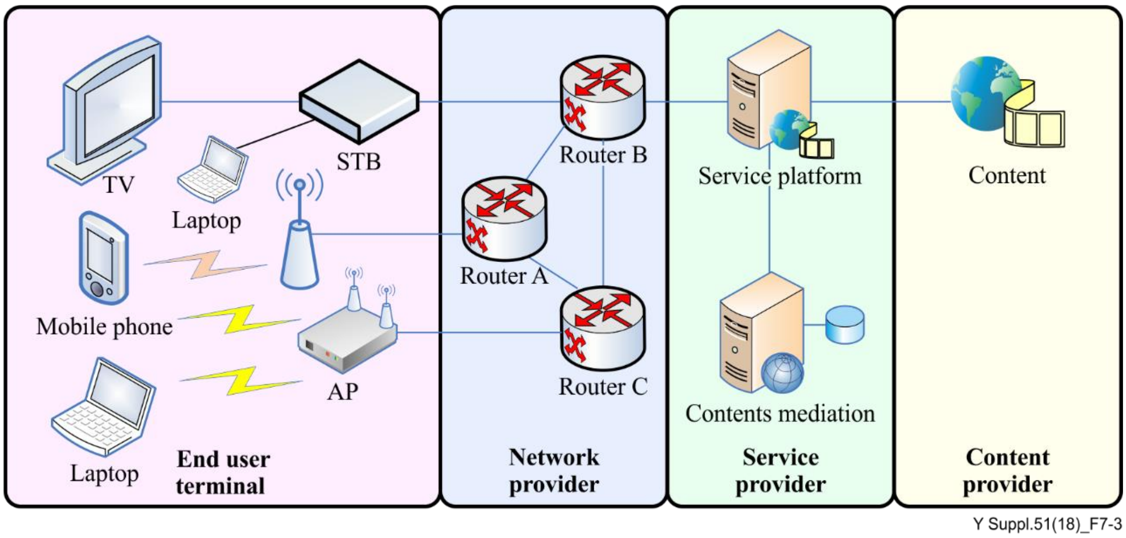

Figure 7-3 – Overall configuration of a thin-client type IPTV DISF service

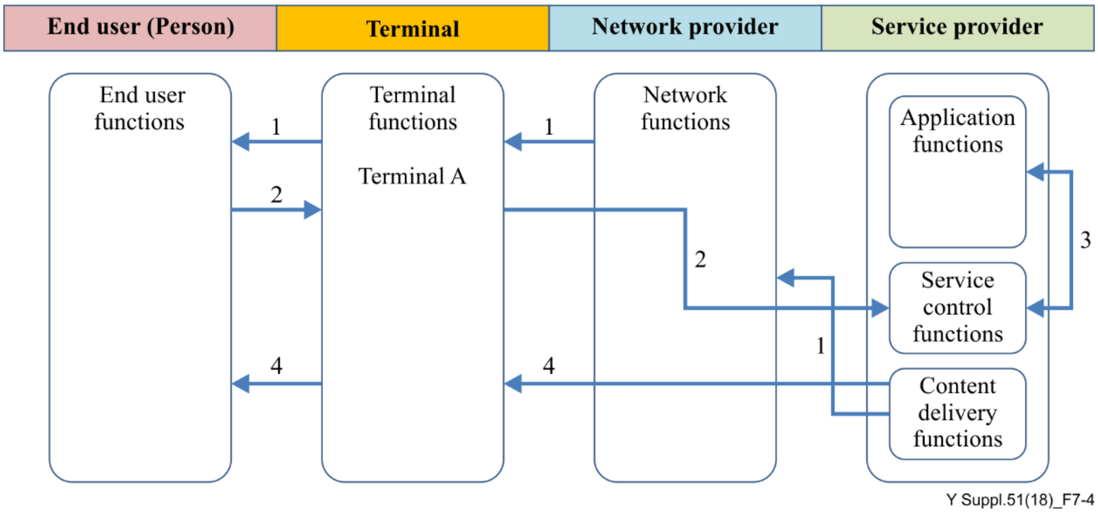

Figure 7-4 – Service scenario of a thin-client type IPTV DISF service

1) [Service Provider > End-user(Person): displaying menu on Terminal A] The screen size of a client is transferred to the server to prepare proper encoding for the client. End-user (Person) is watching menu provided by content delivery functions of a service provider via network functions of a network provider using terminal A (For example, a TV with STB).

