International Telecommunication Union

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Supplement 20

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SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

ITU-T Y.1900-series – Supplement on scenarios and use cases of mobile IPTV

ITU-T Y-series Recommendations – Supplement 20

International Telecommunication Union

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Supplement 20 to ITU-T Y-series Recommendations

ITU-T Y.1900-series – Supplement on scenarios and use cases of mobile IPTV

Summary

Supplement 20 to ITU-T Y-series Recommendations provides mobile IPTV use cases as informative illustrations of how mobile IPTV services can be designed, deployed and operated. The use cases are described with sample scenarios and operational procedures of mobile IPTV services. In addition, the use cases detail functional procedures to illustrate how the service scenarios can be supported with IPTV architectural functions. Finally, the use cases have been categorized in terms of service aspects and capability aspects.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T Y Suppl. 20	2012-06-15	13

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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1 Scope

This Supplement provides mobile IPTV use cases as informative illustrations of how mobile IPTV services can be designed, deployed and operated. The use cases are described with sample scenarios and operational procedures of mobile IPTV services. In addition, the use cases detail functional procedures to illustrate how the service scenarios can be supported with IPTV architectural functions. Finally, the use cases have been categorized in terms of service aspects and capability aspects.

2 References

[ITU-T Y.1901] Recommendation ITU-T Y.1901 (2008), *Requirements for the support of IPTV services*.

[ITU-T Y.1902] Recommendation ITU-T Y.1902 (2011), *Framework for multicast-based IPTV content delivery*.

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

3 Definitions

3.1 Terms defined elsewhere

This Supplement uses the following terms defined elsewhere:

3.1.1 linear TV [ITU-T Y.1901]: 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.

3.1.2 mobility [b-ITU-T Y.2001]: The ability for the user or other mobile entities to communicate and access services irrespective of changes of the location or technical environment. The degree of service availability may depend on several factors including the access network capabilities, service level agreements between the user's home network and the visited network (if applicable), etc. Mobility includes the ability of telecommunication with or without service continuity.

3.1.3 personal mobility [b-ITU-T Q.1761]: Ability of a user to access telecommunication services at any terminal on the basis of a personal identifier, and the capability of the network to provide those services according to the user's service profile. Note that personal mobility involves the network capability to locate the terminal associated with the user for the purposes of addressing, routing and charging of the user's calls.

3.1.4 service mobility [b-ITU-T H.510]: The ability of a user to use the particular (subscribed) service irrespective of the location of the user and the terminal that is used for that purpose.

3.1.5 terminal mobility [b-ITU-T Q.1761]: The ability of a terminal to access telecommunication services from different locations and while in motion, and the capability of the network to identify and locate that terminal.

3.2 Terms defined in this Supplement

This Supplement defines the following terms:

3.2.1 horizontal mobility: Mobility within the same access network technology.

3.2.2 vertical mobility: Mobility between different access network technologies.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

AP	Access Point
BS	Base Station
BTS	Base Transceiver Station
DMB	Digital Multimedia Broadcasting
EPG	Electronic Programme Guide
GSM	Global System for Mobile communication
GSP	Global Positioning System
HD	High-Definition
IPsec	Internet Protocol security protocol
LBS	Location-based Service
P2P	Peer-to-Peer
PDA	Personal Digital Assistant
QCIF	Quarter Common Intermediate Format
QoS	Quality of Service
UCC	User-created Content
USIM	Universal Subscriber Identity Module
VoD	Video on Demand
VPN	Virtual Private Network
WiBro	Wireless Broadband
Wi-Fi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access

5 Conventions

None.

6 Introduction

Mobile IPTV is an application of IPTV as specified in [ITU-T Y.1901]. It applies to cases wherein the end-user IPTV terminal device receives the IPTV content via an IPTV-enabled mobile network. It must be able to communicate and access the IPTV services regardless of the changes of location or technical environment.

This Supplement describes use cases for the mobile IPTV services with deployment examples and operational procedures of IPTV functions. While comprehensive IPTV use cases are described in

[b-ITU-T Y.Sup5], this Supplement focuses on which use cases should be supported for mobile IPTV and how to support them with the IPTV functions defined in [ITU-T Y.1910].

7 Mobile IPTV use cases from the capability perspective

7.1 Terminal mobility support

7.1.1 Horizontal mobility support in linear TV service

Linear TV service is a television service wherein a continuous stream flows in real time from the service provider to the terminal device. While receiving the linear TV content, the terminal device can move to different coverage of the base stations (BSs) in the same access network technology (i.e., horizontal mobility). This scenario describes a use case of linear TV service to support the horizontal mobility of the IPTV terminal devices.

Figure 7-1 below depicts a sample scenario for linear TV service with horizontal mobility.

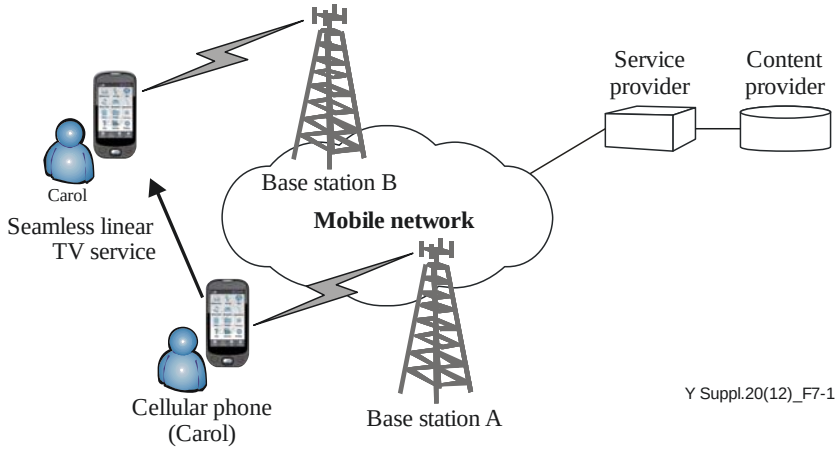

Figure 7-1 – Linear TV service with horizontal mobility support

In this scenario, an IPTV end-user uses linear TV service while changing locations. As the end-user changes location, horizontal mobility takes place, and the IPTV content is provided seamlessly.

The operational procedures of the scenario are as follows:

1) The cellular phone of Carol – who is an IPTV service subscriber – accesses the mobile network through BS-A, which is the nearest one, while she moves on foot.
2) Carol reaches a linear TV service and selects the news content she wants to view after the IPTV service provider identification and IPTV service detection procedures.
3) The selected news stream starts to deliver to the cellular phone, and she keeps watching the news while she walks.
4) After a few minutes, her cellular phone goes out of the coverage of BS-A, and the connected base station is changed from BS-A to BS-B as the most appropriate one accessible by the cellular phone and with sufficient resource. Carol keeps watching the news seamlessly.

The following figure shows a procedural diagram of IPTV functions of linear TV service with horizontal mobility.

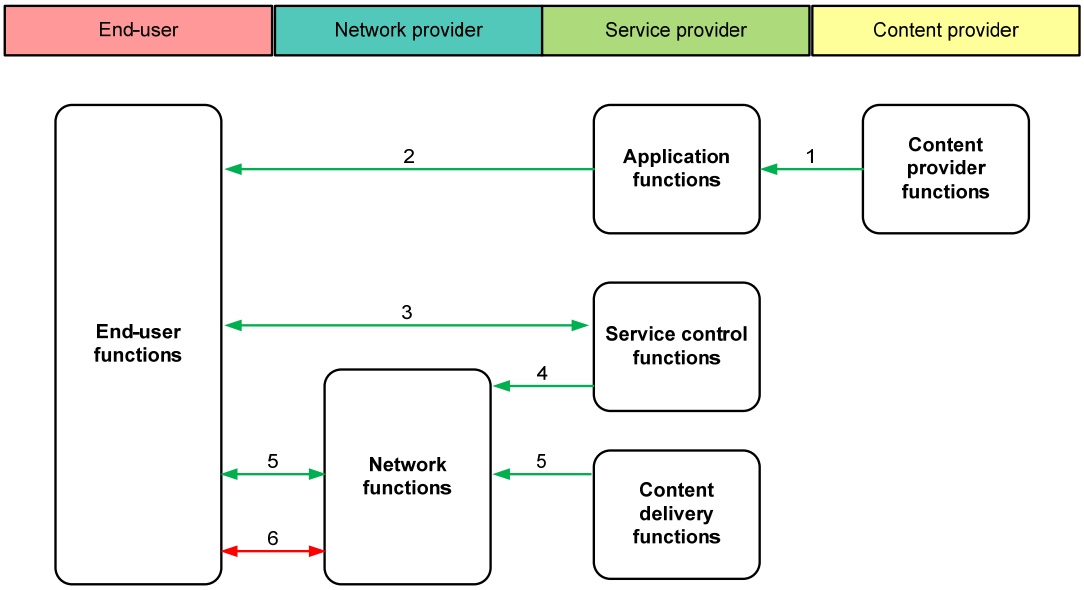

Figure 7-2 – Use case of linear TV service with horizontal mobility

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating the content is ready for consumption.

3) When an end-user wants to access the linear TV service or selects a channel, the request is sent to the service provider. This procedure may include service negotiation (e.g., quality of service (QoS), price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the linear TV service, the service provider interacts with the network provider to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information (e.g., the multicast address assigned to the requested channel) to the end-user. Then he or she can access and watch the channel.

Note that steps 1 to 5 are the same as those depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

6) At horizontal mobility, the end-user is supplied with new channel access information for the visiting access network so that he or she continues to access and watch the channel.

7.1.2 Support for mobility between different broadcasting regions

The IPTV service provider may provide IPTV service to the IPTV terminal devices residing in different regions supported with different IPTV contents. In providing this type of IPTV service on wireless/mobile network environments, an IPTV service provider should perform the following:

– Separate the mobile network into broadcasting regions consisting of wireless access nodes.

– Assign a set of IPTV contents to each broadcasting region. The list of IPTV contents may be different for each broadcasting region.

– Transmit IPTV electronic programme guide (EPG) contents to each broadcasting region.

– Control the wireless channel assignment of wireless access nodes.

In addition, all wireless access nodes in a single broadcasting region should perform the following:

– Periodically broadcast their broadcasting region ID.

– Allocate a dedicated wireless channel/link for mobile IPTV service according to the control of the service provider.

– Maintain synchronization of the broadcasting IPTV EPG and contents with other access nodes that are in the same broadcasting region.

Figure 7-3 below depicts a sample scenario for mobile IPTV service in which the terminal devices move to different broadcasting regions.

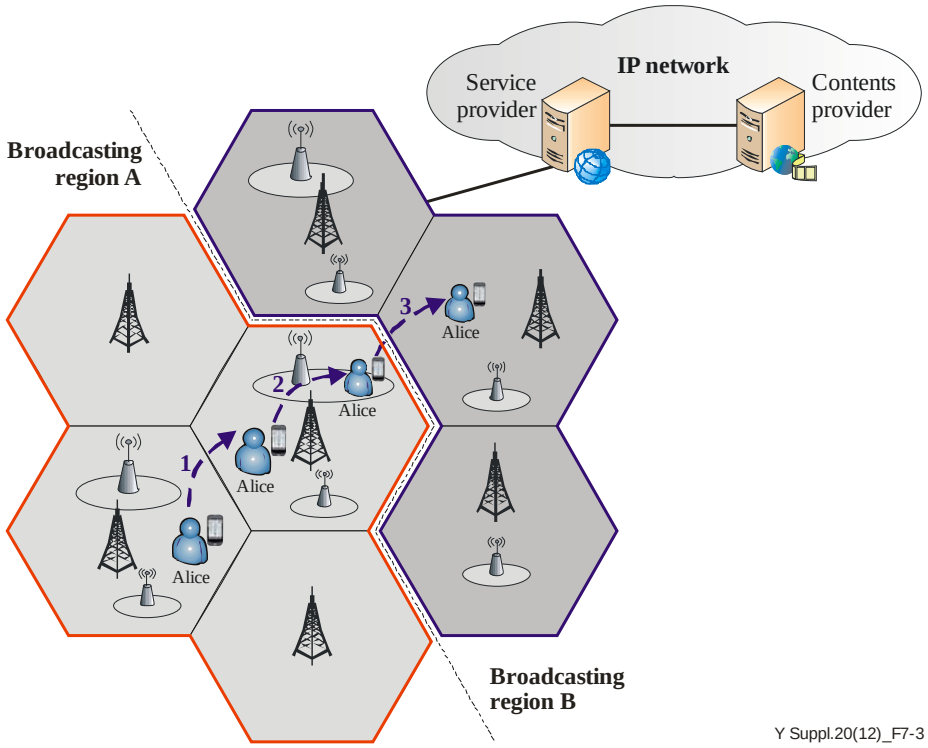

Figure 7-3 – Mobility support within different broadcasting regions

In this scenario, an end-user in the broadcasting region A moves from a cell to a neighbouring cell and uses the IPTV service provided in region A. When this user moves to a different broadcasting region (B), he/she needs to find new contents available in region B. In the figure above, Alice's terminal moves to a neighbouring cell and performs vertical mobility, which selects a new wireless access node and subsequently connects to it.

The operational procedures of the scenario are as follows:

1) Alice's terminal and IPTV application check the identification of the current broadcasting region and confirm that the current broadcasting region (broadcasting region B) is different from the previous one (broadcasting region A).

2) Next, Alice's terminal receives a new EPG containing information of the available IPTV contents in broadcasting region B. Alice's terminal then shows a list of available IPTV content in the current location.

3) Alice chooses one IPTV content item from the list of available ones and views the IPTV content.

The following figure shows a procedural diagram of IPTV functions for the mobile IPTV service between different broadcasting regions.

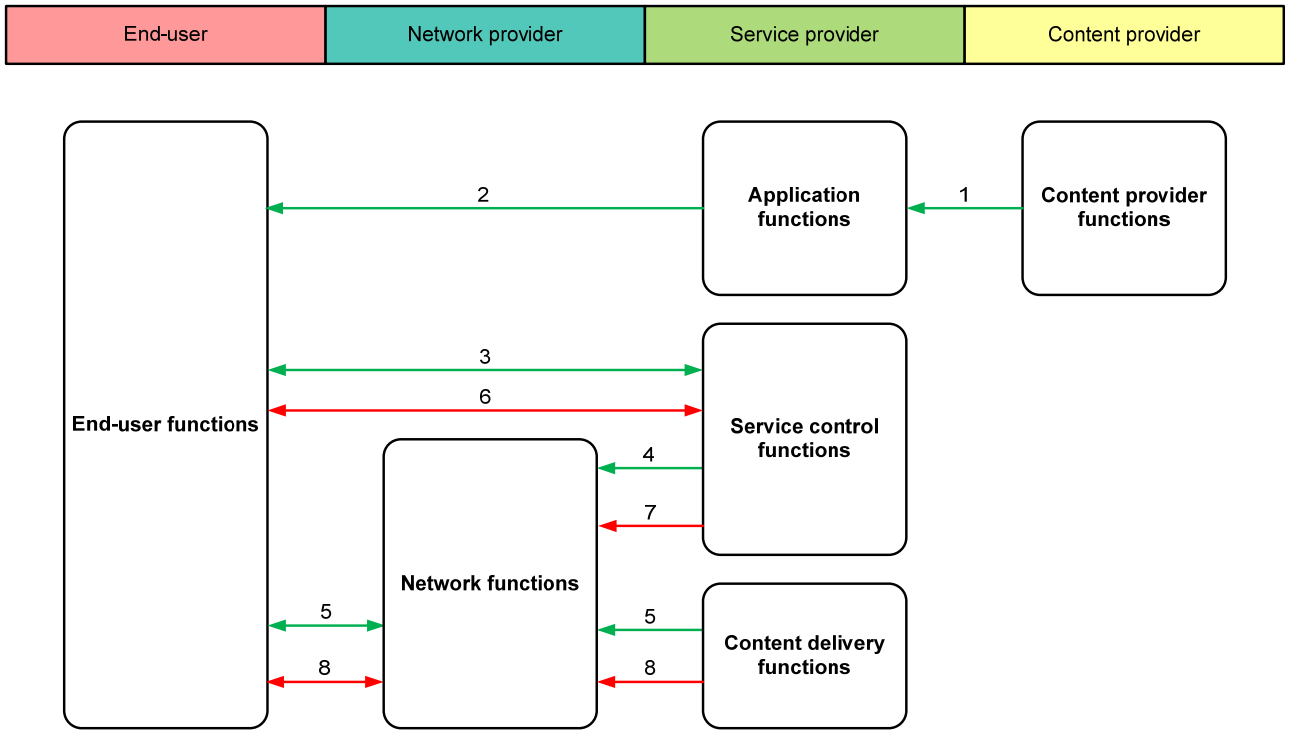

Figure 7-4 – Use case of the mobile IPTV service between different broadcasting regions

1) The mobile IPTV content with related metadata and content protection data are produced and managed by the content provider, and are delivered to the service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating that the content is ready for consumption.

3) When an end-user wants to access the mobile IPTV service or selects a channel, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the mobile IPTV service, the service provider interacts with the network provider to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information (e.g., the multicast address assigned to the requested channel) to the end-user. Then he or she can access and watch the channel.

6) When an end-user wants to receive a different mobile IPTV service due to the change of broadcasting region, the request is sent to the service provider.

7) If the end-user is granted access to the newly requested mobile IPTV service, the service provider interacts with the network provider to transmit the requested service. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

8) Upon completion of step 7, the service provider supplies channel access information (e.g., the multicast address assigned to the newly requested channel) to the end-user. Then he or she can access and watch the newly requested channel.

7.1.3 Vertical mobility support in VoD service

Video on demand (VoD) is a service wherein the end-user can, on demand, select and view video content and can control the temporal order in which the video content is viewed. As one of the basic IPTV services, VoD is also expected to be available on various kinds of mobile IPTV terminal devices which can move from one network to another network which uses a different access technology (i.e., vertical mobility).

Figure 7-5 below depicts a sample scenario for VoD service with vertical mobility.

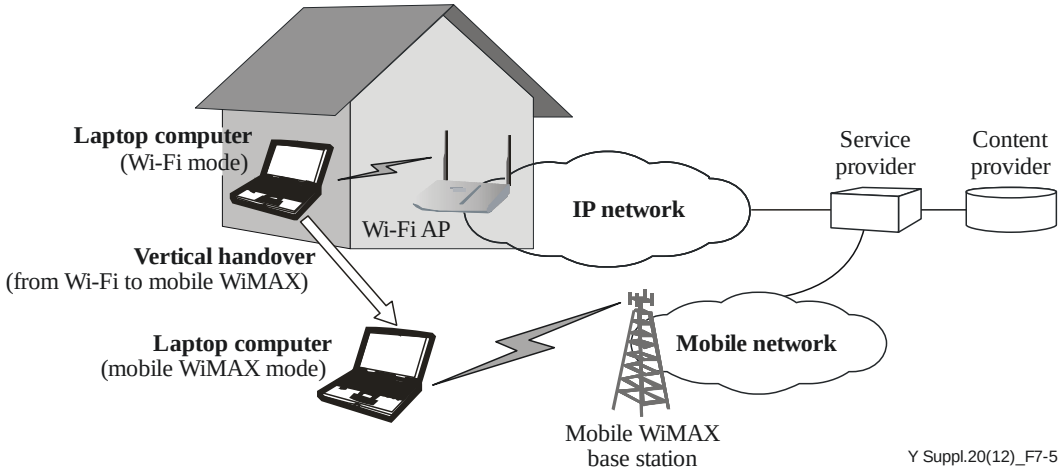

Figure 7-5 – VoD with terminal mobility

In this scenario, while Bob uses an IPTV VoD service on his Wi-Fi-connected laptop computer with terminal mobility, mobility for those scenarios wherein the same terminal equipment is on the move or is used at different locations is provided. More specifically, vertical mobility is supported by the laptop computer.

Since Bob changes his access network from Wi-Fi to Mobile WiMAX [b-IEEE 802.16e], audio and video quality adaptation needs to be supported by the IPTV service provider considering the changes in the resources of the visiting access network, such as bandwidth, delay, etc.

The operational procedures of the scenario are as follows:

1) The laptop computer of Bob, an IPTV service subscriber, connects to a Wi-Fi network at home.
2) Bob then gains access to the VoD service provided by the IPTV service provider to which he is subscribed.
3) While viewing VoD contents, Bob travels in a car and moves to another location. A few seconds after his departure, Bob's laptop computer goes out of the coverage of his Wi-Fi network where the laptop computer connected initially.
4) Then, the laptop computer, which also has WiMAX networking, initiates search for another signal that it can use to secure IP connectivity. His laptop locates a signal from a mobile WiMAX base station and connects to that base station.
5) The network access mode of the laptop computer is changed from Wi-Fi mode to mobile WiMAX mode. Bob then continues to enjoy the VoD service on his laptop computer.

The following figure shows a procedural diagram of IPTV functions for VoD service with vertical mobility.

