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

Next Generation Networks – Service aspects: Service capabilities and service architecture

Functional model and service scenarios for QoS-enabled mobile VoIP service

Recommendation ITU-T Y.2237

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Recommendation ITU-T Y.2237

Functional model and service scenarios for QoS-enabled mobile VoIP service

Summary

Recommendation ITU-T Y.2237 introduces a functional model and service scenarios for QoS-enabled mobile VoIP service in WiFi, 3G, and mobile WiMAX networks. In this Recommendation, mobile VoIP service is assumed to be provided by application of Layer 2 authentication and make-before-break based service continuity in the transport stratum.

The functional model used for the description of service scenarios provided in this Recommendation is based on components and entities defined in Recommendation ITU-T Y.2012 covering user terminal, networks and media handling related aspects.

History

Edition	Recommendation	Approval	Study Group
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Keywords

Mobile WiMAX, mobility, VoIP, WiFi, 3G.

FOREWORD

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Recommendation ITU-T Y.2237

Functional model and service scenarios for QoS-enabled mobile VoIP service

1 Scope

This Recommendation introduces a functional model and service scenarios related to the support of QoS-enabled mobile voice over IP (VoIP) service in WiFi, 3G, and mobile WiMAX networks. More specifically, this Recommendation provides a description of:

- a functional model applicable to the context of QoS-enabled mobile VoIP service;
- service scenarios related to the provision of QoS-enabled mobile VoIP service:
  - in a single operator's network which supports either WiFi, 3G or mobile WiMAX;
  - in multiple operator's networks, each supporting a different wireless network, e.g., a WiFi, mobile WiMAX or 3G wireless network;
  - in a single operator's network where the user terminal moves between different wireless access networks.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

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

[ITU-T Q.1707] Recommendation ITU-T Q.1707/Y.2804 (2008), *Generic framework of mobility management for next generation networks*.

[ITU-T Q.1708] Recommendation ITU-T Q.1708/Y.2805 (2008), *Framework of location management for NGN*.

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

[ITU-T Y.2012] Recommendation ITU-T Y.2012 (2006), *Functional requirements and architecture of the NGN*.

[ITU-T Y.2014] Recommendation ITU-T Y.2014 (2008), *Network attachment control functions in next generation networks*.

[ITU-T Y.2018] Recommendation ITU-T Y.2018 (2009), *Mobility management and control framework and architecture within the NGN transport stratum*.

[ITU-T Y.2111] Recommendation ITU-T Y.2111 (2008), *Resource and admission control functions in next generation networks*.

[ITU-T Y.2201] Recommendation ITU-T Y.2201 (2009), *Requirements and capabilities for ITU-T NGN*.

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

[ITU-T Y.2702] Recommendation ITU-T Y.2702 (2008), *Authentication and authorization requirements for NGN release 1*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 functional entity [ITU-T Y.2012]: An entity that comprises an indivisible set of specific functions. Functional entities are logical concepts, while groupings of functional entities are used to describe practical, physical implementations.

3.1.2 functional model [b-ITU-R M.1224]: A model which identifies and defines functional entities and relationships between these functional entities.

3.1.3 host-based mobility [ITU-T Y.2018]: A mode of operation whereby the mobile UE takes an active role in the provision of mobility service at layer 3, in particular by contacting the mobile service provider directly to invoke this service after gaining network access.

3.1.4 location identifier (LID) [ITU-T Q.1707]: A topological location identifier of a user equipment (UE). An IP address can be used as a location identifier.

3.1.5 network-based mobility [ITU-T Y.2018]: A mode of operation whereby the mobile UE does not take an active role in the provision of mobility service at layer 3.

3.1.6 persistent location identifier (PLID) [ITU-T Q.1708]: A location identifier that does not change even when a mobile user equipment (MUE) moves across different access networks or IP subnets.

3.1.7 seamless service [ITU-T Q.1706]: A service that is implemented such that it will ensure that users will not experience any service disruptions while changing the point of attachment.

3.1.8 service continuity [ITU-T Q.1706]: The ability for a moving object to maintain ongoing service over including current states, such as user's network environment and session for a service.

3.1.9 temporary location identifier (TLID) [ITU-T Q.1708]: A location identifier that changes when a mobile user equipment (MUE) moves across different access networks or IP subnets.