2) [End-user(Person)-> Service Provider: request media-oriented service to Terminal A] End user functions of the end-user request the terminal to provide the selected service to terminal A.

3) [Service Provider: preparing media-oriented service for terminal A] The Application function prepares media-oriented service content. It executes the service then captures the screen for stream encoding at the service control function. The service control function of the service provider encodes the captured screen then adjusts quality of contents to network bandwidth to be changed. The service control functions decide to transcode original contents into suitable contents to be changed, considering display sizes to be changed. An application functions of the service provider may have contents mediation functions like codec convertors. The application functions converts content into small-size or big-size display, depending on the device profile and access network bandwidths.

4) [Service Provider -> Terminal A -> End user(Person): using media-oriented service] The newly generated contents are delivered into designated storage managed by content delivery functions. The content delivery functions send adjusted contents to terminal A. The terminal A decodes the video stream then play the content.

7.2 Thin-client type game DISF service deployment model

Figure 7-5 is a functional architecture of a thin-client type game DISF service system. This architecture is similar to the thin-client type IPTV DISF system but the user input redirection is important in this service. Proper timing of the user input processing is critical in a game play. The response time of the user input should be within 100 ms, which is a delay that could go unnoticed by the user. A time control function should therefore be installed in the game server.

The service flow of the thin-client type game DISF service starts from game execution on the game server. The execution output that is a screenshot on the video card is captured on the game server. The captured screenshot is encoded for the preparation of a transmission to the thin-client (game screen). The encoded screenshot is sent to the thin-client (game screen). Thereafter the received stream of screenshots is decoded at the thin-client (game screen), and then played. When the user input is detected, the detected signal is sent to the game server.

The service scenarios of the thin-client type game DISF service are described using the [ITU-T Y-Sup.14] convention described in Appendix I.

Thin-client type game DISF service is a service on which an end user can play the high-quality game service such as a 3D console game on a TV with low specification STB.