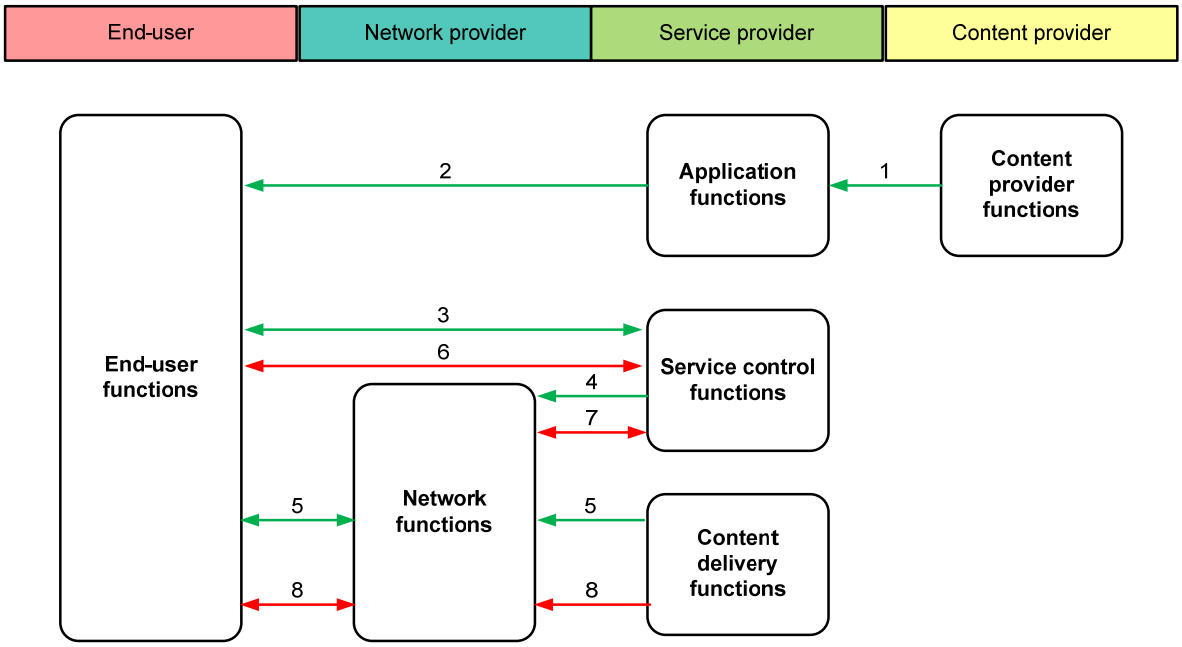

Figure 7-6 – Use case of VoD with vertical mobility

1) Video content and its metadata and content protection data, produced and managed by the content provider, are delivered to the service provider.

2) The service provider prepares the content as per the agreement between the content provider and the service provider.

3) When an end-user selects VoD content, the request(s) is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, packaging option, etc.).

4) If the service provider grants the end-user access to the content, it interacts with the network provider to possibly negotiate the conditions of forwarding the content to the end-user. This procedure may include reserving network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies the content access information (e.g., the multicast address that will be used to forward the content) and the end-user can then receive the video.

Note that steps 1 to 5 are the same as those depicted in Figure 6-8 of [b-ITU-T Y.Sup5].

6) In vertical mobility, the end-user's request(s) for the VoD content with information about the new access network connection is sent to the IPTV service provider. This procedure may include service negotiation (e.g., QoS, price, packaging option, etc.).

7) If the service provider grants the end-user access to the content, the service provider interacts with the network provider to negotiate the conditions of forwarding the VoD content to the end-user. This procedure may include reserving network resources to guarantee the contracted service level on the new access network.

8) Upon completion of step 7, the service provider supplies the new content access information and the end-user can continue to receive the VoD content.

7.2 Personal mobility support

7.2.1 Personal mobility support for IPTV broadcast service

As one of the basic IPTV services, the IPTV broadcast service is expected to be available on various kinds of mobile IPTV terminal devices such as cellular phone, smart phone, and personal digital assistant (PDA). Among the different IPTV terminal devices, an end-user can move while keeping the personal information such as IPTV service subscription information (i.e., personal mobility).

Figure 7-7 below depicts a sample scenario for IPTV broadcast service with personal mobility.

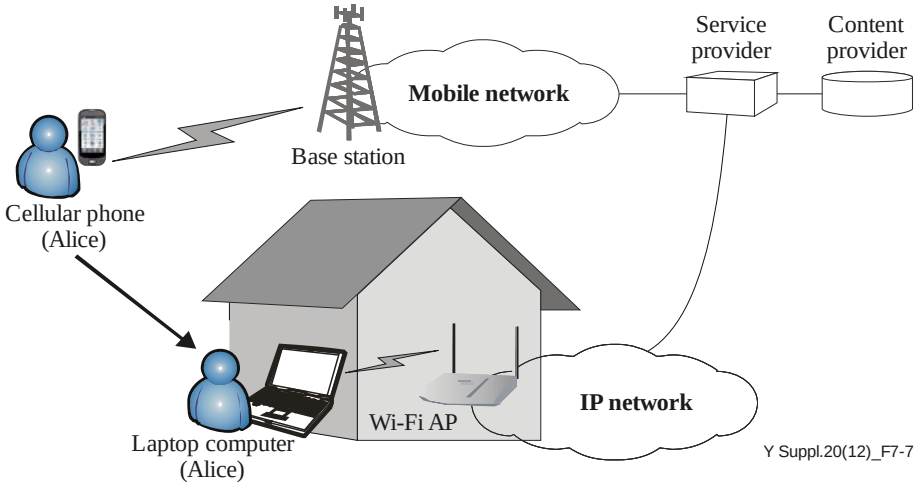

Figure 7-7 – IPTV broadcast service with personal mobility

In this scenario, while Alice uses the IPTV broadcast service on various IPTV terminal devices, personal mobility – as the mobility for those scenarios wherein the user changes the terminal used for network access at different locations – is provided.

The operational procedures of the scenario are as follows:

1) The cellular phone of Alice, an IPTV service subscriber, connects to a mobile network.

2) Alice accesses an IPTV broadcast service provided by an IPTV service provider with her cellular phone. The IPTV service provider authenticates Alice as subscriber based on her personal identity to provide the IPTV broadcast service.

3) Alice watches some TV programmes on her cellular phone for a while and closes the IPTV broadcast service on the cellular phone. The session between the cellular phone and the IPTV service provider is disconnected.

4) Alice goes into her house and attempts to connect to an IPTV service with her laptop computer. The laptop computer connects to a Wi-Fi access point (AP) and accesses the IPTV broadcast service that she had previously accessed on her cellular phone outside. Alice can also use other IPTV services to which she subscribed. For the session establishment between the laptop computer and the IPTV service provider, Alice is authenticated based on her personal identity similar to the use case of a cellular phone.

The following figure shows a procedural diagram of IPTV functions for IPTV broadcast service with personal mobility.

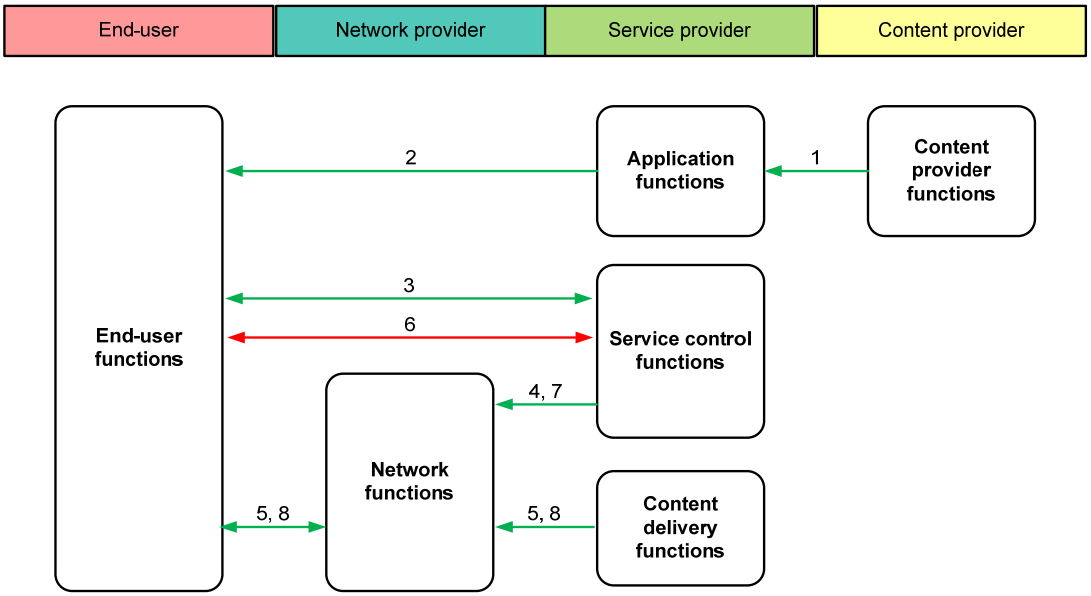

Figure 7-8 – Use case of IPTV broadcast service with personal mobility

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating the content is ready for consumption.

3) When an end-user wants to access the linear TV service or selects a channel, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the linear TV service, the service provider interacts with the network provider to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information (e.g., the multicast address assigned to the requested channel) to the end-user. Then he or she can access and watch the channel.

Note that steps 1 to 5 are the same as those depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

6) With personal mobility, the request for the same service by the end-user in a different terminal device is sent to the service provider. This procedure may include providing the subscription information of the user in the previous terminal device.

Steps 4 and 5 are repeated in steps 7 and 8, respectively.

7.2.2 Secure personal mobility support using mobile VPN

Mobile virtual private network (VPN) is a network configuration wherein mobile devices such as notebook computers or PDAs access a VPN while moving from one physical location to another. Providing continuous service to users, mobile VPN can seamlessly switch across access network technologies and multiple public and private networks.

The scenario uses mobile VPN to support secure personal mobility. There are many kinds of access networks, such as 3G, WiMAX [b-IEEE 802.16e] and Wi-Fi. A mobile terminal can establish a security association as well as create an Internet protocol security protocol (IPsec) [b-IETF RFC 4301] tunnel between a mobile terminal and the secure mobile VPN gateway of the service provider. An IPsec tunnel helps support fast handover for secure personal mobility.

Figure 7-9 below depicts a sample scenario for secure personal mobility support using mobile VPN.

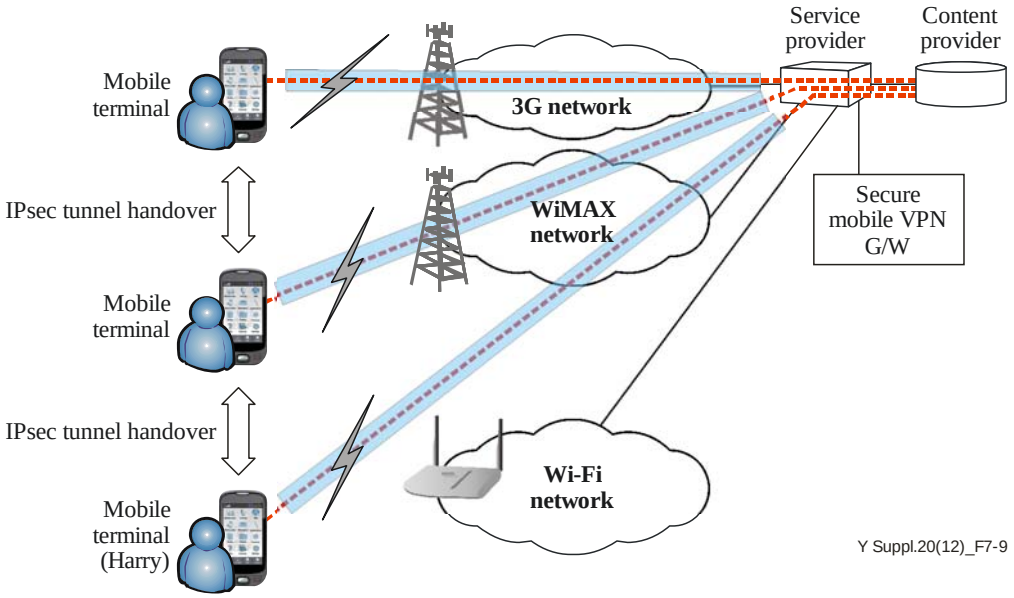

Figure 7-9 – Secure personal mobility support using mobile VPN

In this scenario, Harry's mobile terminal of an IPTV service in the Wi-Fi network establishes a connection, and the terminal initiates a security association with the secure mobile VPN gateway of the service provider. The terminal and the gateway perform key exchange to set up the security association initialization procedure and a key exchange authentication procedure to set up an IPsec tunnel. Harry views IPTV content via the tunnel using mobile VPN.

The operational procedures of the scenario are as follows:

1) Harry moves to another location where the Wi-Fi network is no longer provided but WiMAX is provided.

2) The connection manager in the terminal informs the secure mobile VPN gateway that its IP address has been changed. After the message is exchanged, the IPTV content is sent and received through the WiMAX network via the seamless mobile VPN tunnel.

3) The connection manager in the terminal cuts the Wi-Fi connection for resource saving.

4) Harry moves to another location where the WiMAX network is no longer provided. 3G network is provided at that location.

5) The connection manager in the terminal establishes new connection to the 3G network. The terminal sends to the secure mobile VPN gateway an informal message that its IP address has been changed. After the message is exchanged, the IPTV content is sent and received through the 3G network via seamless mobile VPN tunnel handover.

6) The connection manager in the terminal cuts the WiMAX connection for resource saving.

The following figure shows a procedural diagram of IPTV functions for secure personal mobility support using mobile VPN.

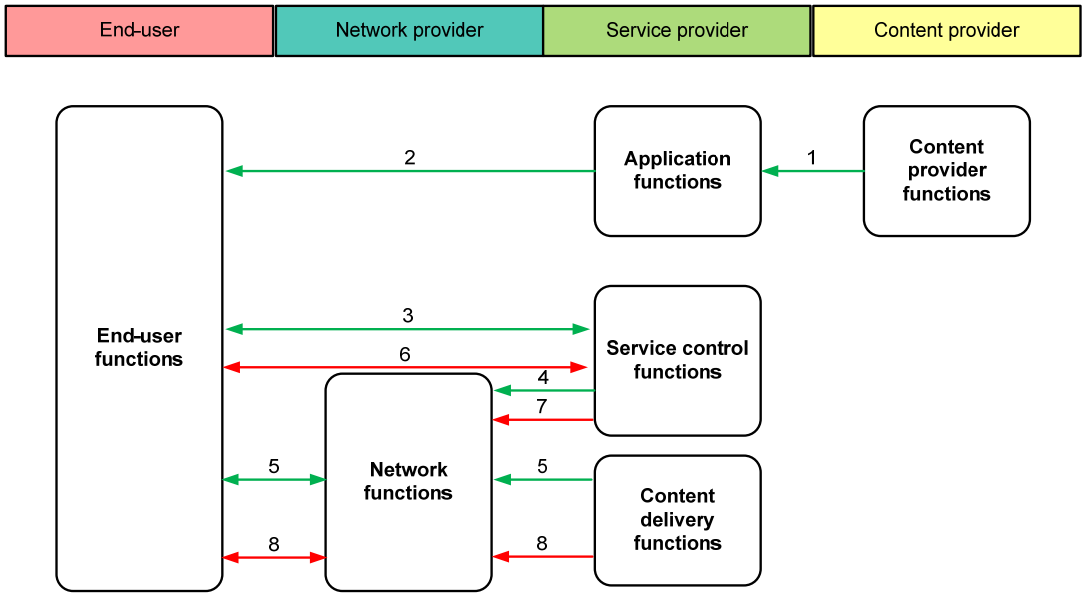

Figure 7-10 – Use case of secure personal mobility support using mobile VPN

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and control the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating the content is ready for consumption

3) When an end-user wants to access using mobile VPN for the mobile IPTV service or selects a channel, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the mobile IPTV service, the service provider interacts with the network provider to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information to the end-user. The end-user establishes security association and creates IPsec tunnel between the end-user and the mobile VPN gateway. Then he or she can access and watch the channel.

6) If the end-user moves to another location where Wi-Fi network is no longer provided, the end-user requests to change the access network to the service provider.

7) The service provider interacts with the network provider to change the access network. From the previous authentication to the secure mobile VPN gateway, the provider can help to change the access network for seamless service.

8) Finally, the end-user can access and watch the contents through the access network technology.

7.3 IPTV content delivery support

7.3.1 Content delivery using the multicast service zone

Multicast service zone is an area where the IPTV service delivered using the multicast mechanism is available. IPTV services may be provided to end-users who are in a specific service zone consisting of one or more base stations. The service zone is created only when and where a user requests a certain mobile IPTV service for the first time. Once the service zone for the mobile IPTV service is configured, the user does not experience service interruption as long as he or she is within the service zone. All base stations consisting of the service zone use the same multicast channel. The service zone can be expanded up to the service zone boundary.

Figure 7-11 below shows a sample scenario of providing mobile IPTV service to end-users using the multicast service zone.

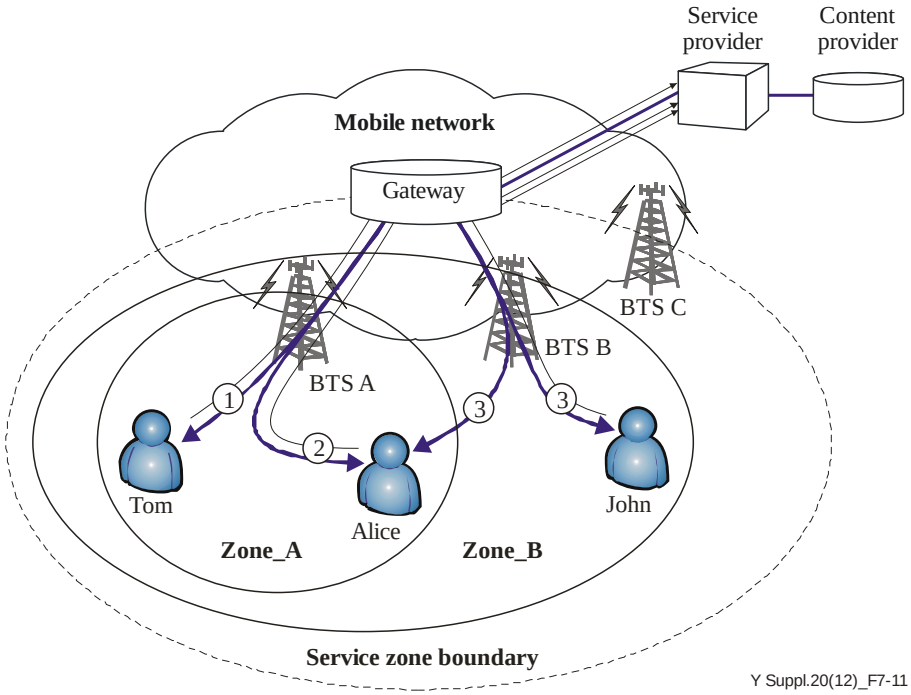

Figure 7-11 – IPTV content delivery using the multicast service zone

In this scenario, the service provider should perform the following:

– Manage the multicast group and user/service profiles.

– Configure a service zone according to the location of users.

The gateway in the mobile network should perform the following:

– Control content synchronization among base transceiver stations (BTSs) within a service area.

All BTSs should perform the following:

– Reserve a dedicated wireless channel for delivering the IPTV content to be aired in the service zone.

– Transmit mobile IPTV content using the reserved resources.

The operational procedures of the scenario are as follows:

1) User Tom sends a mobile IPTV service request to the service provider. Tom makes a multicast connection to BTS A.

2) The service provider makes the multicast service zone ZONE_A, which consists of BTS A. The service provider then sends the IPTV content to Tom, who receives it through BTS A.

3) User Alice wants to join the same mobile IPTV service as Tom. Thus, Alice sends a mobile IPTV service request to the service provider and makes a multicast connection to BTS A.

4) Upon receiving the request message sent by Alice, the service provider checks whether the requested service is already active or not, including whether Alice is in the same multicast service zone as Tom or not. In Figure 7-11, the requested mobile IPTV service is already active, and Alice is also in ZONE_A with Tom. Thus, the service provider maintains the existing multicast service zone.

5) Alice receives the same IPTV content – which is already being multicasted – as Tom.

6) User John wants to join the same mobile IPTV service as Tom and Alice. Thus, John sends a mobile IPTV service request to the service provider. John makes a multicast connection to BTS B.

7) Upon receiving the request message sent by John, the service provider checks whether the existing ZONE_A should be changed or not. In Figure 7-11, although John is joining the same mobile IPTV service as Tom and Alice, he is connected to BTS B, which is outside of ZONE_A. The service provider decides to make a new multicast service zone, ZONE_B, which includes both BTS_B and BTS A.

8) John receives the same IPTV content as Tom and Alice through BTS B and BTS A. Tom and Alice also receive the IPTV content from BTS A and BTS B in ZONE_B.

The following figure shows a procedural diagram of IPTV functions for the mobile IPTV service using service zone.