3.1.10 terminal mobility [ITU-T Q.1706]: This is the mobility for those scenarios where the same terminal equipment is moving or is used at different locations. 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 Recommendation

This Recommendation defines the following terms:

3.2.1 persistent IP address: An IP address that does not change even when a user equipment moves across different access networks or IP subnets.

NOTE – A persistent IP address can be used as a persistent location identifier; see clause 3.1.6.

3.2.2 temporary IP address: An IP address that changes when a user equipment moves across different access networks or IP subnets.

NOTE – A temporary IP address can be used as a temporary location identifier; see clause 3.1.9.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

3G	Third Generation wireless system
AAA	Authentication Authorization Accounting
ABG-FE	Access Border Gateway Functional Entity
AM-FE	Access Management Functional Entity
AN-FE	Access Node Functional Entity
AR-FE	Access Relay Functional Entity
AP	Access Point
BSC	Base Station Controller
CSCF	Call Session Control Function
DNS	Domain Name Server
EN-FE	Edge Node Functional Entity
FRA	Functional Requirements and Architecture
HA	Home Agent
HDC-FE	Handover Decision and Control Functional Entity
HSS	Home Subscriber Server
IBG-FE	Interconnection Border Gateway Functional Entity
I-CSC-FE	Interrogating-Call Session Control Functional Entity
IMS	IP Multimedia Subsystem
IP	Internet Protocol
L2	Layer 2
L2HEF	Layer 2 Handover Execution Function
L3	Layer 3
L3HEF	Layer 3 Handover Execution Function
MAC	Media Access Control
MLM-FE	Mobile Location Management Functional Entity
MMCF	Mobility Management and Control Functions
NACF	Network Attachment Control Functions
NAC-FE	Network Access Configuration Functional Entity
OUT	Originating User Terminal
P-CSCF	Proxy-Call Session Control Function
P-CSC-FE	Proxy Call Session Control Functional Entity
PDA	Personal Digital Assistant
PD-FE	Policy Decision Functional Entity
QoS	Quality of Service
RACF	Resource and Admission Control Functions

RAS Radio Access Station

SAA-FE Service Authentication and Authorization Functional Entity

S-CSC-FE Serving-Call Session Control Functional Entity

SCF Service Control Functions

SIP Session Initiation Protocol

SL-FE Subscription Locator Functional Entity

SUP-FE Service User Profile Functional Entity

TAA-FE Transport Authentication and Authorization Functional Entity

TRC-FE Transport Resource Control Functional Entity

TUT Terminating User Terminal

UT User Terminal

VoIP Voice over Internet Protocol

WiFi Wireless Fidelity

WiMAX Worldwide interoperability for Microwave Access

WLAN Wireless Local Area Network

5 Conventions

None.

6 Overview

In this Recommendation, mobile voice over IP service is assumed to be a seamless service as defined in clause 3.1.7, i.e., a VoIP service that is implemented such that it will ensure that mobile users will not experience any service disruptions while changing the point of attachment. Mobile VoIP service requires the support of service continuity for terminal mobility taking into account network conditions (e.g., the number of user sessions, mobility events and bandwidth consumption) and users' requirements.

QoS enabled mobile VoIP service is a mobile VoIP service which has the characteristic of ensuring the QoS when the user terminal moves, e.g., changes from one access point to another one. This service requires some form of adaptation in order to support service continuity when users' requirements and network conditions mismatch. Adaptation may include negotiation/renegotiation of network QoS and/or terminal parameters (e.g., codec change/adaptation).

When the user terminal moves between different networks, network QoS parameters may either be maintained or adapted. Network QoS parameters include information such as IP layer available bandwidth, maximum packet transfer delay, jitter, packet loss rate, burst loss rate, packet delay variation tolerance, packets per second, etc.

Figure 1 illustrates a general network architecture involving two operators supporting different types of access networks, i.e., cellular access networks (such as 3G), WiFi access networks and mobile WiMAX access networks, and where users of the mobile VoIP service may move between different access networks in the same operator domain or between different operator domains.

As shown in Figure 1, NGN architectural components, i.e., service control functions (SCF), mobility management and control functions (MMCF), network attachment control functions (NACF) and resource and admission control functions (RACF), are assumed to be used for supporting the QoS enabled mobile VoIP service.