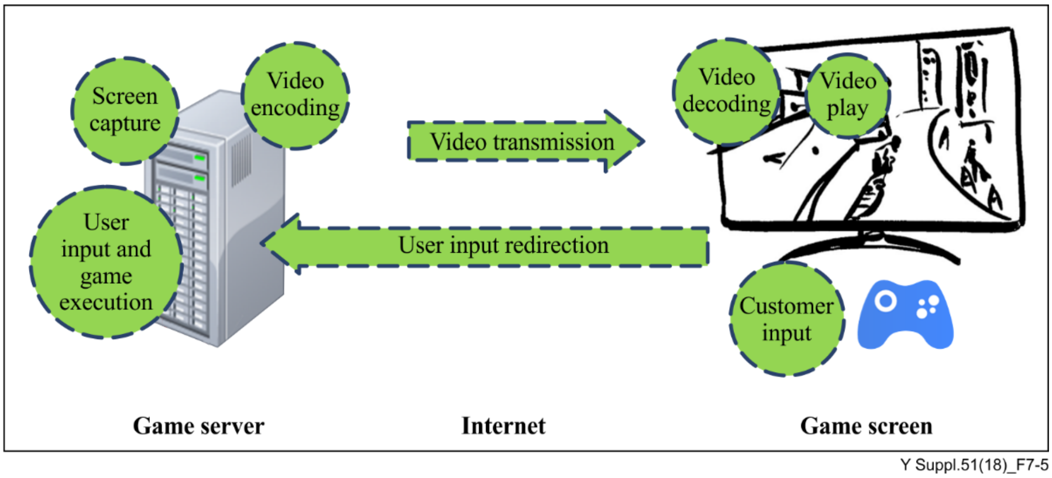

Figure 7-5 – Service flow of thin-client type game DISF service

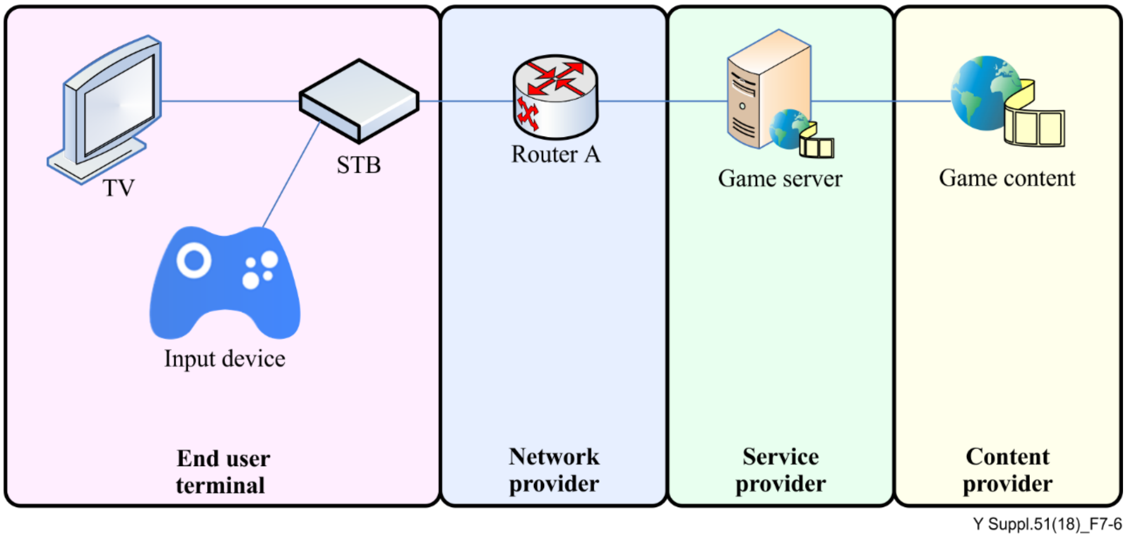

Figure 7-6 – Overall configuration of Thin-client type game DISF service

The following is the service scenario of a thin-client type game DISF service.

1) [Service Provider > End-user(Person): displaying menu on Terminal A] The end-user (Person) is watching menu provided by content delivery functions of a service provider via network functions of a network provider using terminal A (for example, a TV with STB).

2) [End-user(Person)-> Service Provider: request for game service to Terminal A] The end user functions of the end-user request the terminal to provide selected game service to Terminal A.

3) [Service Provider: preparing media-oriented service for Terminal A] The application function prepares the game service content. It executes the game then captures the screen for stream encoding at the content delivery function. The content delivery function of the service provider encodes the captured screen then adjusts the quality of the contents to the network bandwidth to be changed.

4) [Service Provider -> Terminal A -> End user(Person): using game service] The newly generated game contents are delivered into a designated storage managed by the content delivery functions. The content delivery function sends the adjusted game contents to Terminal A. Terminal A decodes the video stream then plays the content.

5) [End user(input device) -> Service Provider: presses the button on the input device] The user responds by pressing the input device. This input should be processed within 100 ms time limit.

6) [Control the time limit] The service control function processes the user input within the 100 ms designated time limit. It has the capability to handle the time limit collaboratively with the content delivery function. The content delivery function then generates a response screen to be delivered to the user.

7) [Service Provider -> Terminal A -> End user(Person): receive response screen] The generated game response contents are delivered to Terminal A by the content delivery functions. The content delivery function sends the adjusted game contents to terminal A. Terminal A decodes the video stream then continues the game play.