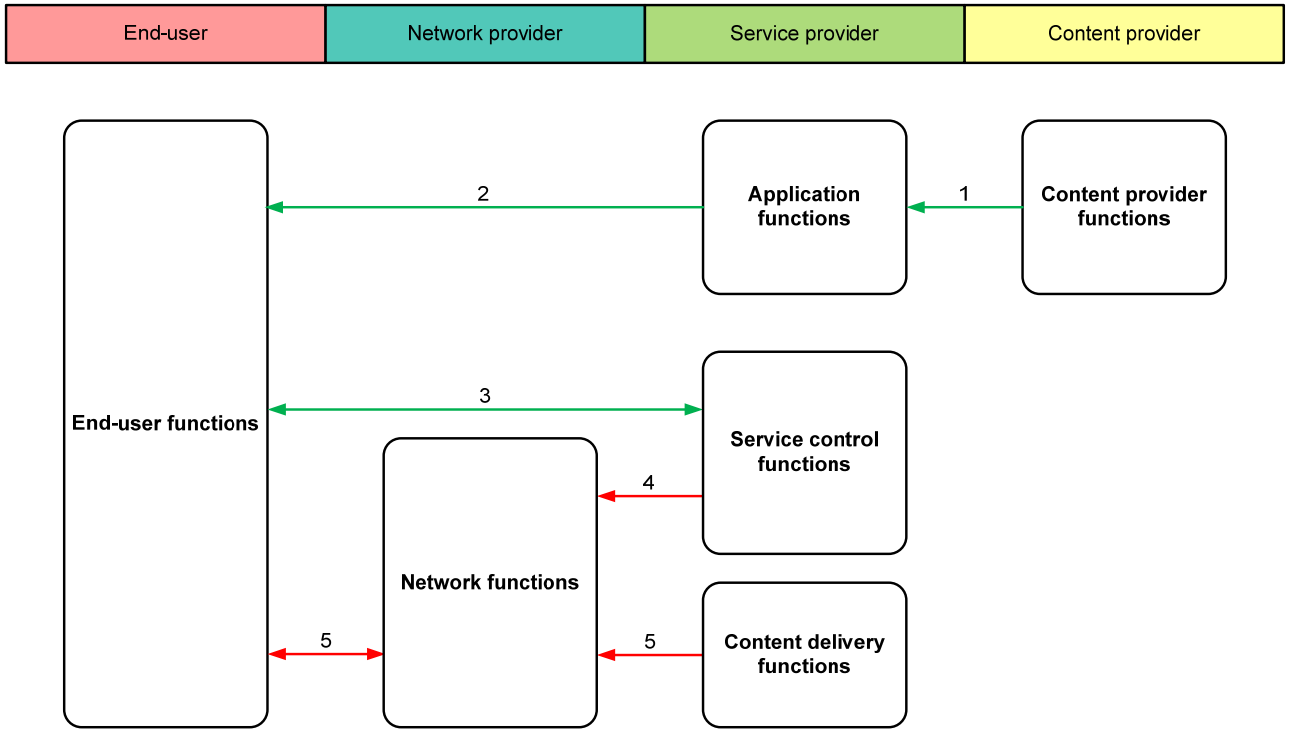

Figure 7-12 – Use case of the mobile IPTV service using service zone

1) IPTV content and its metadata and content protection data, produced and managed by the content provider, are delivered to the service provider.

2) The service provider prepares the IPTV content as per the agreement between the content provider and the service provider.

3) When an end-user selects the IPTV content, the request(s) is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, packaging option, etc.).

Note that steps 1 to 3 are the same as those depicted in Figure 6-8 of [b-ITU-T Y.Sup5].

4) If the service provider grants the end-user access to the IPTV content, it configures multicast service zone. And then, it interacts with the network provider to possibly negotiate the conditions of forwarding the content to the end-user. This procedure includes controlling network resources to guarantee the multicast transmission over wired and wireless network. And also, this procedure may include reserving network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider and network provider supply the content access information (e.g., the multicast address that will be used to forward the content and the multicast connection identifier that will be used to transmit the IPTV content over the wireless link) and the end-user can then receive the IPTV content.

7.3.2 Content delivery using the dynamic service zone

The mobile IPTV service can be delivered to end-users who are in a given multicast service zone. However, if users are not in the service zone, the mobile IPTV service is inaccessible to them. This means that the service mobility of the mobile IPTV service is supported only within the service zone. Thus, the mobile IPTV service needs to be delivered continuously to the end-users who go outside of the service zone. The service zone can be expanded up to the service zone boundary.

Figure 7-13 below shows an example of the scenario wherein the multicast service zone is dynamically configured according to the movement of the end-user. This kind of service zone is called a dynamic service zone or a dynamic multicast service zone.

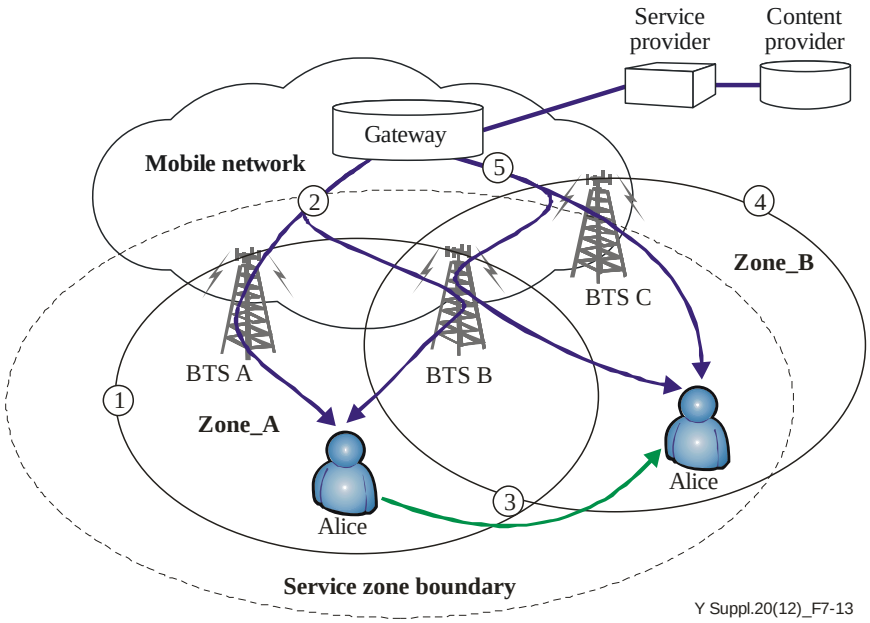

Figure 7-13 – Mobile IPTV service based on the dynamic service zone

In this scenario, for the service continuity of the mobile IPTV service based on the dynamic service zone, the service provider should perform the following:

– Reconfigure the service zone according to the user's movement.

– Manage the multicast group and user/service profiles.

– Decide which base stations will be a member of the dynamic service zone.

The gateway in the mobile network should perform the following:

– Control data synchronization among BTSs belonging to the same service zone.

BTSs belonging to the same service zone should perform the following:

– Transmit IPTV content to users at the same time.

– Monitor the user's movement and report the location of the user to the service provider.

The operational procedures of the scenario are as follows:

1) User Alice accesses the mobile network through base station B (BTS B) and sends a mobile IPTV service request to the service provider. Alice makes a multicast connection to BTS B.

2) The service provider makes the service zone ZONE_A, which consists of BTS A and BTS B. The member base stations of the service zone are chosen by the service provider based on the information sent by the user. Then, the service provider sends the IPTV content to Alice. Alice receives it through BTS A and BTS B as members of ZONE_A. The members of ZONE_A multicast the IPTV content to Alice.

3) While the mobile IPTV service is in use, Alice performs handover from BTS B to BTS C. BTS C notifies the service provider of Alice's movement and channel information of the neighbouring base stations.

4) Upon receiving the report on the movement of user and channel information from the user who is already using the mobile IPTV service, the service provider replaces the old service zone, ZONE_A, with a new one – ZONE_B – according to the report message. The member BTSs of ZONE_B are BTS B and BTS C. After finishing the configuration of the new service zone, the service provider sends the IPTV content to the new service zone, ZONE_B.

5) Now, Alice receives the IPTV content through BTS B and BTS C simultaneously.

The following figure shows a use case of the mobile IPTV service using dynamic service zone.

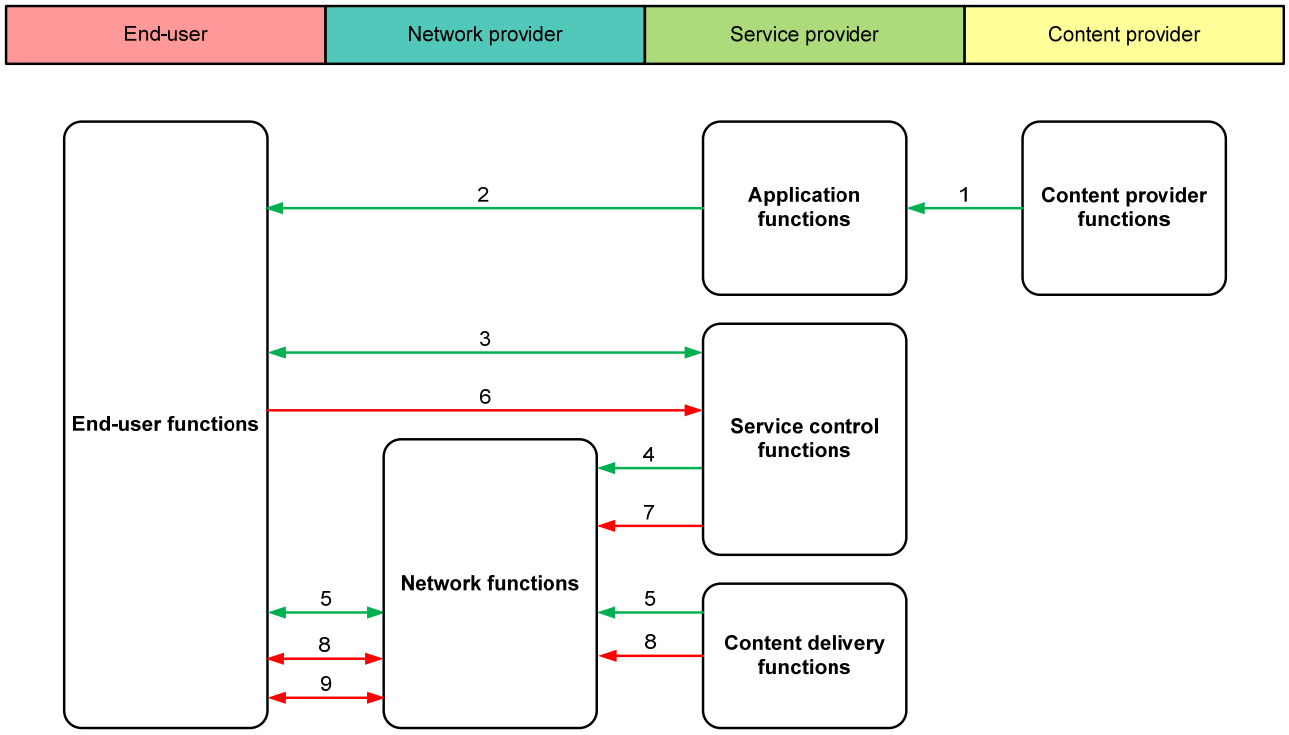

Figure 7-14 – Use case of the mobile IPTV service using dynamic service zone

1) IPTV content and its metadata and content protection data, produced and managed by the content provider, are delivered to the service provider.

2) The service provider prepares the IPTV content as per the agreement between the content provider and the service provider.

3) When an end-user selects the IPTV content, the request(s) is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, packaging option, etc.).

Note that steps 1 to 3 are the same as those depicted in Figure 6-8 of [b-ITU-T Y.Sup5].

4) If the service provider grants the end-user access to the IPTV content, it configures multicast service zone. And then, it interacts with the network provider to possibly negotiate the conditions of forwarding the content to the end-user. This procedure includes controlling network resources to guarantee the multicast transmission over wired and

wireless network. And also, this procedure may include reserving network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider and network provider supply the content access information (e.g., the multicast address that will be used to forward the content and the multicast connection identifier that will be used to transmit the IPTV content over the wireless link) and the end-user can then receive the IPTV content.

6) The end-user sends a request for the zone re-configuration to the service provider according to the pre-defined rule by the end-user functions.

7) The service provider re-configures the multicast service zone which is already configured. This procedure is same as step 4.

8) Upon completion of step 7, the end-user can then receive the IPTV content continuously.

9) At handover, the end-user checks whether he or she is inside the multicast service zone, or not. If the end user is inside the multicast service zone, he or she makes only wireless link connection with the network provider. Otherwise, the end user should perform step 3 to step 5 to use the IPTV content.

7.3.3 Content delivery using multiple access networks

A mobile terminal has multiple interfaces to use different types of network in need. In general, radio resource is not enough in a single wireless access network. To enhance the usage efficiency of wireless access network and increase the streaming quality of contents for the mobile IPTV service, the multi-interface mobile terminal needs to receive streaming data simultaneously through multiple access networks such as 2G/3G, Wi-Fi, and wireless broadband (WiBro)/WiMAX [b-IEEE 802.16e]. This scenario provides a mechanism for improving network and user terminal efficiency and utilization. In content delivery through multiple access networks, content synchronization between multiple wireless access networks should be guaranteed.

Figure 7-15 below depicts a sample scenario for content delivery using multiple access networks.

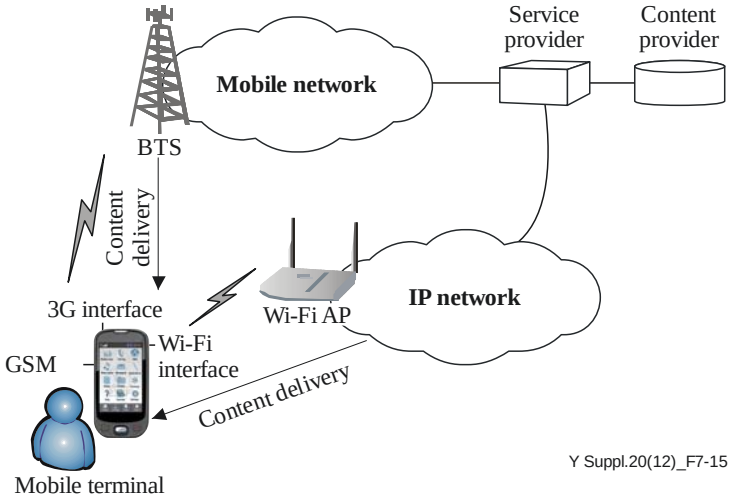

Figure 7-15 – Content delivery using multiple access networks

In this scenario, Jack, an IPTV service subscriber, uses a mobile terminal equipped with Wi-Fi, 3G, and global system for mobile communication (GSM) interfaces.

The operational procedures of the scenario are as follows:

1) Jack, an IPTV service subscriber, wants to view HD IPTV contents and selects high-definition (HD) contents.

2) He requests the IPTV service provider to use multiple access networks for the selected HD contents.

3) The IPTV service provider receives the capability information of each interface. Based on the information, each interface is to be allocated a limited transmission rate.

4) The contents can be delivered to the mobile terminal simultaneously through multiple access networks consisting of 3G, GSM, and Wi-Fi.

5) Jack views the selected contents through multiple access networks.

The following figure shows a procedural diagram of IPTV functions for IPTV content delivery using multiple access networks.

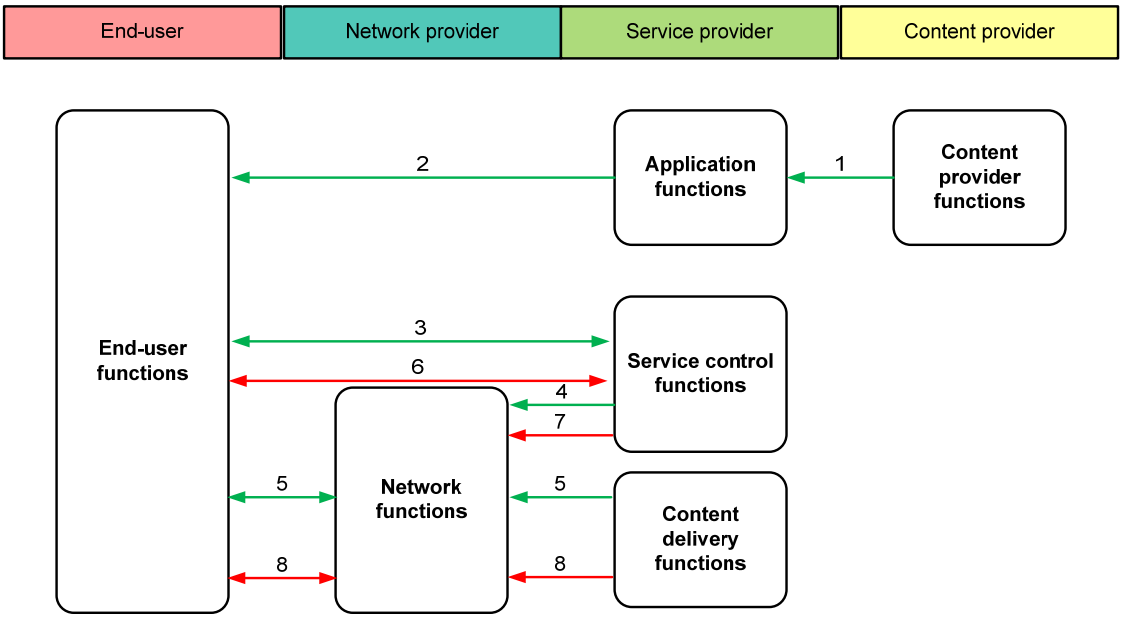

Figure 7-16 – Use case of IPTV content delivery using multiple access networks

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets.

3) When an end-user wants to access the mobile IPTV service, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

Note that steps 1 to 3 are the same as those depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

4) If the end-user is granted access to the mobile IPTV service, the service provider interacts with the network providers to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information to the end-user. Then he or she can access and watch the channel.

6) If the end-user wants to watch the content via multiple network interfaces such as 3G, GSM and Wi-Fi interfaces, the end-user can request to the service provider.

7) If the end-user is granted access to the newly requested multi-interfaces service, the service provider interacts with each network provider for using multiple network interfaces such as 3G, GSM and Wi-Fi to transmit the content simultaneously. This procedure may include reserving and allocating network resource to guarantee the contracted service level.

8) Finally, he or she can watch the content via multiple network interfaces such as 3G, GSM and Wi-Fi.

7.3.4 P2P-based IPTV content delivery to mobile terminals

Peer-to-peer (P2P) technology provides the targeted infrastructure with efficient cooperation among end-users for IPTV [ITU-T Y.1902]. A P2P-based mobile IPTV terminal should support important service capability to deliver/receive real-time IPTV streaming traffic through a mobile network. It also ensures traffic efficiency and cost effectiveness in providing IPTV services to mobile end-users.

Figure 7-17 below shows a sample scenario for P2P-based mobile IPTV service with terminal mobility.

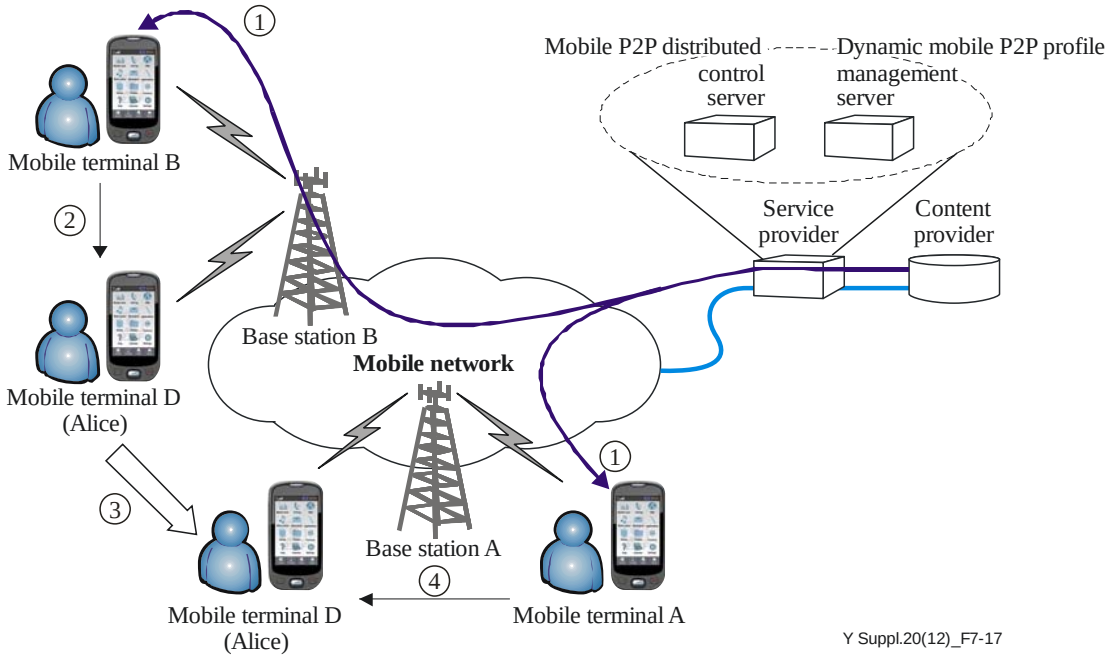

Figure 7-17 – P2P-based mobile IPTV service

In this scenario, the dynamic mobile P2P profile management server confirms the subscriber's terminal profile. In addition, the mobile P2P distributed control server controls and manages the peering of P2P service subscribers. The cellular phone of Alice, an IPTV service subscriber (with mobile terminal – D), connects to a mobile network through BS-B.

The operational procedures of the scenario are as follows:

1) Peering members (mobile-terminal-B and mobile-terminal-A) share contents from the content provider.

2) Alice joins a peering group of the content based on information of a mobile P2P distributed control server. She views the content from mobile terminal-B.