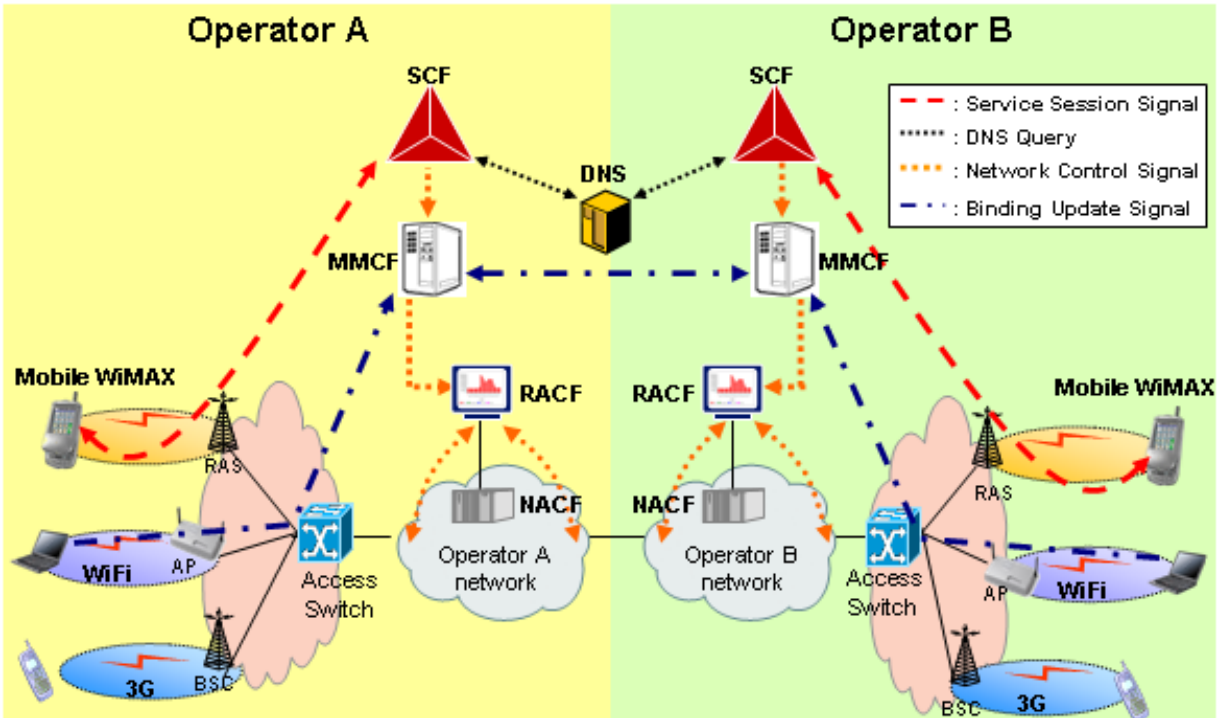

Figure 1 – General network architecture for QoS enabled mobile VoIP service

The objective of this Recommendation is to describe corresponding service scenarios for the case where QoS enabled mobile VoIP service is provided to the mobile users. The following provides the functional model used for describing the corresponding service scenarios, while clause 8 provides the overall key assumptions. Appendix I contains the detailed description of service scenarios.

7 Functional model

This clause provides a functional model for the support of QoS enabled mobile VoIP services. This functional model is based on the NGN framework architecture [ITU-T Y.2012] and reuses the functions and functional entities of RACF [ITU-T Y.2111], NACF [ITU-T Y.2014], MMCF [ITU-T Y.2018] and SCF [ITU-T Y.2012].