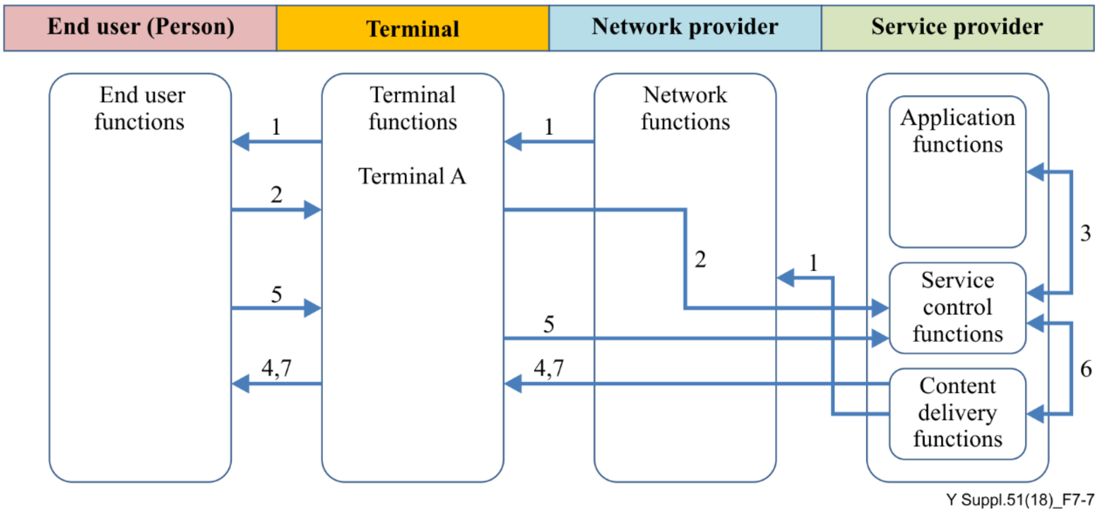

Figure 7-7 – Service scenario of a thin-client type game DISF service

7.3 Thin-client type augmented reality DISF service deployment model

Augmented reality (AR) is an interactive experience of a real-world environment whose elements are "augmented" by computer-generated value-added information. The overlaid value-added information can be an additive to the natural environment and is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment. In this way, augmented reality alters the perception of a real world environment, whereas virtual reality completely replaces the user's real world environment with a simulated one.

Figure 7-8 is a service flow of a thin-client type AR DISF service system. The camera input of the AR glass transmitted to the AR analysis server, and then the server does an analysis, makes value-added information of the building such as the name of the building and the shops in the building shown in the screen. The information transmitted to the glass is then overlaid on the AR glass screen.

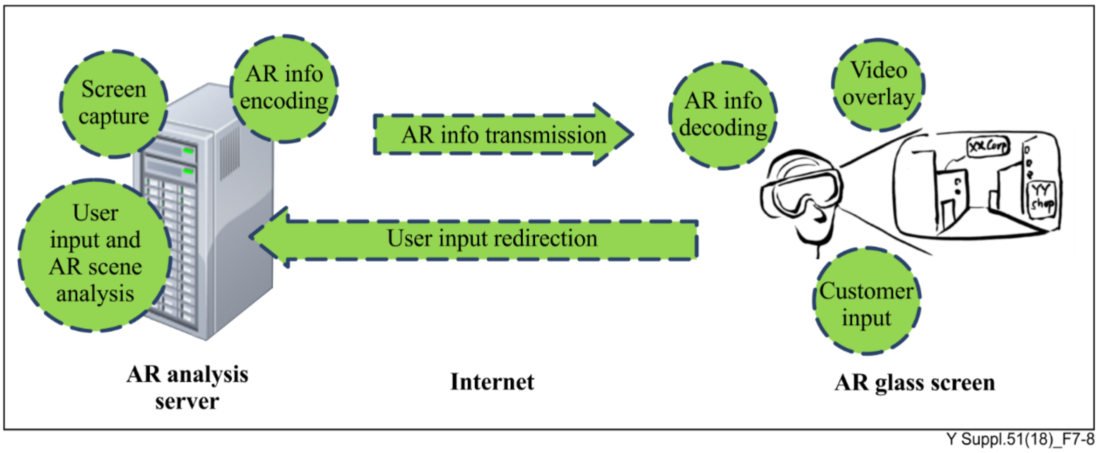

Figure 7-8 – Service flow of thin-client type AR DISF service

The service scenarios of a thin-client type AR DISF service are described using the [ITU-T Y-Sup.14] convention described in Appendix I.

Thin-client type AR DISF service is a service on which an end user can see real world through AR glass whereby the objects that reside in the real world are "augmented" by computer-generated perceptual information. The information screen is generated at the AR server, service and content provider side, and then sent to the AR device that is an end user terminal.