3) Alice moves to another location and connects to the mobile network through BS-A.

4) She keeps viewing the content by changing the peering member to another peer, mobile terminal-A.

The following figure shows a procedural diagram of IPTV functions for P2P-based IPTV content delivery.

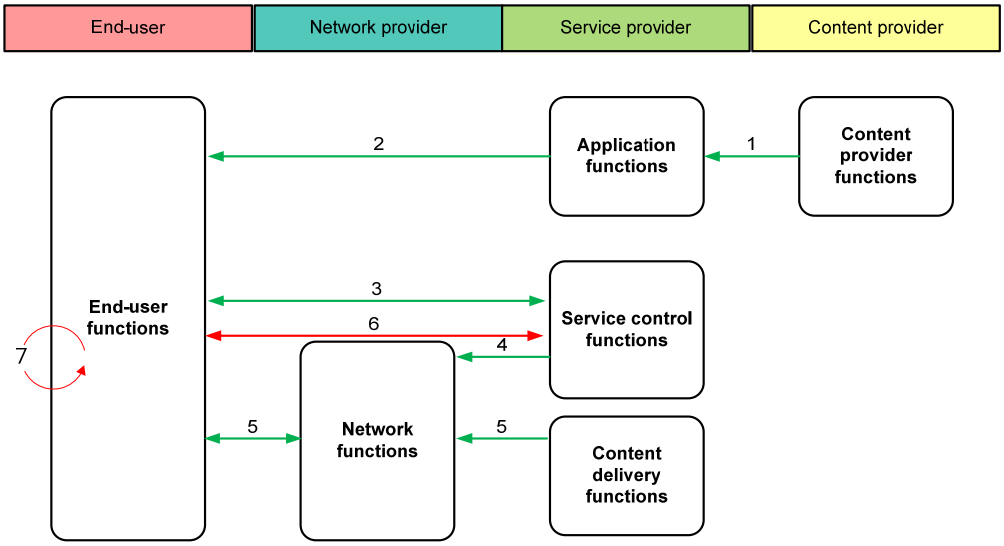

Figure 7-18 – Use case of P2P-based IPTV content delivery

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets.

3) When an end-user wants to access to the mobile IPTV service using P2P system, the request is sent to the service provider.

4) If the end-user is granted access to the mobile IPTV service, the service provider interacts with the network provider to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information to the end-user. Then he or she can access and watch the P2P content under the same BS.

6) When the end-user moves to another location, he or she requests the service provider to find another end-user who shares the same content in the P2P system.

7) The service provider with P2P server interacts with the end-user to notify parents peer to receive the same content. Then he or she can access and watch the content from an end-user as a parents peer through the same BS.

7.4 Delivery support of user-created IPTV content

Because of the two-way communication capability of the mobile IPTV terminal device, an end-user of mobile IPTV can provide user-created content (UCC) to the mobile IPTV system by using the mobile IPTV terminal device. There may be two types of scenario according to the handover of mobile IPTV terminal device. One case is that the mobile IPTV terminal device is moving into one base station coverage area, and the other is that it is moving from one base station to another while sending contents to the IPTV service provider.

7.4.1 UCC delivery over mobile networks

An IPTV terminal device can provide the user-created IPTV content while being connected to a mobile network.

Figure 7-19 below depicts a sample scenario for UCC delivery of IPTV terminal devices over mobile networks.

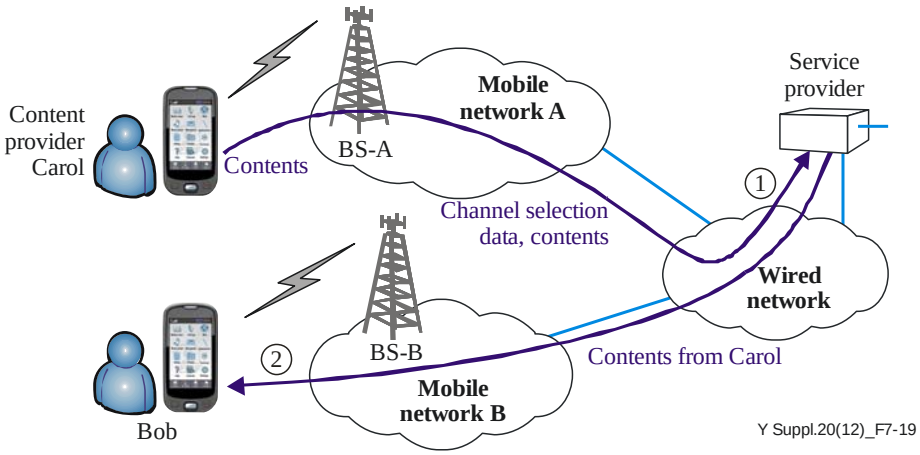

Figure 7-19 – Delivery of UCC over mobile networks

In this scenario, an IPTV terminal device is providing contents to other IPTV terminal devices when the originating terminal device is moving within a base station coverage area. This scenario has the following pre-conditions:

– The mobile IPTV terminal device of user Carol is connected to the mobile network.

– The mobile IPTV terminal device of user Bob is connected to the mobile network.

– Carol and Bob can exist in the same base station area or in different base station areas, but this scenario assumes that they are in different base stations.

The operational procedures of the scenario are as follows:

1) The mobile IPTV terminal device of Carol sends contents to the service provider through base station A.

2) The service provider stores the content delivered from the user to its media server.

3) In case Bob, a mobile IPTV user, selects the contents provided by Carol, the selection information of that channel is sent to the IPTV service provider first.

4) The service provider then sends the contents to Bob by multicast, P2P, or unicast method based on the content delivery policy of the IPTV service provider.

5) Bob enjoys the content from Carol on his mobile IPTV terminal device.

The following figure shows a procedural diagram of IPTV functions for IPTV content delivery by a mobile IPTV terminal device within a single base station coverage.

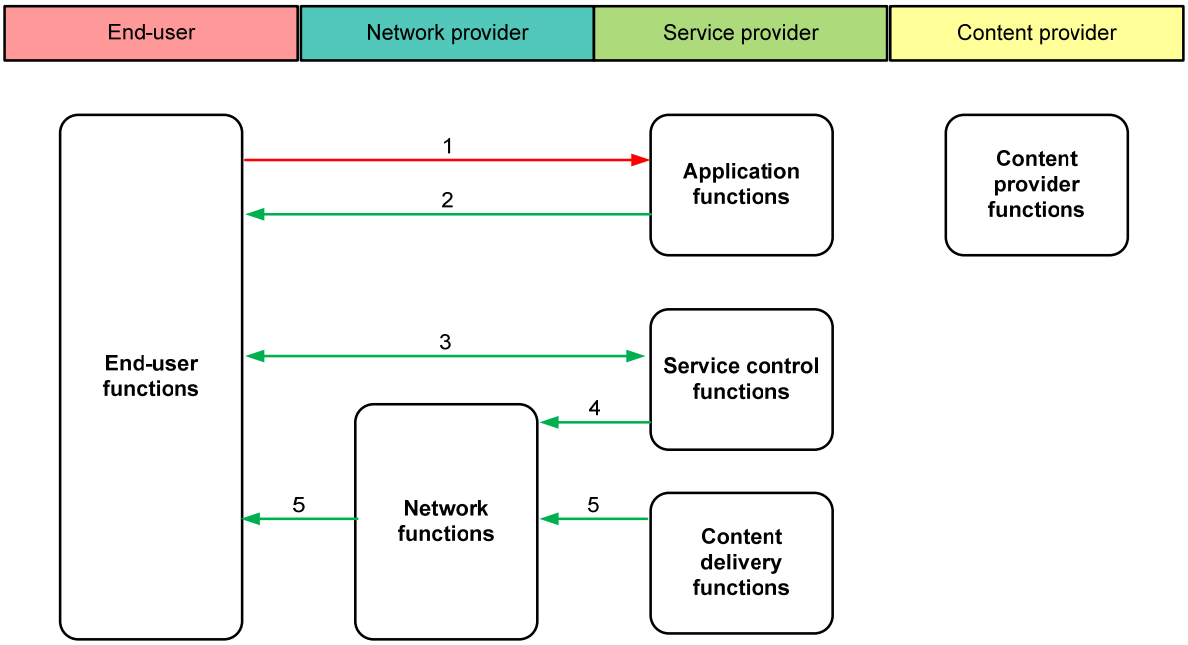

Figure 7-20 – Use case of UCC delivery over mobile networks

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the end-user, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating the content is ready for consumption.

3) When an end-user wants to access the linear TV service or selects a channel, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the linear TV service, the service provider interacts with the network provider to transmit the requested content via multiple access networks.

5) Upon completion of step 4, the service provider supplies channel access information over multiple access networks (e.g., the multicast addresses assigned to the requested channel) to the end-user.

Note that steps 2 to 5 are the same as those depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

7.4.2 UCC delivery from a moving IPTV terminal

An IPTV terminal device can provide the user-created IPTV content while moving to different base station coverage areas.

Figure 7-21 below depicts a sample scenario for UCC delivery of IPTV terminal devices while moving to different locations.

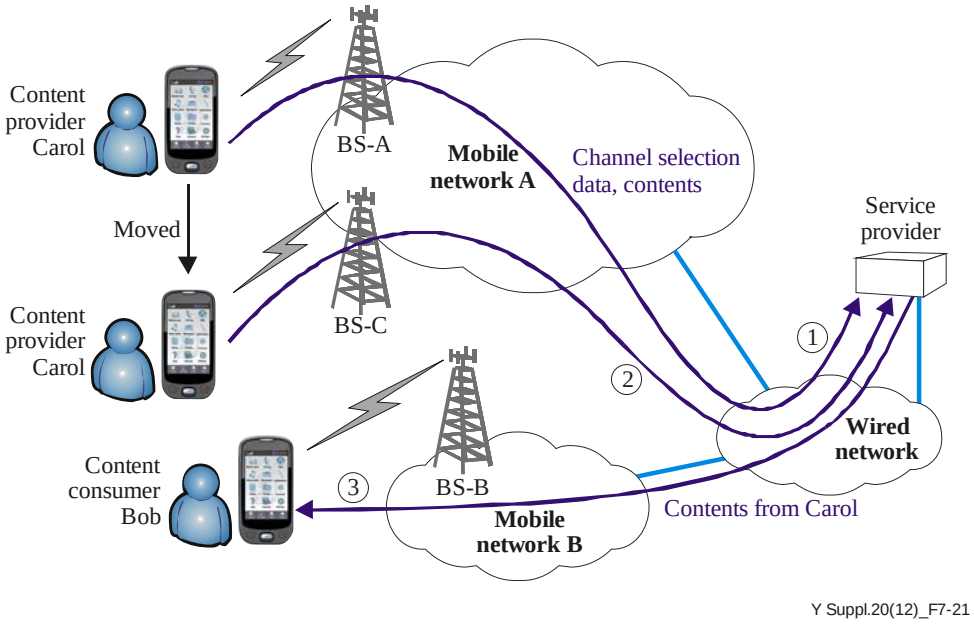

Figure 7-21 – Delivery of UCC from a moving IPTV terminal device

In this scenario, a subscriber, Carol, is providing IPTV content while her mobile IPTV terminal device is moving from one base station coverage area to another.

The operational procedures of the scenario are as follows:

1) If Carol's mobile IPTV terminal device moves from base station A coverage to base station C coverage area, then Carol's mobile IPTV terminal device sends contents to the mobile IPTV service provider through base station C continuously regardless of the location of the mobile IPTV terminal device.

2) Other service procedures are the same as those in clause 7.4.1.

The following figure shows a procedural diagram of IPTV functions for IPTV content delivery by a mobile IPTV terminal device.

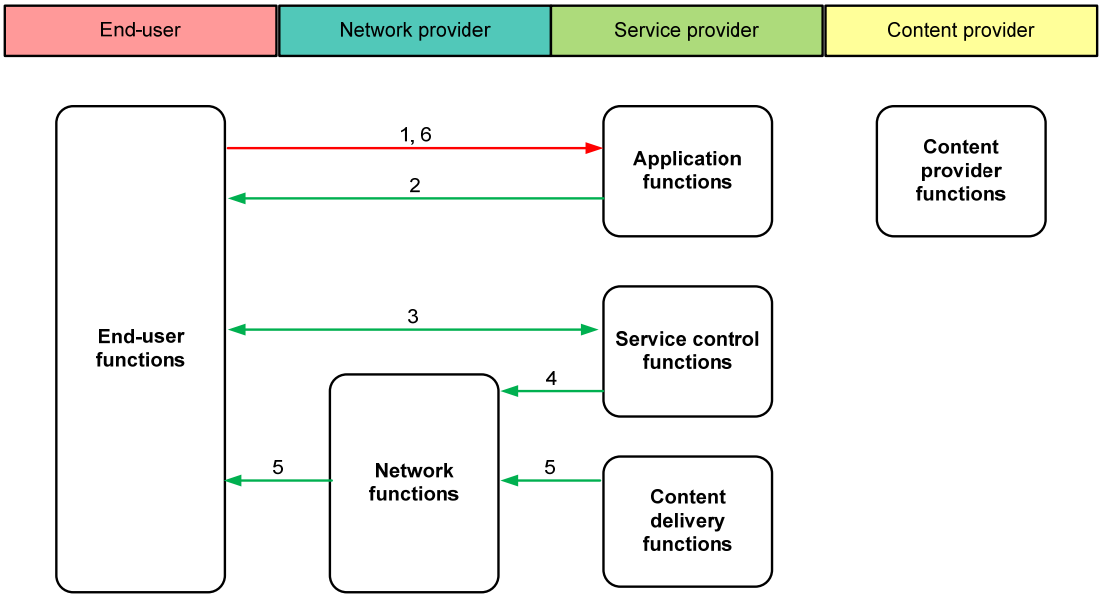

Figure 7-22 – Use case of UCC delivery from a moving IPTV terminal device

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the end-user, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating the content is ready for consumption.

3) When an end-user wants to access the linear TV service or selects a channel, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the linear TV service, the service provider interacts with the network provider to transmit the requested content via multiple access networks.

5) Upon completion of step 4, the service provider supplies channel access information over multiple access networks (e.g., the multicast addresses assigned to the requested channel) to the end-user.

Note that steps 2 to 5 are the same as those depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

6) When the IPTV terminal device moves to a different base station coverage, the end-user supplies new channel access information for the visiting access network so that he or she continues to send the IPTV content in the visiting access network.

7.4.3 P2P-based UCC delivery to mobile terminals

The user-created IPTV content can be delivered to mobile IPTV terminal devices with P2P technologies.

Figure 7-23 below depicts a sample scenario for UCC delivery with P2P technologies.

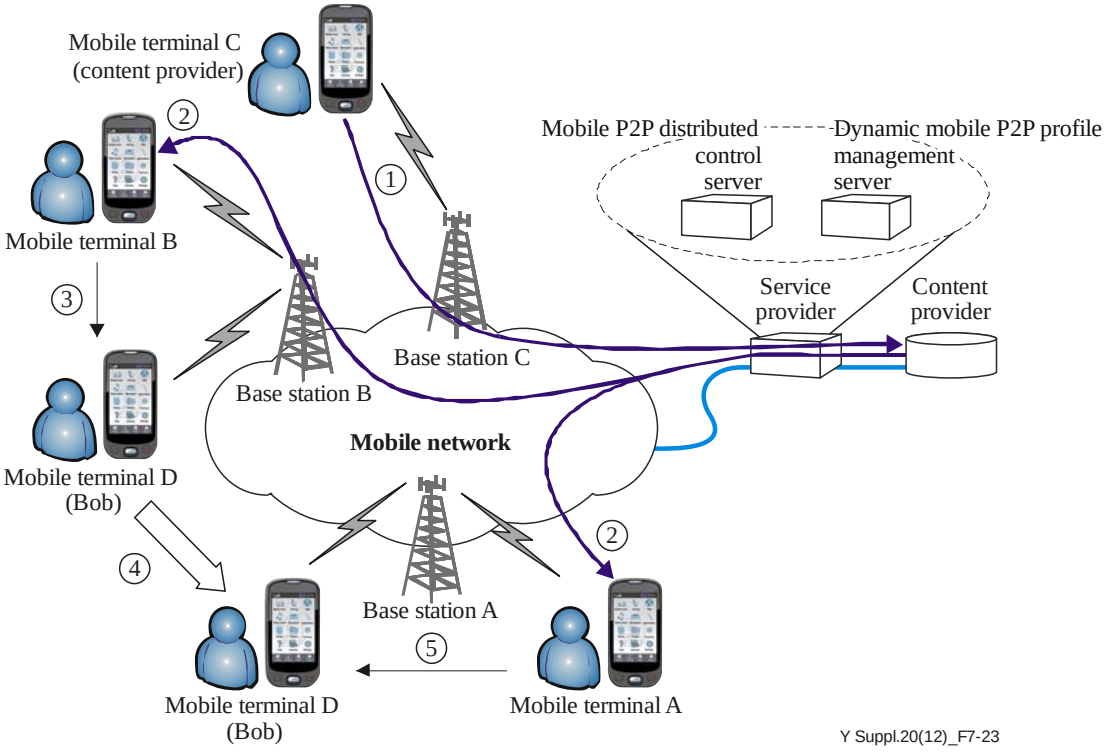

Figure 7-23 – P2P-based UCC delivery to mobile terminals

In this scenario, the dynamic mobile P2P profile management server confirms the subscriber's terminal profile; the mobile P2P distributed control server controls and manages the peering of service subscribers. The cellular phone of Bob, an IPTV service subscriber (with mobile terminal – D), connects to the mobile network through BS-B.

The operational procedures of the scenario are as follows:

1) Mobile-terminal-C provides its personalized contents to the content provider.

2) Peering members (mobile-terminal-B and mobile-terminal-A) share contents from the content provider.

3) Bob joins the peering group of the contents based on the information of the mobile P2P distributed control server. He views contents from mobile-terminal-B.

4) Bob moves to another location.

5) He keeps viewing the personalized contents by changing the peering member to another peer, mobile-terminal-A.

The following figure shows a procedural diagram of IPTV functions for P2P-based UCC delivery to mobile terminals.

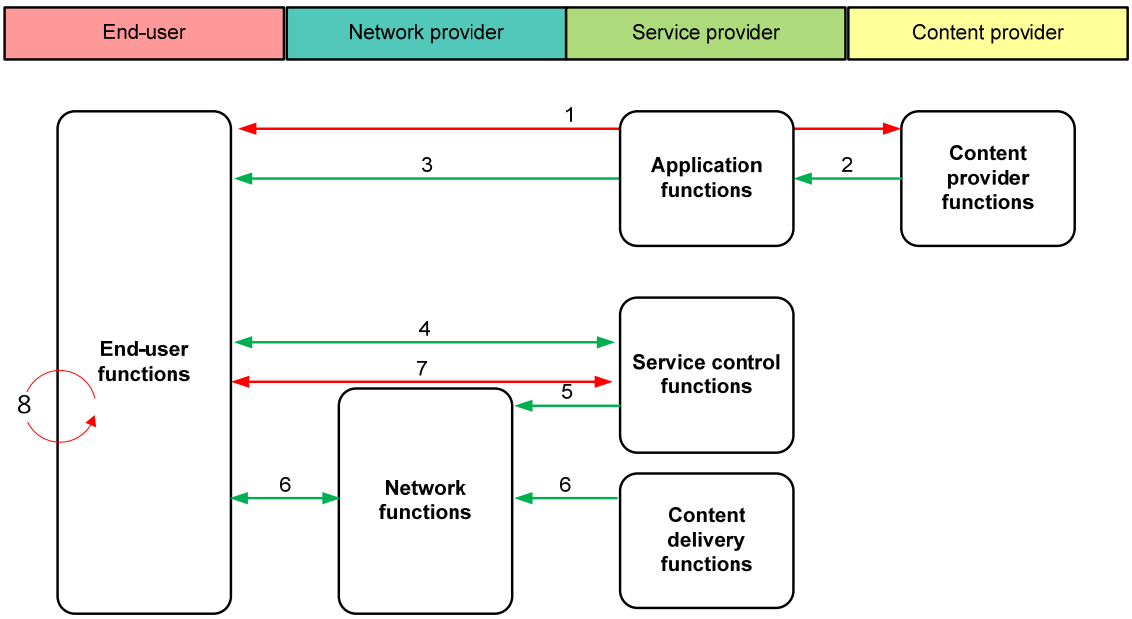

Figure 7-24 – Use case of P2P-based UCC delivery to mobile terminals

1) End-users can provide its personalized contents for sharing between P2P users to the content provider.

2) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

3) The service provider then formats the data prepared by the content provider into IP packets.

4) When an end-user wants to access to the mobile IPTV service using P2P system, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

5) If the end-user is granted access to the mobile IPTV service, the service provider interacts with the network provider to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

6) Upon completion of step 5, the service provider supplies channel access information to the end-user. Then he or she can access and watch the content.

7) When an end-user moves to another location, he or she requests the service provider to find another end-user who shares the same content in the P2P system.

8) The service provider with P2P server interacts with the end-user to notify parents peer to receive the same contents. Then he or she can access and watch the content from an end-user as a parents peer under the same BS.

8 Mobile IPTV use cases from the service perspective

8.1 n-screen service

8.1.1 n-screen service with contents sharing

n-screen service allows an IPTV service subscriber to use IPTV service contents on TV, PC, and wireless screens. One of the typical n-screen services involves sharing the same IPTV service contents on more than one screen among the three kinds of screens.