Figure 7-9 is an overall configuration of a thin-client type AR DISF service using the [ITU-T Y-Sup.14] convention. Figure 7-10 is a service scenario diagram using the same convention.

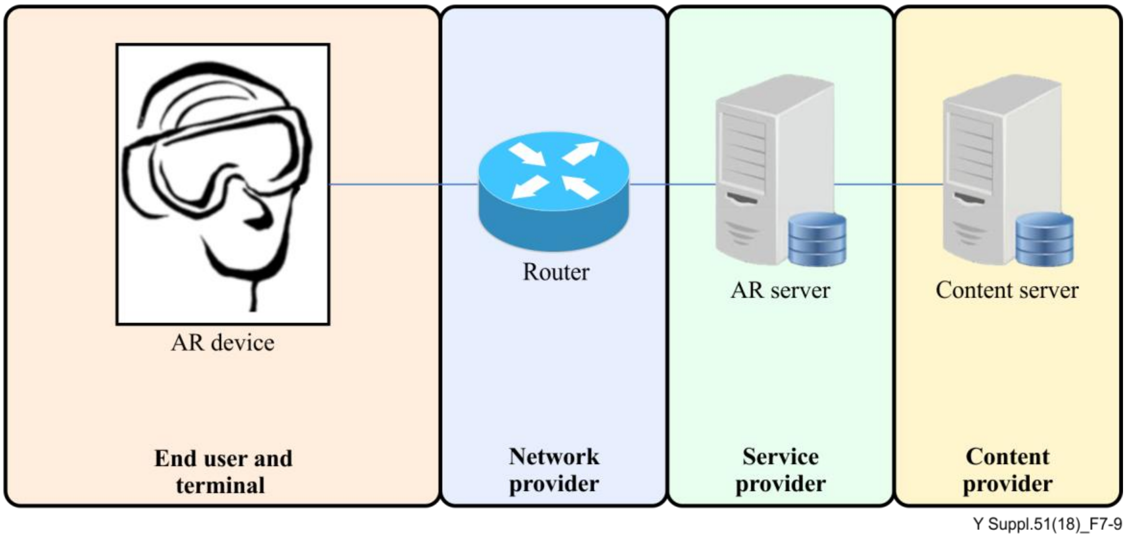

Figure 7-9 – Overall configuration of a thin-client type AR DISF service

The following is the service scenario of a thin-client type AR DISF service.

1) [End-user(Person)->Service Provider: sending real-world camera capture] The end-user (Person) is watching a real-world through an AR glass. The camera attached at the AR glass captures the real-world then the captured screen is sent to a service provider's control function.

2) [Service Provider: analyse the real-world to abstract real-world objects] The application function analyses the transferred real-world screen to abstract real-world objects. The application function then generates perceptual information that should be shown on the abstracted real-world objects.

3) [Service Provider: transfer perceptual information] The content delivery function delivers the generated perceptual information to the AR glass to be seen by the end user.

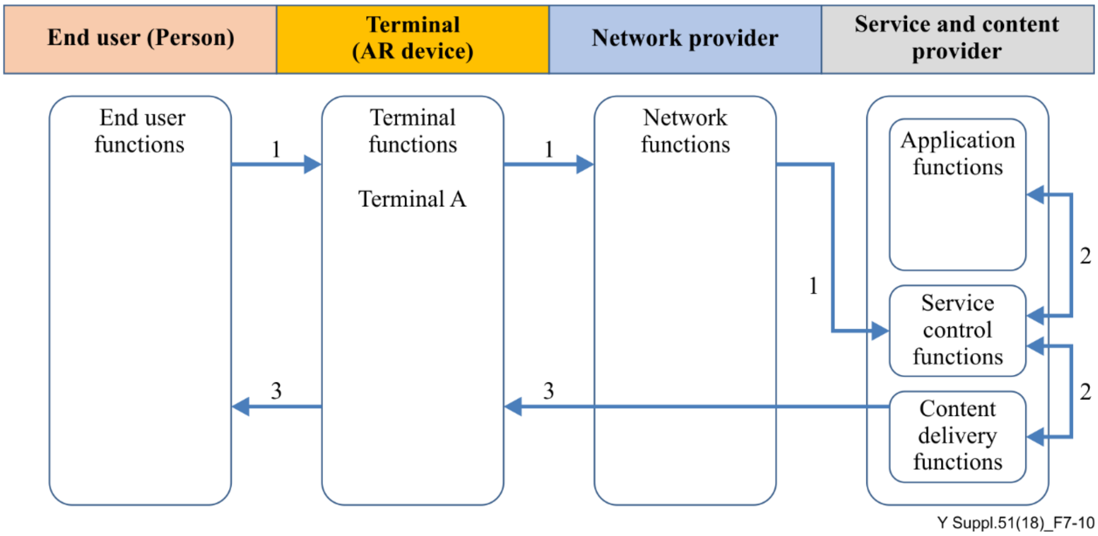

Figure 7-10 – Service scenario of a thin-client type AR DISF service

8 Security considerations

This Supplement conforms to [ITU-T Y.2701] for security aspects. No specific security considerations have been identified.

Appendix I

Overall scenario model over FMC, ITU-T Y-Sup.14

[ITU-T Y-Sup.14] describes an overall scenario model for various services over fixed mobile convergence (FMC).

Use cases and service scenarios described in clauses 7.1, 7.2 and 7.3 conform to the convention of [ITU-T Y-Sup.14].

The example shown in Figure I.1 describes the case where content quality is converted to display the same content on different types of terminals. Another scenario is of end users using their terminal devices while the unit feature of the converged service is operated on separate devices synchronously. Examples are the case of displaying VOD on TV+STB, starting the VOD using electronic programme guide (EPG) displayed on a mobile phone, and displaying the VOD related information on a notebook.