Figure 8-1 below depicts a sample scenario for n-screen service with contents sharing.

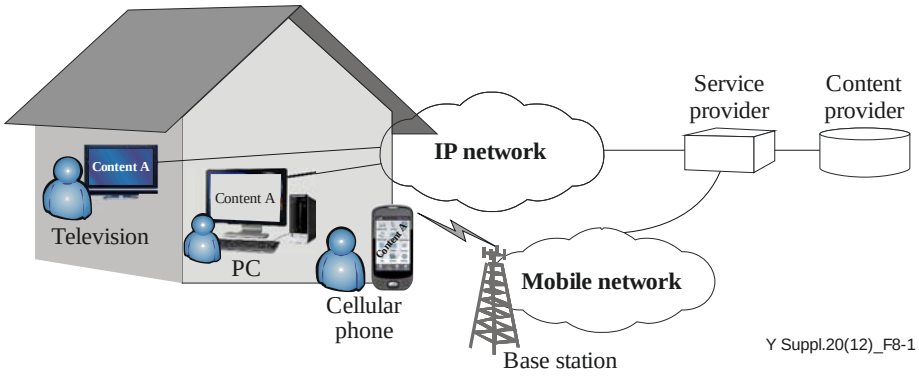

Figure 8-1 – n-screen service with contents sharing

In this scenario, Eve, an IPTV service subscriber, and her friends want to watch a movie at Eve's home. Eve will watch the movie on her cellular phone, and others will watch the movie on the television and PC. For the provision of n-screen service in this scenario, the capability information of each terminal device needs to be delivered to the IPTV service provider. Then, the IPTV service provider adapts the IPTV contents to the screens considering the capabilities of each terminal device.

The operational procedures of the scenario are as follows:

1) Eve's cellular phone accesses the mobile network. Eve connects to the IPTV service to which she subscribed and accesses VoD service after the IPTV service discovery procedure. She selects the movie that she and her friends plan to watch.

2) She notifies the IPTV service provider that she wants to use the n-screen service with the selected VoD content, which means that the TV, PC and Eve's cellular phone use the same VoD content anytime within a valid date.

3) The IPTV service provider receives the capability information of each IPTV terminal, adapts the audio and video of the content to the screens considering the capabilities, and delivers the content to the IPTV terminal devices. Eve and her friends watch the same movie on the screens.

The following figure shows a procedural diagram of IPTV functions for n-screen service with contents sharing.

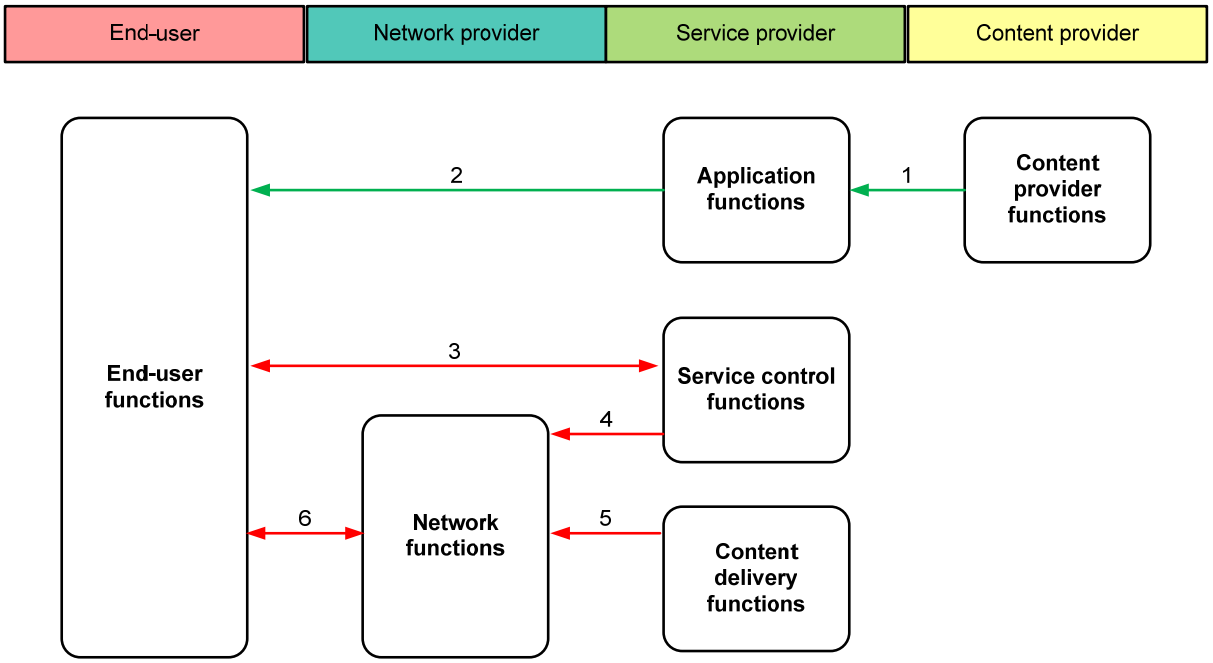

Figure 8-2 – Use case of n-screen service with contents sharing

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating the content is ready for consumption.

Note that steps 1 to 2 are the same as those depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

3) When an end-user wants to access the linear TV service or selects a channel, the request is sent to the service provider including the capability information about different IPTV terminal devices. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the linear TV service, the service provider interacts with the network provider to transmit the requested content to multiple IPTV terminal devices for content sharing.

5) Upon completion of step 4, the service provider supplies channel access information for multiple IPTV terminal devices (e.g., the multicast addresses assigned to the requested channel) to the end-user. The content delivery functions need to segment the IPTV content to deliver the segments to different devices.

6) Then the end-user can share the IPTV content using different IPTV terminal devices.

8.1.2 n-screen service with service mobility

n-screen service allows an IPTV service subscriber to use IPTV service contents on TV, PC, and wireless screens continuously. It is regarded as one of the representative IPTV services supporting service mobility among the three kinds of screens.

Figure 8-3 below depicts a sample scenario for n-screen service with service mobility.

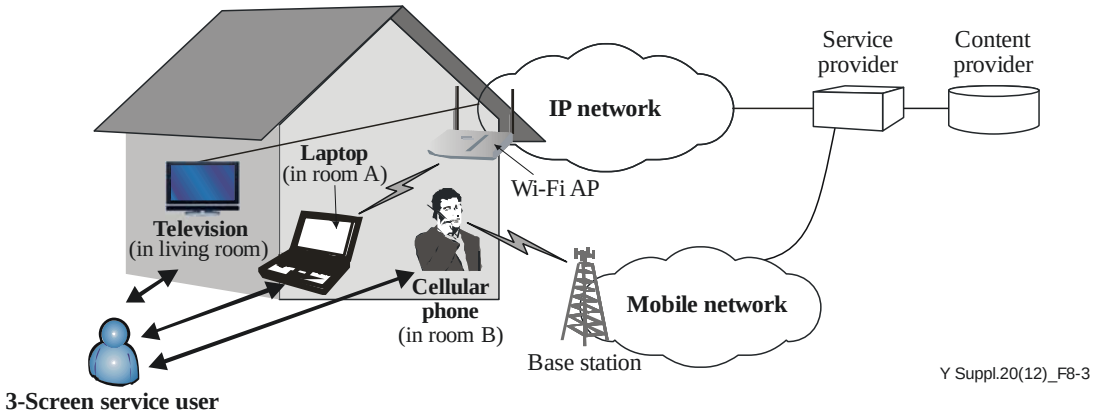

Figure 8-3 – n-screen service with service mobility

In this scenario, while Charlie uses the IPTV VoD service on a television, a laptop computer, and a cellular phone seamlessly, service mobility supporting seamless IPTV service regardless of the location of the user and the IPTV terminal device is provided. Content protection-related issues should be taken into consideration to share IPTV contents on several IPTV terminal devices.

The operational procedures of the scenario are as follows:

1) Charlie, an IPTV service subscriber, views VoD contents on the television in the living room.

2) After a few minutes, Charlie moves to Room A and views the same VoD content on his laptop computer.

   a. Charlie turns on the laptop in Room A and requests the laptop to show continuously the same VoD content shown by the television in the living room.

   b. The laptop connects to Wi-Fi AP.

   c. The laptop is authenticated as part of the n-screen service, and it requests the IPTV service provider to send the same VoD content.

   d. The IPTV service provider verifies the information on Charlie and the VoD service used by Charlie and sends the same content to the laptop computer.

   e. Charlie views the VoD content continuously on the laptop computer. During this process, A/V quality adaptation may be supported by the IPTV service provider considering the capabilities of IPTV terminal devices and bandwidth of network access technologies.

3) After a while, Charlie moves to Room B and uses his cellular phone to view the same VoD content continuously. The cellular phone connects to the mobile network and shows the same VoD content through the same process described above. A/V quality adaptation may also be supported considering the capabilities of the cellular phone and bandwidth of the mobile network.

The following figure shows a procedural diagram of IPTV functions for n-screen service with service mobility.

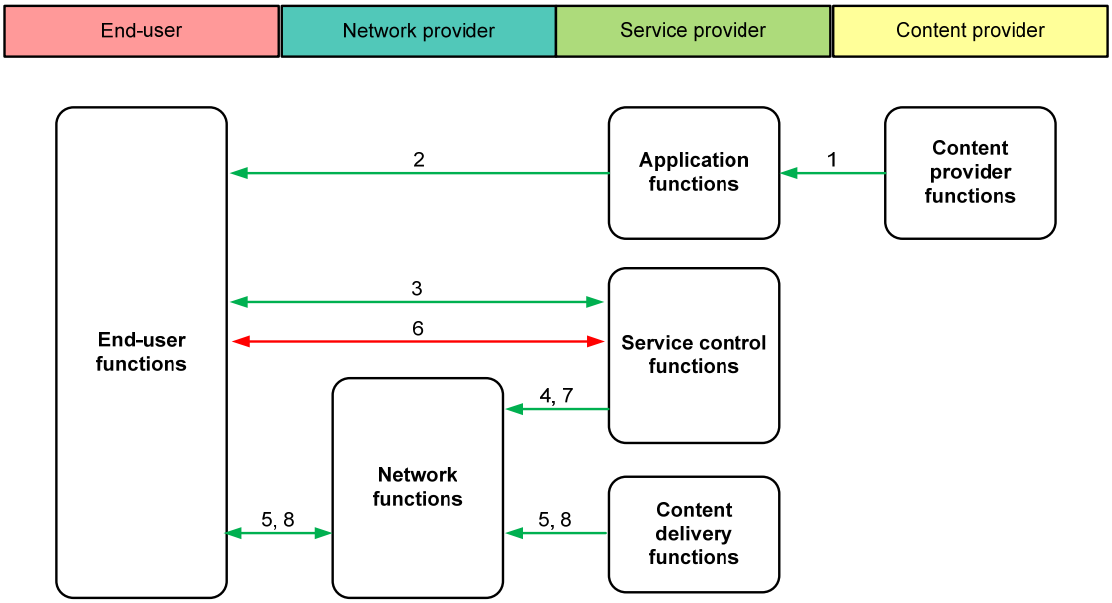

Figure 8-4 – Use case of n-screen service with service mobility

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating the content is ready for consumption.

3) When an end-user wants to access the linear TV service or selects a channel, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the linear TV service, the service provider interacts with the network provider to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information (e.g., the multicast address assigned to the requested channel) to the end-user. Then he or she can access and watch the channel.

Note that steps 1 to 5 are the same as those depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

6) At personal mobility, the request for the same service by the end-user in a different terminal device is sent to the service provider. This procedure may include the subscription information of the user in the previous terminal device.

Steps 4 and 5 are repeated in steps 7 and 8, respectively.

8.1.3 Contents sharing with cloud computing technologies

This scenario offers a personalized mobile IPTV service using cloud computing technologies. Cloud computing technologies provide efficient content integration service that can be rapidly provisioned and released with minimal management effort. Without the overhead of repeated and complex searches of contents, the technologies can automatically search for nearby multimedia data that users are browsing as well as reconstruct dispersed video contents. IPTV service provider can use more flexible and efficient resources such as IT resources, server, storage, and network resources using virtualization technology.

Figure 8-5 below depicts a sample scenario for contents sharing scheme with cloud computing technologies.

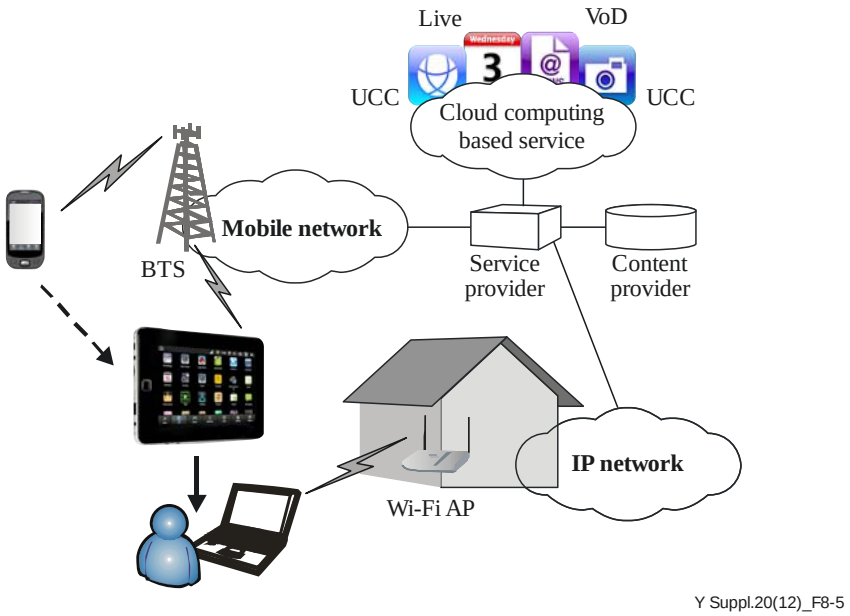

Figure 8-5 – Contents sharing with cloud computing technologies

The operational procedures of the scenario are as follows:

1) Mobile user Steve, who is an IPTV service subscriber with several devices such as smart phone, pad computer, and laptop computer, views VoD content on his smart phone through cloud computing technologies while moving on foot.

2) After a few minutes, Steve goes into a coffee shop and views the same VoD content on his pad computer using cloud computing technologies.

3) A/V quality adaptation may also be supported considering the capabilities of the end-user's device. After a while, Steve comes back home. He views the same VoD content using cloud computing technologies continuously on the laptop computer at his room.

The following figure shows a procedural diagram of IPTV functions for the mobile IPTV service using cloud computing technologies.

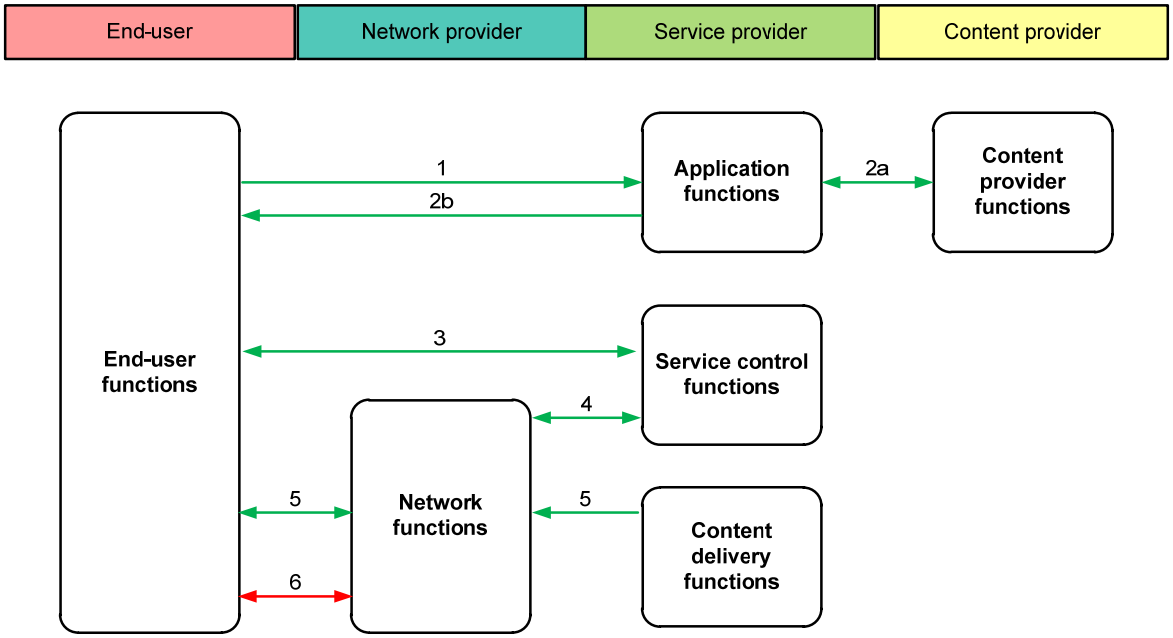

Figure 8-6 – Use case of contents sharing using cloud computing technologies

1) An end-user accesses the integrated service provider using user-ID and associated password.

2) Contents (video, audio, data, etc.) with related metadata and content protection data are produced and managed by the content provider, and are delivered to the service provider. The service provider provides content information to the end-users. The content is ready for consumption.

3) When an end-user accesses the cloud computing-based service for contents, the request is sent to the service provider. This procedure may include service negotiation and service availability confirmation.

4) If the end-user is granted access to the cloud computing-based service, the service provider interacts with the network provider to transmit the requested content. This procedure may include service availability confirmation procedures. If current available resources are enough to support the request, the cloud computing-based service control functions try to allocate the resource and activate the network and IT services through the network function. The network function can monitor and control the network resource or IT resources via their own control functions while the service is activated.

5) The service provider supplies channel access information to the end-user. He or she can access and watch the channel.

6) At vertical handover, the end-user is supplied with new channel access information for service continuity. If an error occurred in network functions, then the IT resources can moved to another location to solve the problem. Otherwise, if the problem is caused by IT resources, the IT resources can be re-allocated with unused IT resources for cloud computing-based service.

8.1.4 Cooperative n-screen service with multi-terminals

Cooperative n-screen service allows an IPTV service subscriber to use IPTV contents on TV and mobile terminal simultaneously. The basic type of n-screen service involves sharing the same content on several kinds of screens. If an IPTV user wants additional contents together with the content of a main user terminal device, the extended/hidden scenes in the main content will be streamed to n-screen service terminals, pad computer, smart phone, laptop computer, etc. Moreover, additional contents, e.g., extended scenes around the stadium, hidden contents of players for the main scene, scenes of stadium location, and football players, can be streamed via the user terminal devices.

Figure 8-7 below depicts a sample scenario for cooperative n-screen service with multi-terminal.

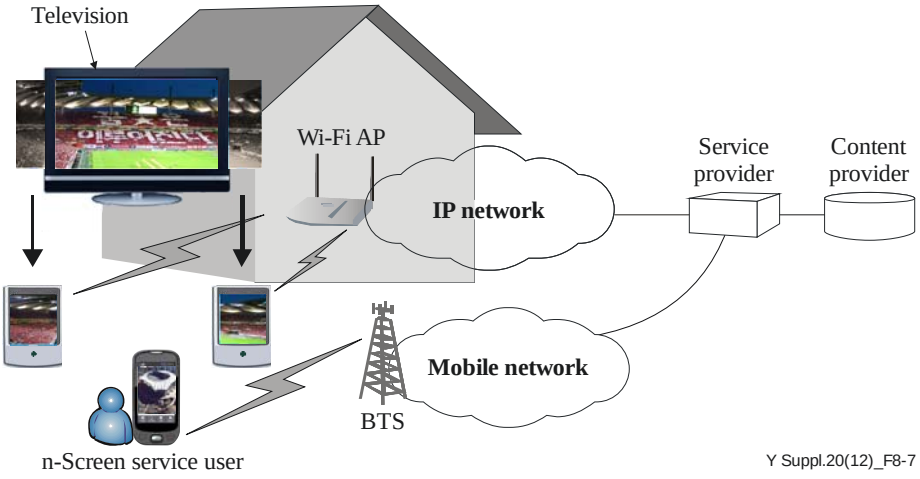

Figure 8-7 – Cooperative n-screen service with multi-terminal

In this scenario, an IPTV user has several devices such as smart phone, pad computer, laptop computer and TV. Providing n-screen service – specifically multiple types of user terminals of the n-screen service – requires that capability information of the user terminal devices be delivered to the service provider. The service provider activates multiple user terminals to deliver the extended/hidden contents.

The operational procedures of the scenario are as follows:

1) IPTV service user Thomas, who is a cooperative n-screen subscriber with several devices such as smart phone, pad computer, and TV, selects a movie to watch.

2) He notifies the IPTV service provider that he wants to use the cooperative n-screen service with the selected content, which means that his TV, pad computer, and smart phone will use the content based on each device's capabilities. The service provider receives the capability information of each terminal.

3) If he wants to watch the extended/hidden scenes through pad computer, the service provider delivers the content to the device. Additional information such as weather and location of the stadium or player's profile can also be provided to the smart phone.

4) Finally, Thomas views the content through multiple terminals in a cooperative n-screen manner.

The following figure shows a procedural diagram of IPTV functions for cooperative n-screen service with multi-terminal.