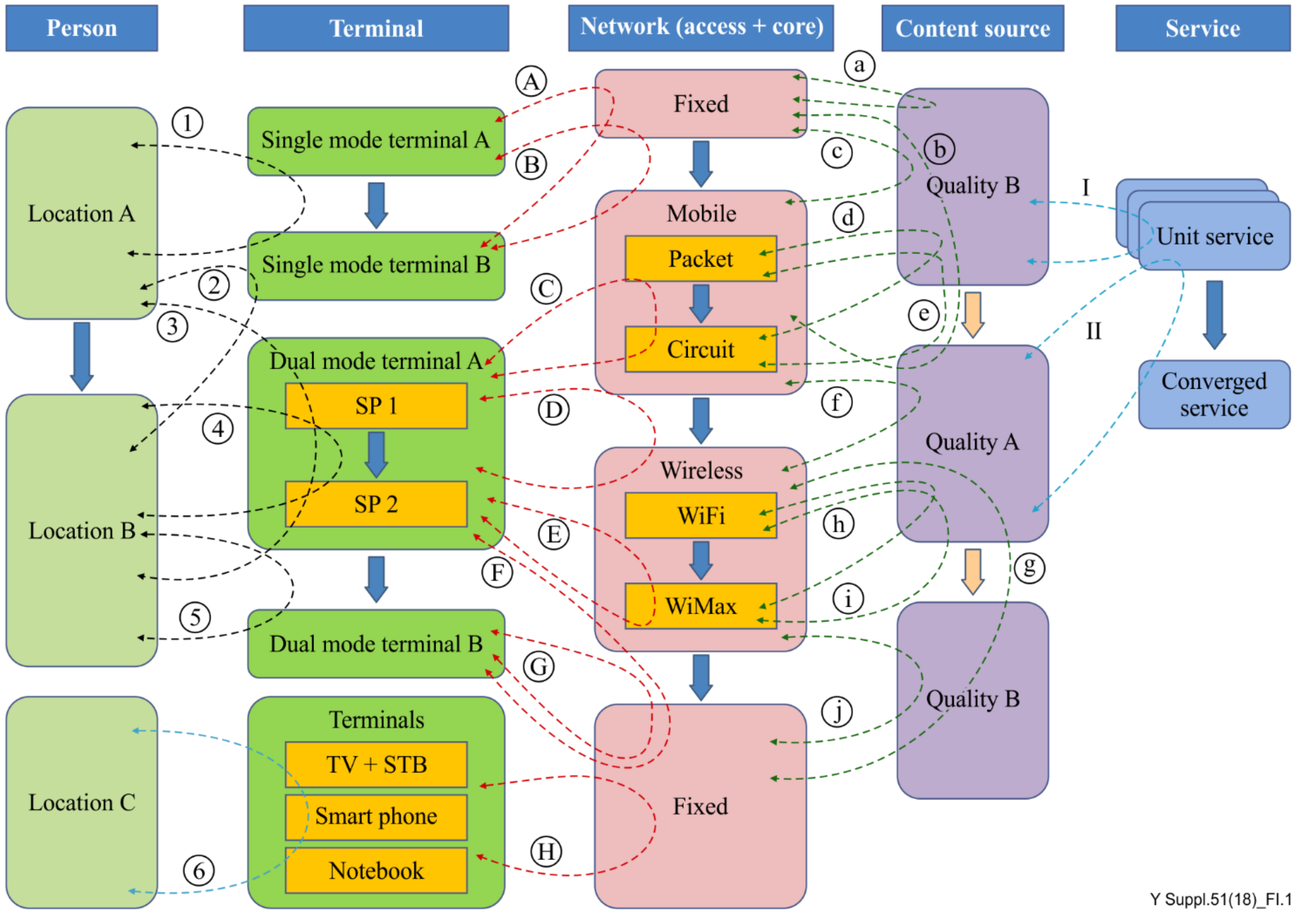

Figure I.1 – Overall scenario model for FMC

Appendix II

Functional model example of a thin-client type IPTV service

This appendix describes the example of a functional model of a thin-client type IPTV service described in clause 7.1.

The thin-client has an operating system and a minimum amount of memory to execute the essentially required programs. Even without an operating system, the screen device can get streaming data, decode and display it. This type of device is called a zero-client. Figure II.1 shows a thin-client equipped with an OS and a small interface agent SW. If all those SW parts are embedded in the system on a chip (SoC), the thin-client can be manufactured into a tiny size HW chip that is called a zero-client.

The user input for the application is captured in a STB input agent, and transferred to the server's service engine after being processed by an input handler.

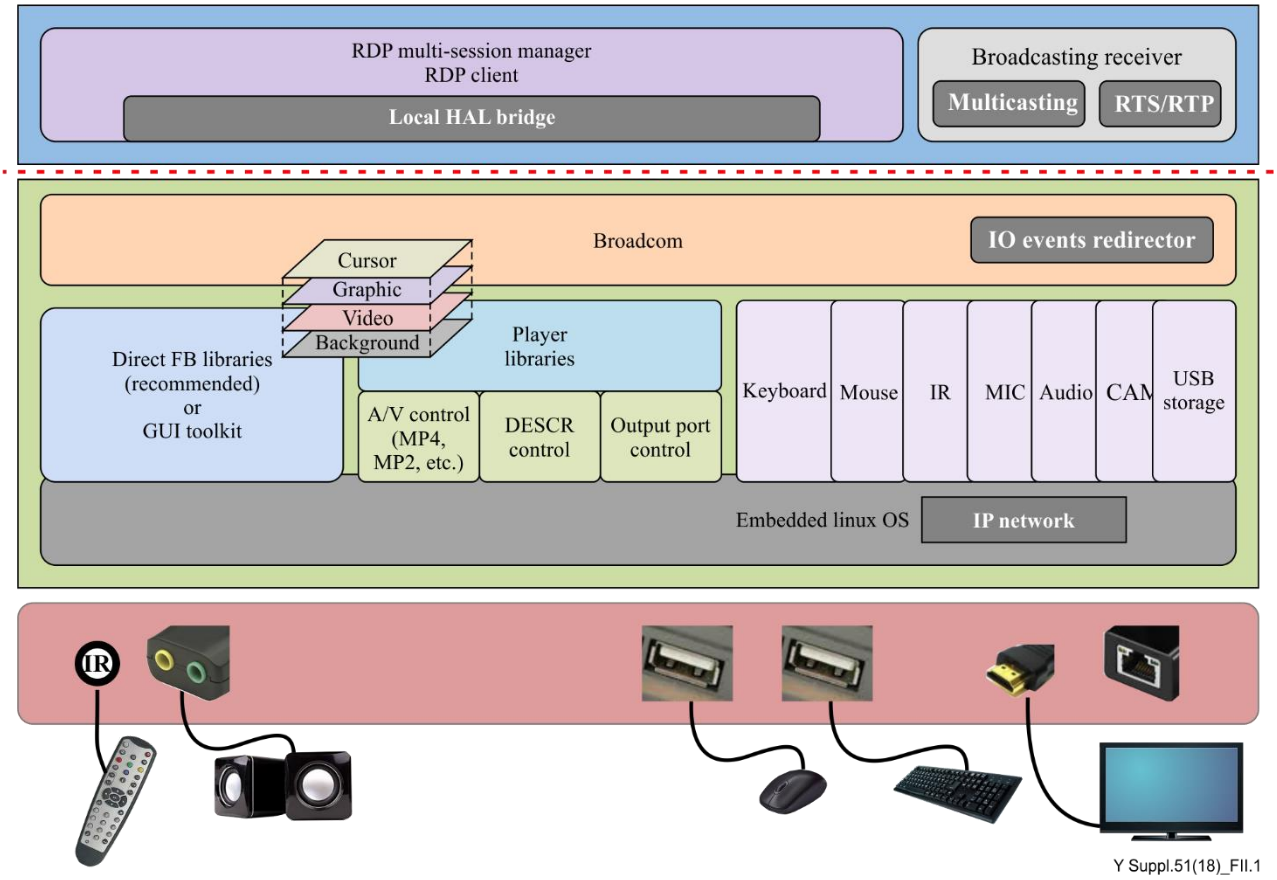

Figure II.1 – Example functional model of thin-client type IPTV device

One of the candidate screen encoding method is MEPG4-ES (Elementary Stream). The performance of the system is over 15 frames/sec for an HD screen streaming service. For the overlay menu image transfer, alpha image transmission technology can be used.

To support service interactivity, a virtual interface is used (see Figure II.2). It transfers remote controller input and redirects USB protocol messages. All events generated from a set-top's input device are redirected to the virtual server, then the events are processed at the server and the result is reflected to the streaming video and transferred to the client set-top box.

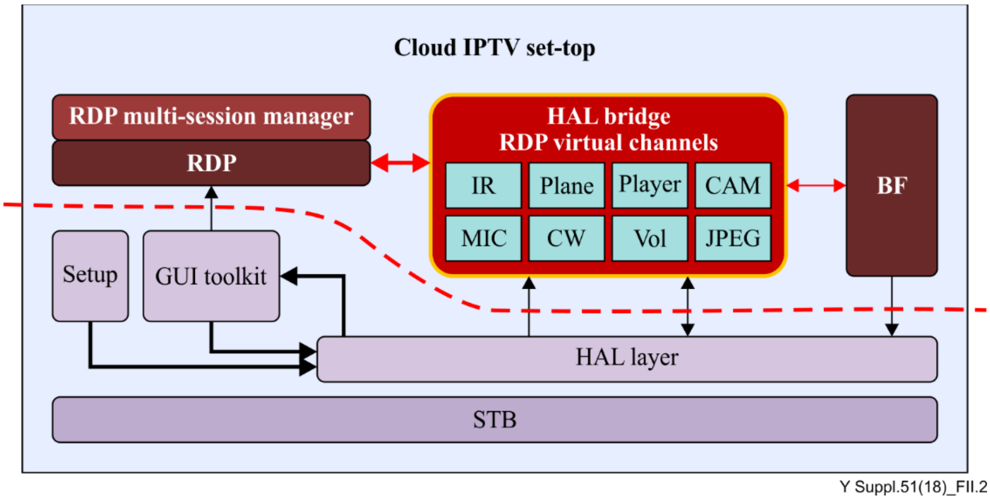

Figure II.2 – IPTV STB virtual interface

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