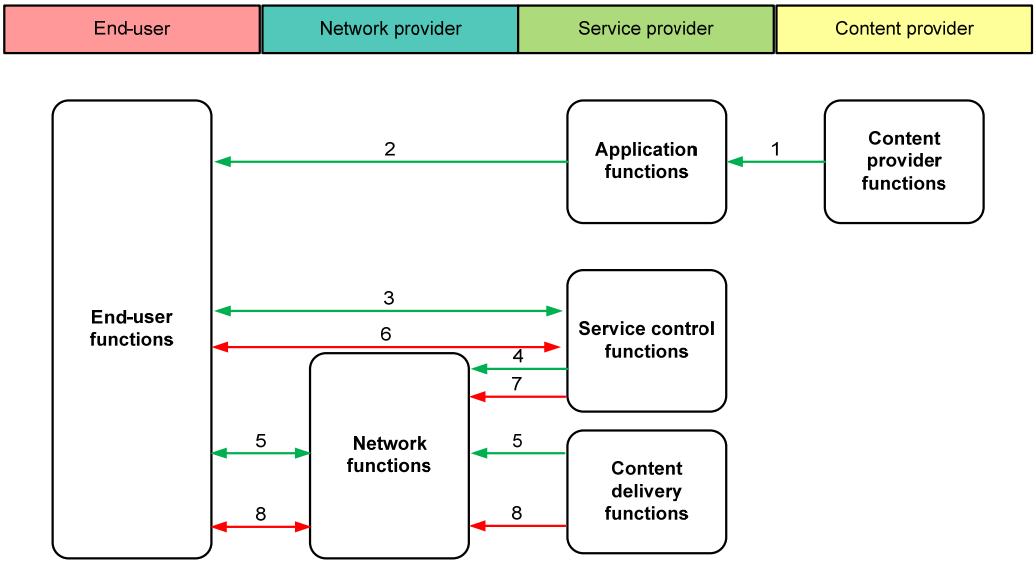

Figure 8-8 – Use case of cooperative n-screen service with multi-terminal

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets.

3) When an end-user wants to access the mobile IPTV service, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

4) If the end-user is granted access to the mobile IPTV service, the service provider interacts with the network provider to transmit the requested content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information to the end-user. Then he or she can access and watch the channel.

6) When an end-user wants to use n-Screen service for the watching content, the end-user can request to the service provider.

7) If the end-user is granted access to the newly requested n-Screen service, the service provider interacts with each network provider for n-Screen service to transmit the requested service. This procedure may include reserving and allocating network resource to guarantee the contracted service level.

8) The service provider provides the n-Screen service for the end-user with multiple mobile terminals. Finally, he or she can watch the same content using multiple devices for the n-Screen service.

8.2 Location-based services

8.2.1 Location-based information service

Location-based service (LBS) is an information and entertainment service that is accessible with mobile devices through the mobile network using the ability to make use of the geographical position of the mobile device. LBS can be provided to mobile end-users since the mobile IPTV terminal device has mobility. In case of indoor environments, location determination technologies using Wi-Fi will provide value-added IPTV information service such as news, weather and traffic forecasts, and advertisements.

Figure 8-9 below depicts a sample scenario for location-based information service.

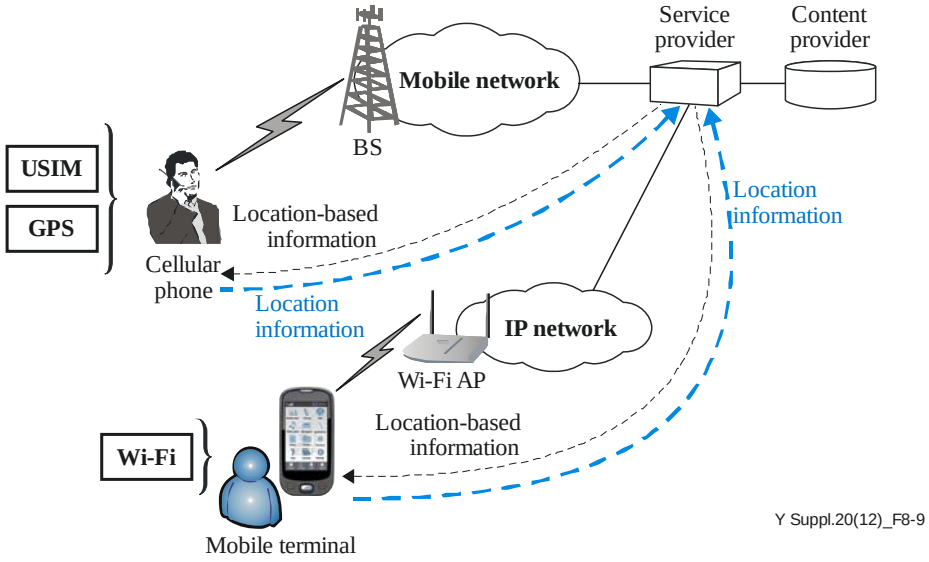

Figure 8-9 – Location-based information service

In this scenario, a user wants to get – through mobile IPTV service – some information on restaurants in an unfamiliar area where he/she is staying. In the provision of the above-mentioned IPTV service, the user is authenticated by universal subscriber identity module (USIM). For the provision of location-based IPTV service, the location of the terminal is determined using global positioning system (GPS). Although the location information determined by the network operator may also be available, the location information determined by GPS is usually more accurate.

The operational procedures of the scenario are as follows:

1) Frank rents a mobile IPTV terminal device with a GPS receiver from a rental shop and inserts his USIM into the terminal.

2) The mobile IPTV terminal device accesses the mobile network, and Frank is authenticated by the IPTV service provider to which he subscribed.

3) Frank connects to the location-based information service on the terminal after the IPTV service discovery procedure.

4) The mobile IPTV terminal device determines its location using GPS and sends the location information to the IPTV service provider.

5) When Frank selects "restaurant" in the location-based information service, information or related content on restaurants in the area where Frank is located gets delivered to him. The delivery of information or related content/advertisement of some restaurants is also possible if he wants.

6) After Frank gets information or related content/advertisement on his desired restaurant, including the exact location and telephone number, LBS is terminated.

The following figure shows a procedural diagram of IPTV functions for the location-based information service.

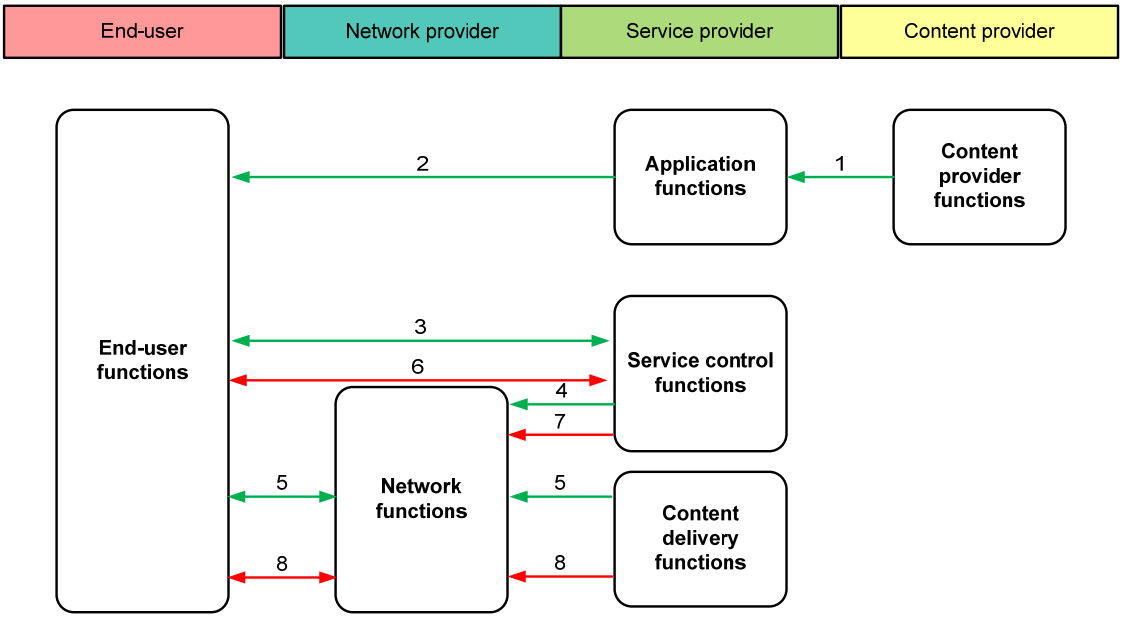

Figure 8-10 – Use case of location-based information service

1) A location-based information for IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and control the programme schedule and distribution. Then, the information for LBS is provided to the end-users, indicating the content is ready for consumption.

3) When an end-user wants to access the mobile IPTV service provider with location-based information service, the request is sent to the service provider.

4) If the end-user is granted access to the mobile IPTV service, the service provider interacts with the network provider to transmit the requested location-based content. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies location-based information to the end-user. Then he or she can access and use the location-based information service.

6) When the end-user moves to indoor, the end-user requests the service provider to find the same location-based information service continuously.

7) If the end-user is granted access to the newly requested location-based service, the service provider interacts with the network provider. This procedure may include reserving and allocating network resource to guarantee the contracted service level.

8) For the indoor user, the LBS information sends to the user using Wi-Fi interface. Finally, he or she can watch the location-based information or content.

8.2.2 Advertising services with terminal mobility

Advertising service is part of the IPTV service wherein commercials/advertisements are inserted into or between A/V programmes. The insertion of advertisement into a video stream is handled by an ad insertion system utilized by the service provider. Service providers typically make use of an end-user's information such as location, profile, and preferences when selecting those advertisements so that they can give more personalized advertisement to the end-user. Since the location of an end-user may change due to terminal mobility in mobile IPTV, the advertising service is considered to be adaptive to the changes accordingly.

Figure 8-11 below depicts a sample scenario for advertising service with terminal mobility.

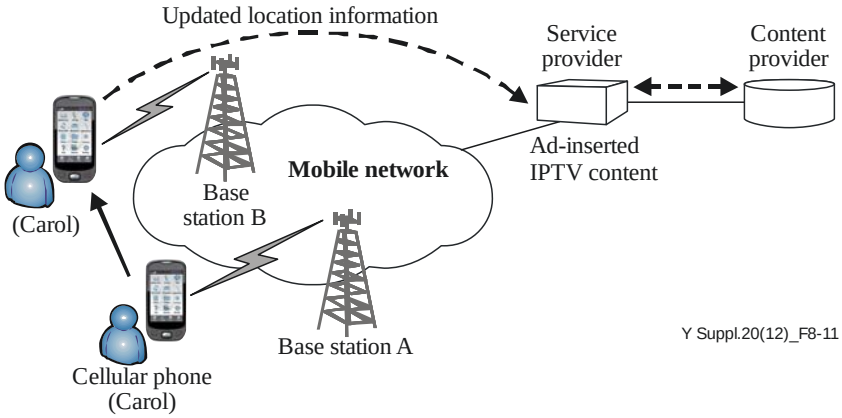

Figure 8-11 – Advertising service with terminal mobility

In this scenario, an end-user receives ad-inserted IPTV content while she moves on foot. Upon mobility, the new geographical location information of the end-user is updated.

The operational procedures of the scenario are as follows:

1) The cellular phone of Carol, an IPTV service subscriber, accesses the mobile network through BS-A, which is the nearest one, while she moves on foot.

2) Carol receives and views IPTV content with an advertisement selected according to her current geographical location.

3) After a few minutes, her cellular phone goes out of the coverage of BS-A, and the connected base station is changed from BS-A to BS-B as the most appropriate one accessible by the cellular phone and with sufficient resource. Her geographical location is changed accordingly.

4) The new location information of Carol is provided to the service provider. The service provider selects a new advertisement according to the updated location information with or without interaction with the content provider.

5) Carol keeps viewing the same IPTV content but with a different advertisement that is more suitable to her current location.

The following figure shows a procedural diagram of IPTV functions for advertising services with terminal mobility

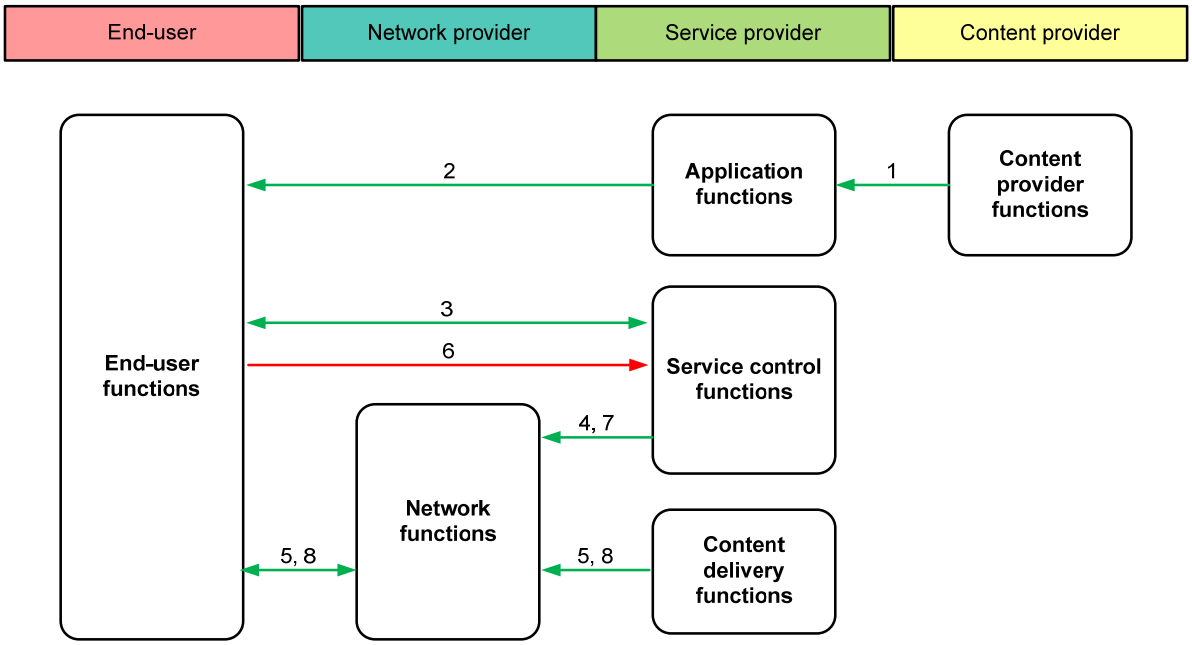

Figure 8-12 – Use case of advertising services with terminal mobility

1) IPTV content (video, audio, data, etc.) with related metadata and content protection data are provided by the content provider, and are delivered to the IPTV service provider.

2) The service provider then formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the scheduled channel information is provided to the end-users, indicating the content is ready for consumption.

3) When an end-user wants to access the linear TV service or selects a channel, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

Note that steps 1 to 3 are the same as those depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

4) If the end-user is granted access to the linear TV service, the service provider interacts with the network provider to transmit the requested content with advertisements inserted. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, the service provider supplies channel access information (e.g., the multicast address assigned to the requested channel) to the end-user. Then he or she can access and watch the channel with advertisements inserted.

6) At terminal mobility, the end-user provides the updated location information to the service provider. Then the service provider adapts the advertisements based on the new location.

Steps 4 and 5 are repeated in steps 7 and 8, respectively.

8.3 Hybrid IPTV services

The IPTV content can be broadcasted via traditional distribution techniques such as digital satellite TV or digital multimedia broadcasting (DMB) combining with on-demand content delivered over the IP-based network in a hybrid manner [b-ITU-T Y.Sup5]. This hybrid IPTV service provides two use cases for service transition and cooperation scenarios due to mobility.

8.3.1 Service transition between the mobile IPTV and mobile TV

Mobile broadcasting service such as DMB is usually provided through a non-IP based broadcasting network. On the other hand, mobile IPTV service is provided to users through the IP-based network. In addition, the mobile TV network is not yet interoperable with the mobile IPTV

network. Thus, if users change their access network from the mobile IPTV network to the mobile TV network, or vice versa, the service in use needs to be continued via service transitions.

Figure 8-13 below shows a sample scenario on the service transition between the mobile TV service and the mobile IPTV service.

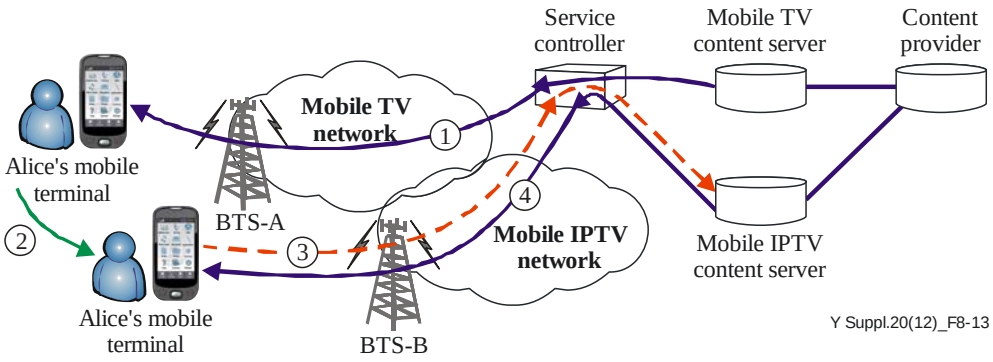

Figure 8-13 – Service transition scenario between mobile TV and mobile IPTV

In this scenario, for the service transition between the mobile TV service and the mobile IPTV service, the content provider should perform the following:

– Provide the TV programmes to the mobile TV content server in the service provider.

– Provide TV programmes and related value-added services to the service provider. The TV programmes are the same as the ones provided to the service provider. Note, however, that the quality such as coding rate or content resolution may be different from the TV programme for the mobile TV service.

The service provider should perform the following:

– Send mobile TV programmes to users through the mobile TV network.

– Send mobile IPTV programmes to users through the mobile IPTV network.

The terminal device should perform the following:

– Access the mobile TV network.

– Access the mobile IPTV network.

The terminal has multiple network interfaces to access various access networks.

The operational procedures of the scenario are as follows:

1) User Alice accesses the mobile TV network through access point BTS_A. Then, Alice receives and uses the TV programme. BTS_A is already transmitting (or broadcasting) it.

2) When she goes outside of the service region of the mobile TV network or wants to use the value-added service with the TV programme simultaneously through a different mobile network, Alice as a user terminal will search for an available mobile network.

3) If Alice as a user terminal finds that the mobile IPTV network is available, Alice changes her wireless access point from BTS_A to BTS_B as a wireless access point belonging to the mobile IPTV network. Thus, it is no longer possible to receive the mobile TV service. The connection for mobile TV between BTS_A and Alice is gone.

4) Alice wants to receive the TV programme continuously. At this time, there can be two scenarios. One, Alice wants to watch the same TV programme just as in the mobile TV network. The other is that Alice wants both the TV programme and the related value-added services. In the first case, Alice sends only channel information on the TV programme to the service provider through the mobile IPTV network. In the second case, however, Alice

sends the channel information on the TV programme and the value-added service information that she wants to receive through the mobile IPTV network.

5) Upon receiving only the channel information from Alice, the service provider sends TV programmes corresponding to the received channel information to her through the mobile IPTV network. If it receives both the channel information and the value-added service information, however, the service provider sends the TV programme corresponding to the received channel information and the requested value-added service related to the TV programme to Alice through the mobile IPTV network. The value-added service sent by the service provider can include various services related to the TV programme, e.g., detailed programme information, commercial advertisements, or personalized information service, etc. The TV programme sent by the mobile IPTV content server may be different from the TV programme provided by the mobile TV content server. For example, the mobile IPTV content server provides HD-resolution content, but the mobile TV content server provides quarter common intermediate format (QCIF)-resolution contents.

6) Alice receives the TV programme, which may include the value-added service related to the TV programme.

In this scenario, wireless access points BTS_A and BTS_B use different access technologies. The mobile IPTV network delivers both the TV programme and the related value-added service. In contrast, the mobile TV network delivers the TV programme only.

The following figure shows a procedural diagram of IPTV functions for the service transition scenario between mobile IPTV and mobile TV.

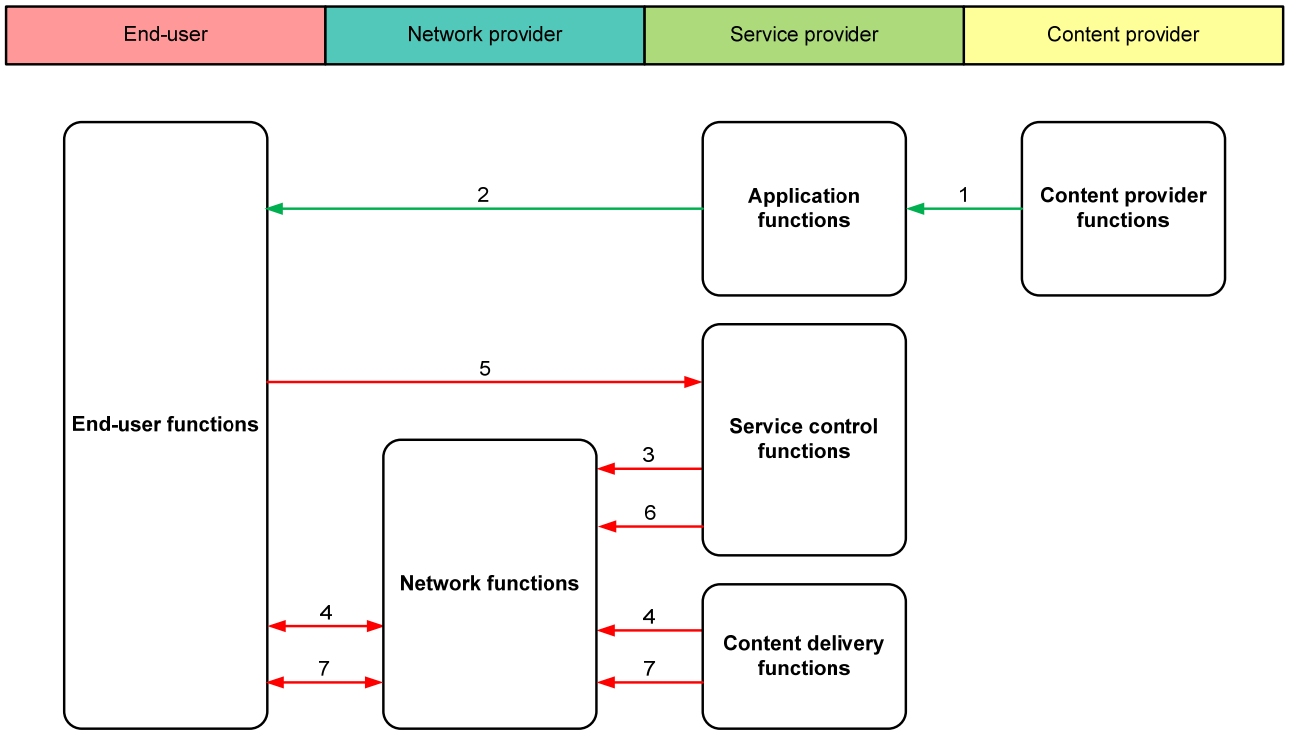

Figure 8-14 – Use case of the service transition between mobile IPTV and mobile TV

In this procedural diagram, the mobile IPTV has the same contents as the mobile TV. But the delivery network for the mobile TV is different from the one of mobile IPTV.

1) The contents (mobile TV, mobile IPTV) with related metadata and content protection data are produced and managed by the content provider, and are delivered to the service provider.

2) The service provider then formats the mobile TV and the mobile IPTV data prepared by the content provider into the proper type of packet. Then, the scheduled channel information related to the contents is provided to the end-users, indicating the contents are ready for consumption. And also the service provider prepares the value-added services related to the mobile TV service.

3) The service provider interacts with the network provider to transmit the requested mobile TV service data. This procedure may include reserving and allocating network resources to guarantee the predefined service level for the mobile TV.

4) Upon completion of step 3, the service provider supplies the mobile TV service to the end-user. Then he or she can access and watch the channel.

5) When an end-user wants to receive mobile IPTV service instead of mobile TV, the request is sent to the service provider. The end-user may also request the value-added service related to the mobile IPTV service. This procedure may include channel information for the currently using mobile TV service.

6) If the end-user is granted access to the mobile IPTV service, the service provider interacts with the network provider to transmit the requested service. This procedure may include reserving and allocating network resources to guarantee the contracted service level for the mobile IPTV.

7) Upon completion of step 6, the service provider supplies the mobile IPTV service and its valued-added service to the end-user. Then he or she can access and use the mobile IPTV service and the value-added service related to it at the same time.

8.3.2 Service cooperation between the mobile IPTV and mobile TV

Mobile TV service such as DMB is a unidirectional service, i.e., broadcasting service, whereas the mobile IPTV service is a bidirectional service. Thus, the latter has many advantages compared to the former. Nonetheless, the mobile TV service will become richer if it can have an uplink path to deliver control information to the service provider through the mobile IPTV network. There can be two scenarios on the service cooperation between the mobile TV service and mobile IPTV service. One, the user terminal can receive the value-added services related to the TV programme broadcasting through the mobile TV network. The other is that the mobile IPTV network can help the mobile TV network maintain its TV programme connection even though the user terminal goes outside of the current service region for the TV programme.

Figure 8-15 below shows a sample scenario for the cooperative service of the mobile TV service and the mobile IPTV service.

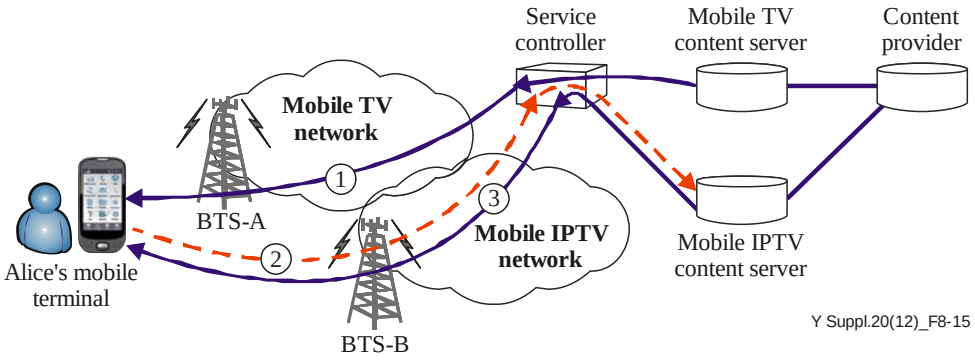

Figure 8-15 – Cooperation scenario between mobile TV and mobile IPTV

In this scenario, the mobile TV network consists of many service regions for the TV programme. It does not provide the user terminals with an uplink path to a service provider.

For the cooperative service of the mobile TV service and the mobile IPTV service, the mobile IPTV (or TV) content provider should perform the following:

– Provide the mobile IPTV content server with value-added services related to the TV programme.

– Provide the TV programme to the mobile TV content server.

The service provider should perform the following at the request of the user terminal:

– Send mobile TV service data to users through the mobile TV network.

– Send value-added service data related to the TV programme to users through the mobile IPTV network.

The terminal device should perform the following:

– Be able to connect to the mobile TV network and mobile IPTV network simultaneously.

Note that the wireless access points BTS_A and BTS_B in this scenario use different access technologies.

The operational procedures of the scenario are as follows:

1) User Alice accesses the mobile TV network through access point BTS_A. Alice receives and uses the TV programme. BTS_A is already transmitting (or broadcasting) it.

2) While Alice watches the TV programme, there are two possible scenarios. One is that Alice wants to use the value-added service related to the TV programme, so Alice sends the service request message for the value-added service to the service provider through the mobile IPTV network. The other is that Alice goes outside of the current service region broadcasting the TV programme in the mobile TV network. Thus, Alice can no longer receive the TV programme. Because Alice does not know the channel information needed to receive the TV programme in the new service region, she sends a request to get the channel information corresponding to the TV programme she is watching in the new service region.

3) Upon receiving the service request message for the value-added service from Alice, the service provider sends the requested value-added service related to the TV programme to Alice through the mobile IPTV network. If it receives the request for channel information from Alice, however, the service provider sends channel information related to the TV programme to Alice through the mobile IPTV network. The value-added service sent by the service provider can include various services related to the TV programme, e.g., detailed programme information, commercial advertisements, personalized information service, etc.

4) Upon receiving the requested value-added service from the service provider, Alice uses it properly while continuously receiving the TV programme through the mobile TV network. If she receives the channel information for the TV programme from the service provider, however, Alice tunes in to the TV programme using the received channel information and watches the TV programme in the new service region. Alice receives both the mobile TV service itself through the mobile TV network and the additional service data related to the mobile TV service through the mobile IPTV network.

The following figure shows a procedural diagram of IPTV functions for the cooperation service scenario of mobile IPTV and mobile TV.

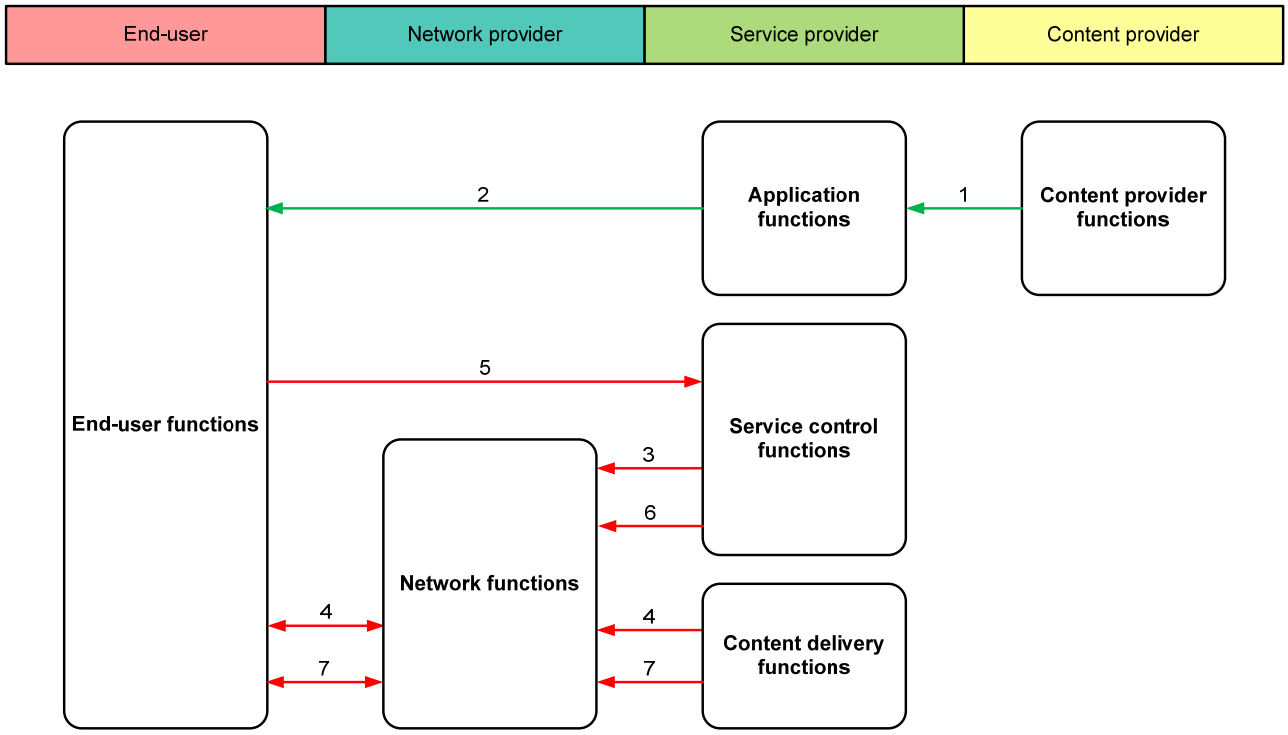

Figure 8-16 – Use case of the service cooperation between mobile IPTV and mobile TV

1) A mobile TV content with related metadata and content protection data are produced and managed by the content provider, and are delivered to the service provider.

2) The service provider then formats the mobile TV data prepared by the content provider into the proper type of packet. Then, the scheduled channel information related with the contents is provided to the end-users, indicating the contents are ready for consumption. And also the service provider prepares the value-added services related to the mobile TV content.

3) The service provider interacts with the network provider to transmit the requested mobile TV service data. This procedure may include reserving and allocating network resources to guarantee the predefined service level for the mobile TV.

4) Upon completion of step 3, the service provider supplies the mobile TV service to the end-user. Then he or she can access and watch the channel.

Note that steps 1 to 4 are very similar with those steps depicted in Figure 6-2 of [b-ITU-T Y.Sup5].

5) When an end-user wants to receive a value-added service related to the mobile TV service which the end-user is watching, the request is sent to the service provider.

6) If the end-user is granted access to the value-added service related to the mobile TV content, the service provider interacts with the network provider to transmit the requested value-added service. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

7) Upon completion of step 6, the service provider supplies the valued-added service to the end-user. Then he or she can access and use the mobile TV content and the value-added service related to it at the same time.

9 Security considerations

The security considerations of this Supplement are as provided in [ITU-T Y.1901].

Appendix I

Deployment approach to mobile IPTV and mobile TV services

I.1 Mobile TV plus IP

The "mobile TV plus IP" approach uses the traditional digital broadcast networks to deliver IP-based audio, video, graphics and other broadband data services. And it is a prime example of the increasing convergence of broadcasting, telecommunications and computing, and pursues to build a content environment that combines the stability and usability of broadcasting and the diverse services of the Internet.

To make this approach more attractive, wide area wireless networks such as cellular networks are integrated to support interactivity. Figure I.1 shows an example of the "Mobile TV plus IP" approach.

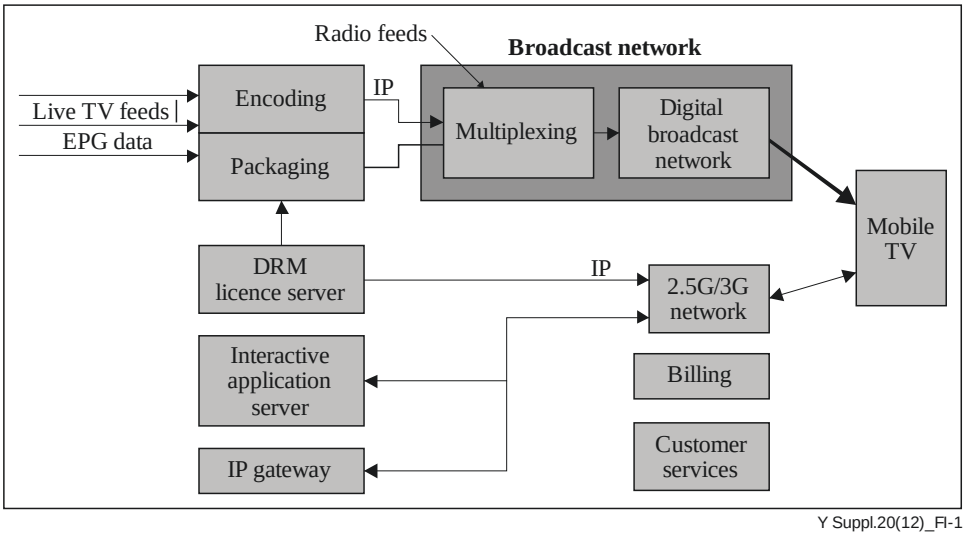

Figure I.1 – Mobile TV services based on IP

I.2 IPTV plus mobile approach

IPTV services were originally targeted to fixed terminals such as set-top boxes, however, with the expansion of mobile technologies, issues on the requirements for mobility support were raised under the auspices of the fixed-mobile convergence (FMC) trend. The development of mobile IPTV specification is at an early stage. Currently, it is major issue to collect requirements regarding mobility and wireless characteristics. Mobility service entirely based on IP multimedia subsystem (IMS) which is a set of specification for delivering IP multimedia to mobile users will be forthcoming.

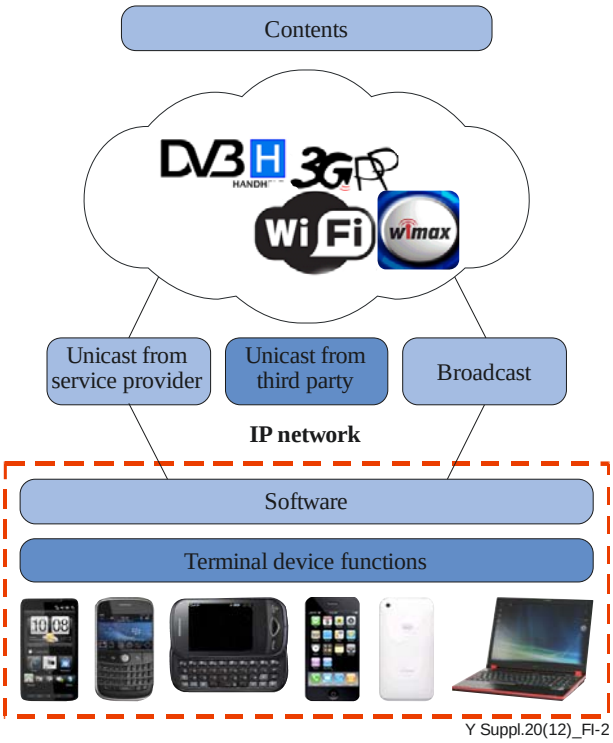

Figure I.2 – IPTV services based on IP

I.3 Cellular-based IPTV approach

"Cellular-based IPTV" approach could be defined as an end-to-end framework for IP-based mobile broadcasting networks. It also compiles the set of necessary enablers. Its features are bearer agnostic, which means any broadcast distribution network (BDN) can be adopted as its transport means. However, it is only applicable to mobile terminals up to now and showing interest in expanding its specification to cover fixed terminals.

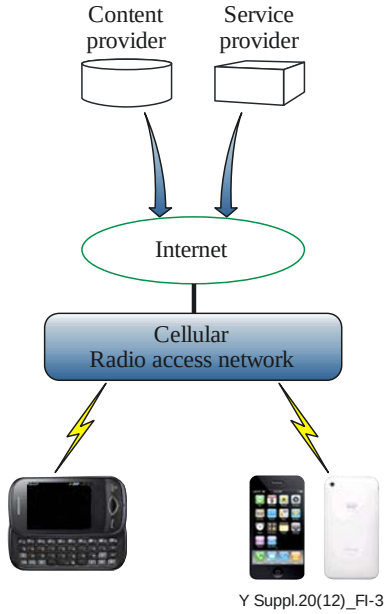

Figure I.3 – Mobile TV services in cellular

I.4 Mobile Internet-based IPTV approach

With this approach, there can be quite different models developing on the business type and infrastructure used. This approach is open for anybody to play a role in the value chain: anybody can be a content provider, a service provider, or simply a consumer. This results in a universe of highly diversified and dynamically independent production. In addition, the openness gives global reach. However this Internet-based approach has a shortcoming that the QoS is not guaranteed since it is based on the best-effort service model. However, considering its rapid adaptation to customer's needs, this approach may be dominant in the near future. As long as mobile devices use the Internet, users can access IPTV service through various wireless access networks.

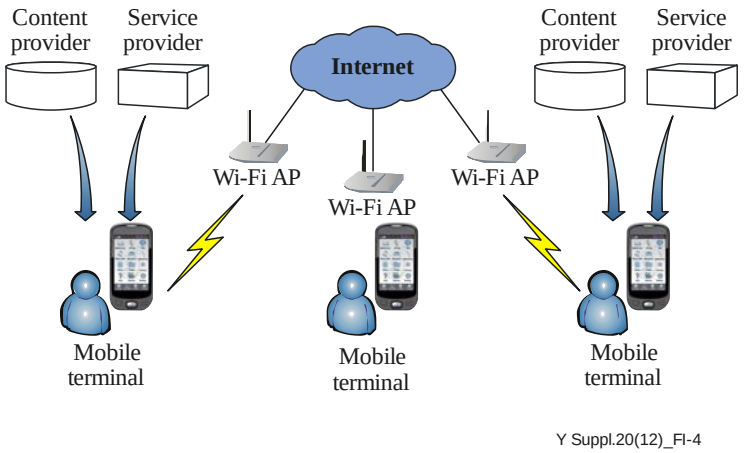

Figure I.4 – Mobile TV services in the Internet-based approach

Appendix II

Specific scenarios and mechanisms for mobile IPTV use cases

II.1 3D image delivery service based on multiple access networks

3D image service can be provided through multiple access networks. In general, the radio resource is not enough to provide 3D image in a single wireless access network. Therefore, it is useful to provide 2D image service in a single wireless access network and provide 3D image service through multiple access network environments by using a terminal equipped with multiple network interfaces.

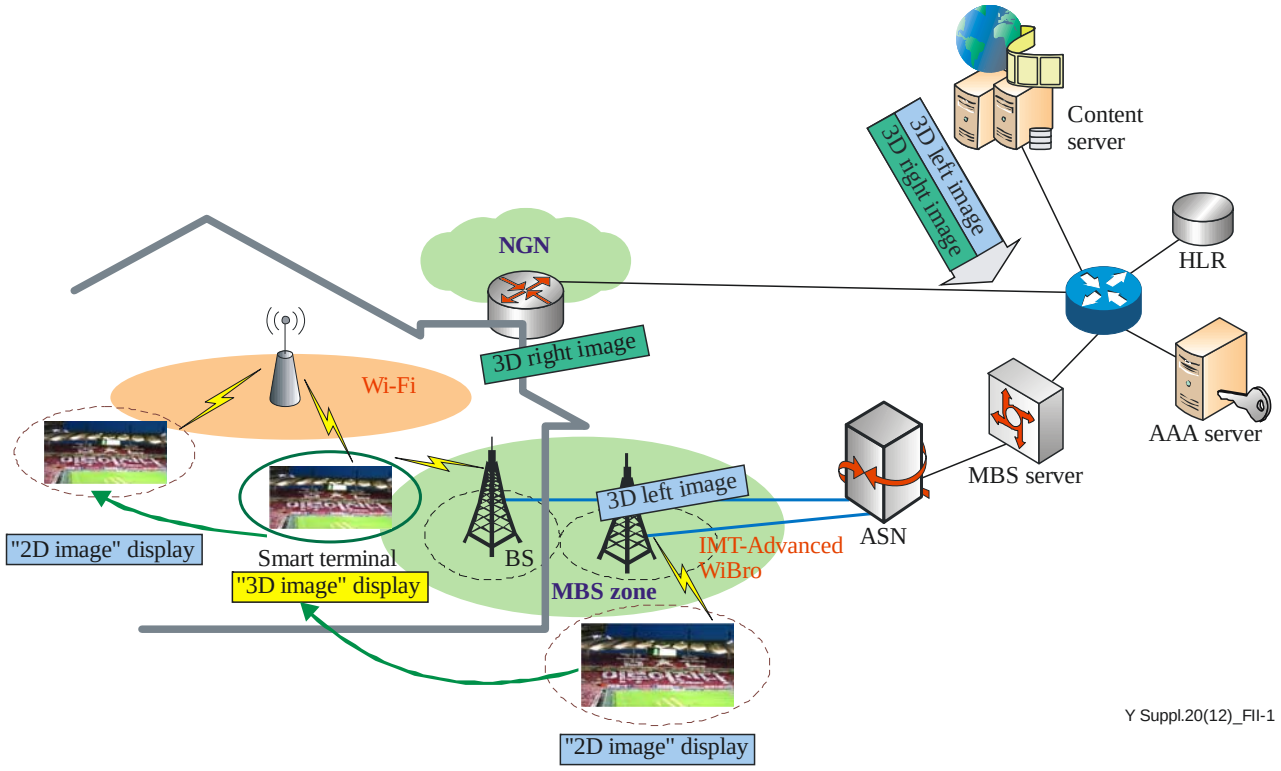

Figure II.1 – 3D image delivery service

A service scenario of 3D image service using multiple access networks is as follows:

1) Content server creates 3D image and send 3D left image to Wi-Fi access network, and send 3D right image to IMT-Advanced access network.
2) Frank uses a mobile IPTV terminal device supporting multiple access technologies.
3) Frank connects to IMT-Advanced access network, and selects 3D image service.
4) Frank receives 3D left image in IMT-Advanced access area, and mobile IPTV terminal displays the received signal in the form of 2D.
5) When Frank moves to some place where Wi-Fi and IMT-Advanced radio signal are coexisting, mobile IPTV terminal receives 3D right image through Wi-Fi access network, and receives 3D left image through IMT-Advanced access network, and display 3D image using 3D left image and right image.
6) When Frank moves to Wi-Fi access area, mobile IPTV terminal receives 3D right image and displays the received image in the form of 2D.

For the 3D image delivery service based on multiple access networks, content synchronization between different wireless access networks should be guaranteed.

II.2 Web-based mobile IPTV service

Web-based mobile IPTV service provides end-users with various contents from different service providers over the web. Figure II.2 shows the web-based mobile IPTV service scenario. The service discovery server searches available service providers using HTTP(S). The service provider receives metadata from the IPTV service discovery server, and provides all available mobile IPTV service and content information to end-users using HTTP(S). The end-users can access to various services of the mobile IPTV service provider through a web browser.

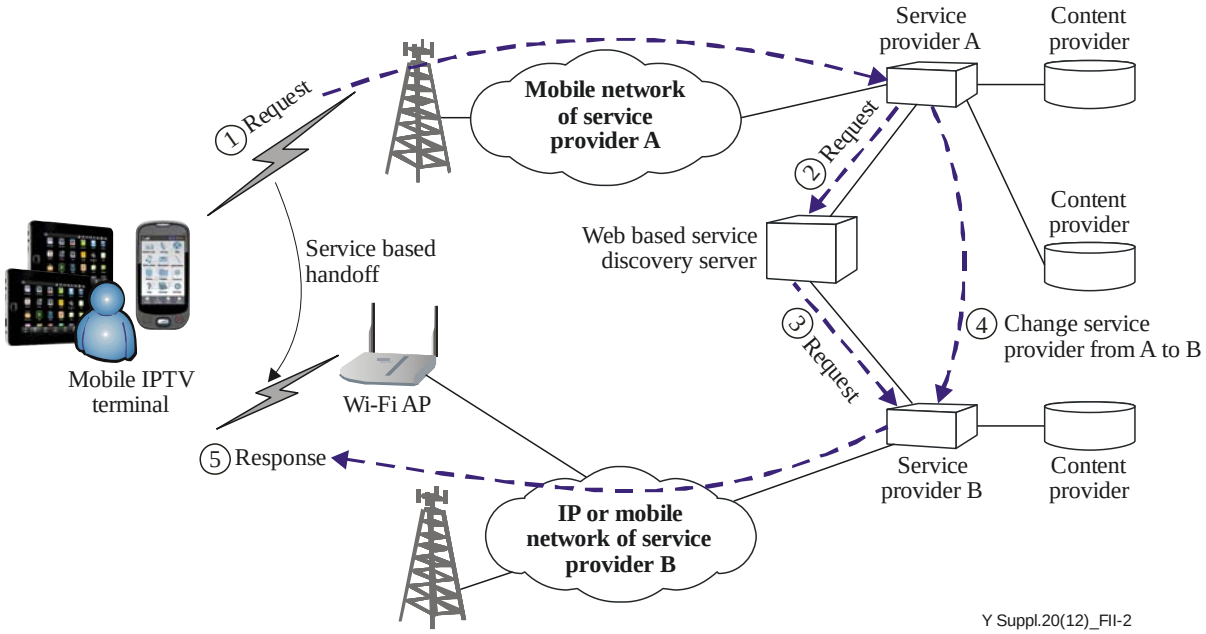

Figure II.2 – Sample scenario for web-based mobile IPTV

Service scenario of web-based mobile IPTV is as follows:

1) A mobile IPTV terminal of Catherine, who is an IPTV service subscriber, connects to service provider A.
2) To use web-based mobile IPTV service, Catherine requests to service provider A.
3) But service provider A could not provide appropriate service and content to Catherine, so service provider A requests to web-based service discovery server.
4) The web-based service discovery server verifies which service provider can provide the service and content requested by Catherine. If the provider B has the service and content requested, the server confirms/requests service and content to service provider B. Finally, the service provider is changed.
5) Catherine keeps using the same service and watching the content seamlessly through web-based service discovery server.

The following figure shows a procedural diagram of IPTV functions for the web-based mobile IPTV service.

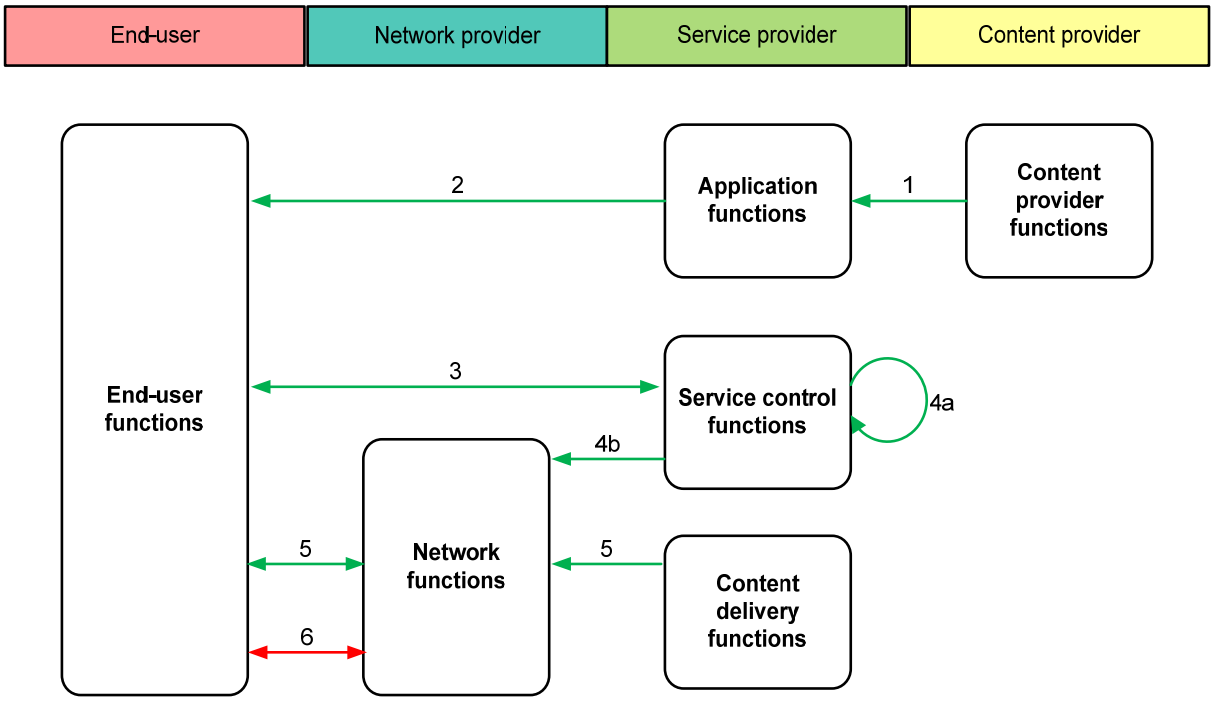

Figure II.3 – Use case of web-based mobile IPTV

1) Contents (video, audio, data, etc.) with related metadata, content protection data are produced and managed by the content provider. These are delivered to the service provider.

2) The service provider formats the data prepared by the content provider into IP packets, and controls the programme schedule and distribution. Then, the channel information scheduled is provided to the end-user, indicating the content is ready for consumption.

3) When the end-user wants to access the mobile IPTV service or selects contents, its request is sent to the service provider.

4) If the service provider does not have any mobile IPTV service or contents requested, it is sent to another service provider through service discovery function. This procedure may include reserving and allocating network resources to guarantee the contracted service level.

5) Upon completion of step 4, another service provider supplies channel access information to the end-user. Then, he or she can access and watch the channel via another service provider. Finally, the end-user can receive the content.

6) At vertical mobility, the end-user is supplied with new channel access information for the visiting access network so that he or she continues to access and watch the channel.

II.3 Mobile IPTV service with cost effective peering

P2P-based mechanisms provide the dynamic peering selection for cost effective transmission, so P2P transmission cost is cheaper than other mechanisms. There is no need for users to worry about the amount of traffic downloaded to their mobile IPTV terminals. End-users usually pay for radio access based on the amount of traffic transmitted in wireless networks. The cost of radio transmission for mobile IPTV service from the perspective of wireless network can be reduced if wireless network is designed to utilize idle radio resource and avoid congestion. In order to avoid traffic congestion in radio network, the cost effective peering helps to solve the problem. For providing the cost effective peering, P2P control plane should have capabilities to monitor and collect the traffic condition in the radio access network and should also adaptively reconfigure P2P connections when the radio traffic congestion is detected or foreseen.

Figure II.4 below depicts the sample scenario for mobile IPTV service with cost effective peering.

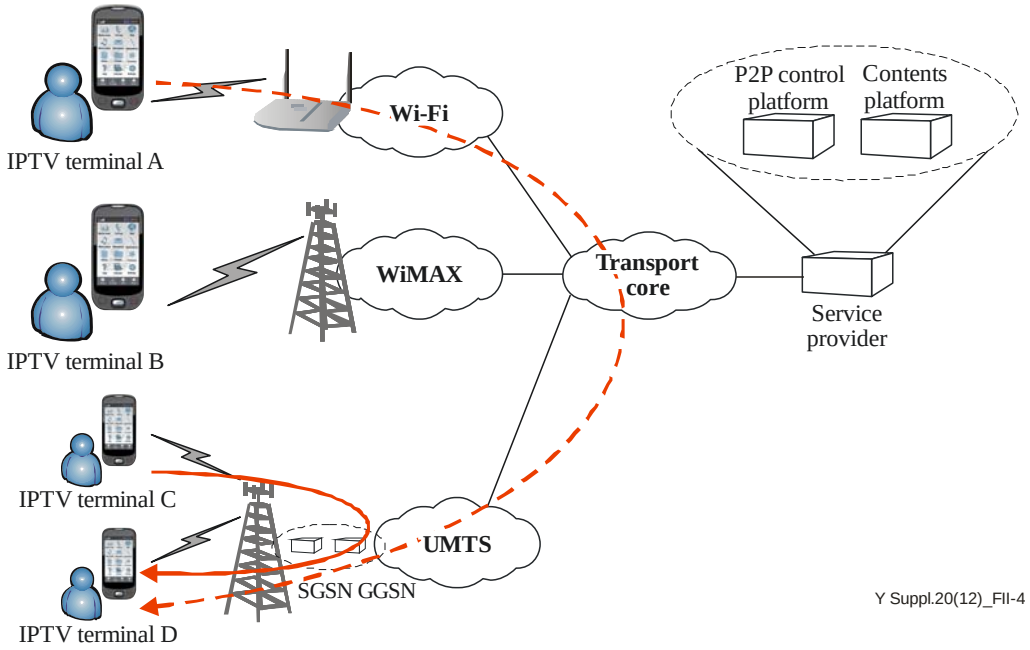

Figure II.4 – Mobile IPTV service with cost effective peering

The operational procedures of mobile IPTV service with cost effective peering is as follows:

1) A mobile terminal of an IPTV service subscriber, called Sophia (with mobile terminal-A), connects to Wi-Fi network, and another IPTV service subscriber, called Lauren (with mobile terminal-C), connects to UMTS network. Two P2P users, Sophia and Lauren, have same content stored in their terminal.

2) An IPTV service subscriber, called Patrick (with mobile terminal-D), connects to same BS as Lauren. Patrick requests the same content that Lauren and Sophia has one. The service provider confirms the peers who have same content stored in terminal.

3) The Wi-Fi network and UMTS network are operated by different operators. P2P control manager of the service provider receives a report that the cost for inter-operator traffic exchange between Wi-Fi and UMTS is not negligible. As a result, the radio transmission cost of Wi-Fi is much smaller than UMTS. So Patrick changes his streaming peer from Sophia to Lauren.

4) Patrick continuously watches the same content from Lauren (with mobile terminal-C).

The following figure shows a procedural diagram of IPTV functions for the mobile IPTV service with cost effective peering.

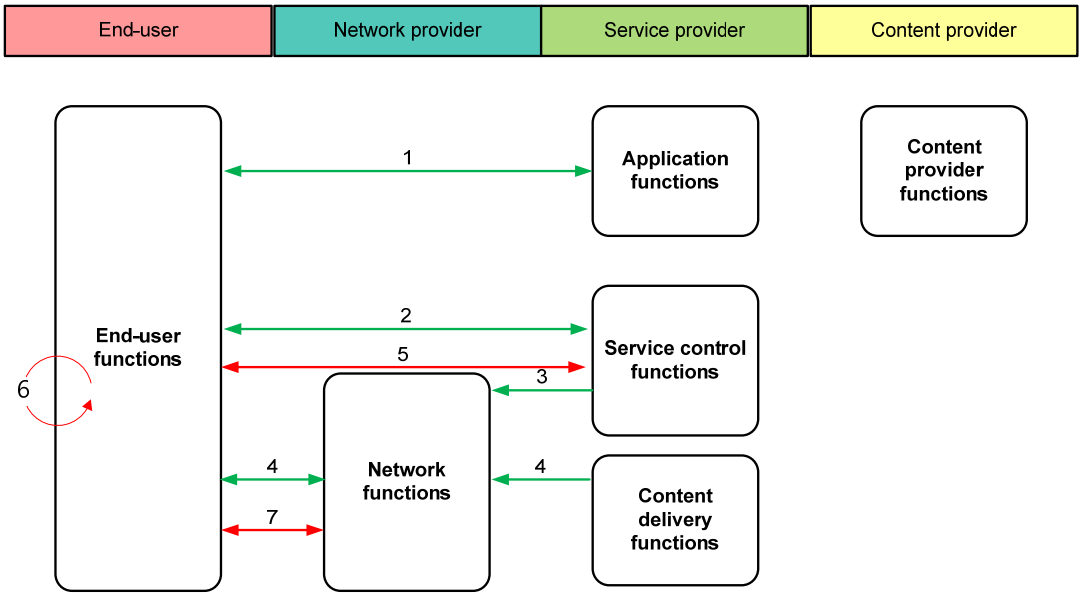

Figure II.5 – Use case of mobile IPTV service with cost effective peering

1) IPTV content with related metadata and content protection data are provided by the end-user, and are delivered to the IPTV service provider. Then, the service provider authenticates the P2P service subscriber.

2) When an end-user wants to access the mobile IPTV service using the P2P system, the request is sent to the service provider. This procedure may include service negotiation (e.g., QoS, price, etc.) and service availability confirmation procedures.

3) If the end-user is granted access to the mobile IPTV service using P2P, the service provider interacts with the network provider to transmit the requested content information.

4) Upon completion of step 3, the service provider supplies P2P channel access information to the end-user. Then he or she can access and watch the P2P content from Wi-Fi.

5) The P2P control manager of the service provider receives a report that the cost for inter-operator traffic exchange between Wi-Fi and UMTS is not negligible; the transmission cost of Wi-Fi is much smaller than UMTS. As a result, the service provider interacts with the end-user to notify him or her of the transmission cost.

6) The end-user wants to change the parents peer as a streaming peer under the same BS.

7) For the cost-effectiveness transmission, he or she can access and watch the same content continuously from another end-user as a parents peer under the same BS.

Appendix III

Mobile IPTV service with cloud computing technologies

Cloud computing-based mobile applications are more scalable and leverage the server-based computing infrastructure. These applications are accessible through a mobile application interface, and are not limited to the data storage and processing power contained in a mobile device. Mobile IPTV platform provides a framework and functions to support context aware, dynamic adaptive and self-organizing networks to configure a user specific service over NGN. Mobile IPTV platform composes a set of service entities to support customer oriented service features and their applications using NGN. Mobile IPTV platform would help the 3rd party to provide and improve a much richer service to the end users through composing services dynamically from NGN.

III.1 Mobile IPTV middleware platform collaboration with cloud computing

Cloud computing technologies are delivered in an "as a service" manner and promise to deliver operational saving by only requesting firms to pay for the software, platform and mobile resources. In this case, the approach uses the third-party services in cloud service manner. This helps to save the cost to maintain an overlay service. If there is a same service from a user request in the third-party cloud service, mobile IPTV platform forwards the request to the cloud service of third-party without new service creation procedure. In order to provide service continuity and service mobility, mobile IPTV platform can include functions such as service session continuity management/control function, IPTV session control function, content processing information function and user mobility management function. If a user requests a service from the mobile IPTV platform, the mobile IPTV platform confirms the third-party cloud service without any new service composition. Using third-party cloud service, network efficiency can be increased and users receive variety of services from the service provider.

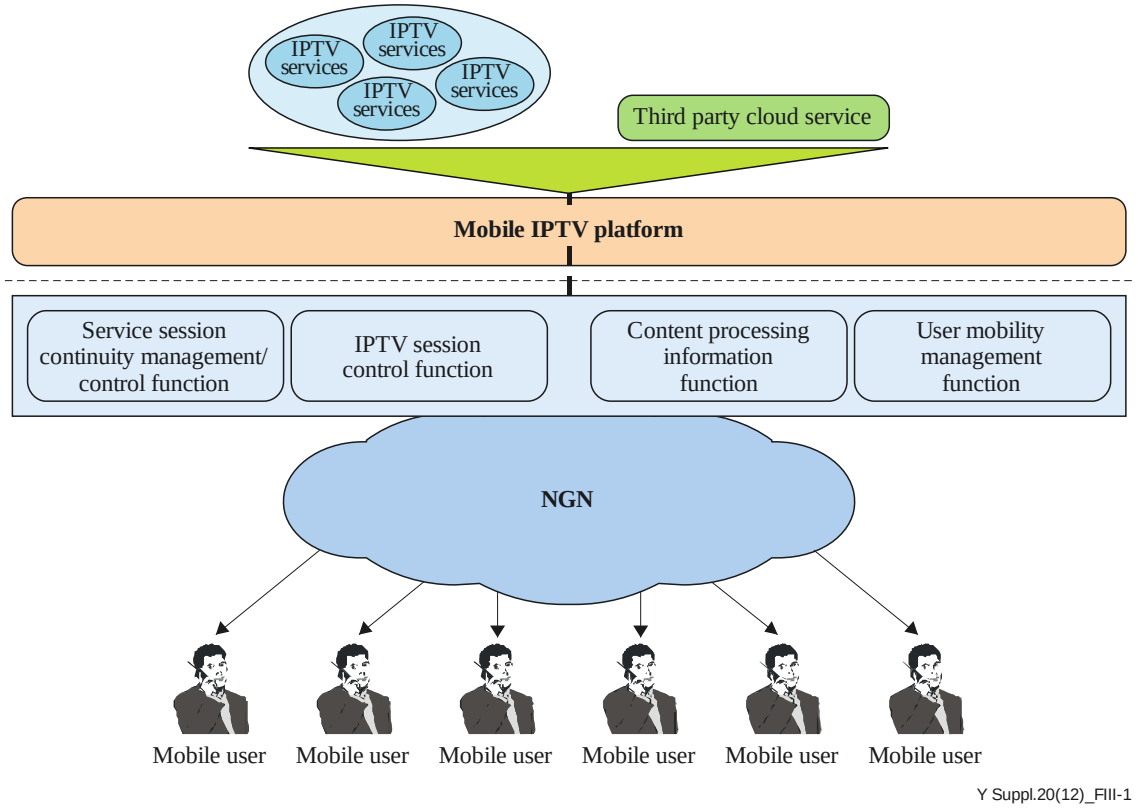

Figure III.1 – An example of mobile IPTV platform collaborating with cloud computing

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