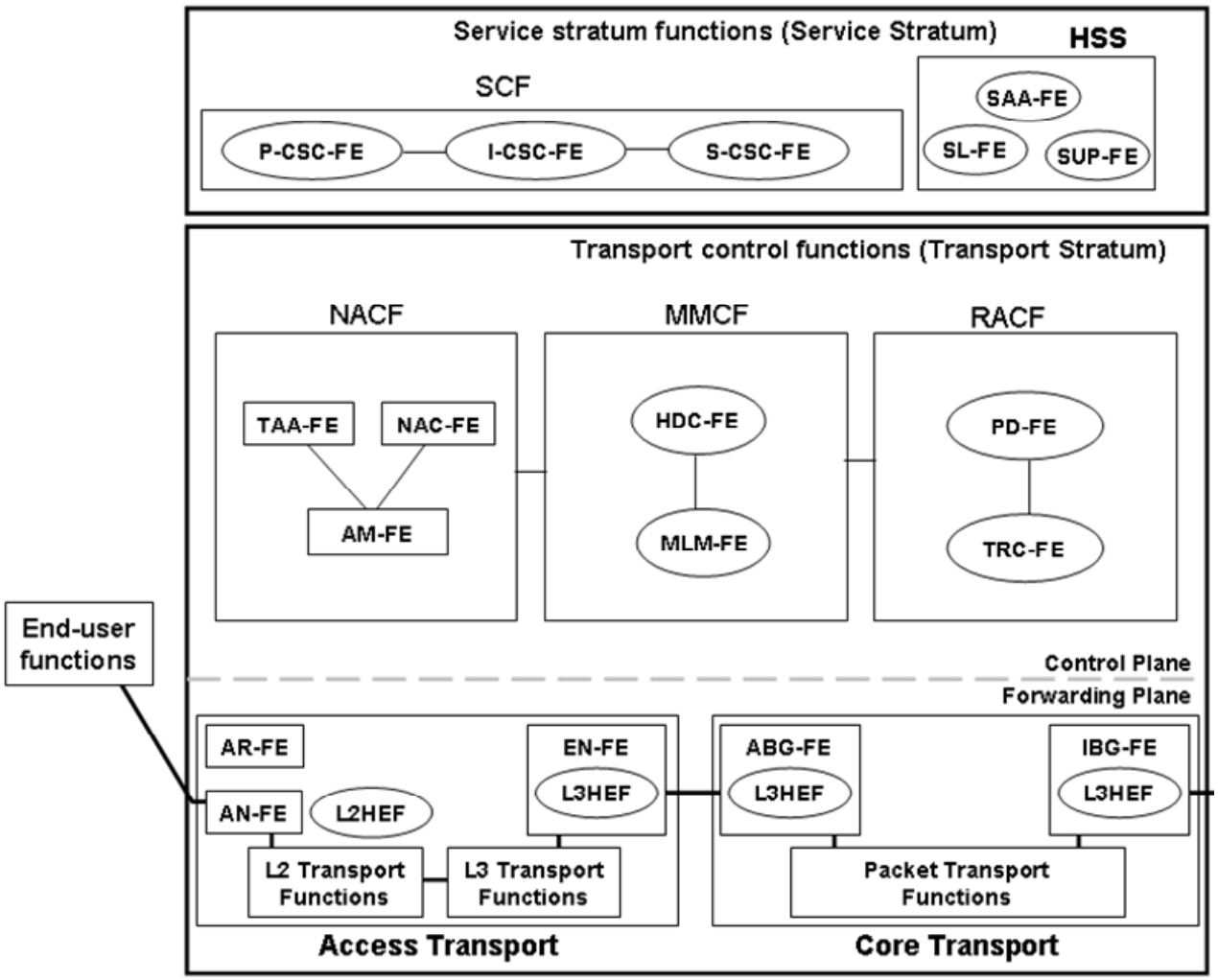

Figure 2 – Functional model

The functional model shown in Figure 2 includes the following functional entities:

- The functional entities in SCF for providing QoS enabled mobile VoIP service are composed of S-CSC-FE, P-CSC-FE, I-CSC-FE, SL-FE, SUP-FE, and SAA-FE. Further details can be found in [ITU-T Y.2012].
- The required functional entities in MMCF for providing QoS enabled mobile VoIP service are composed of HDC-FE, and MLM-FE. For further details see [ITU-T Y.2018].
- The required functional entities in RACF for providing QoS enabled mobile VoIP service are composed of PD-FE and TRC-FE. For further details see [ITU-T Y.2111].
- The required functional entities in NACF for providing QoS enabled mobile VoIP service are composed of TAA-FE, NAC-FE and AM-FE. For further details see [ITU-T Y.2014].
- The required functional entities in the forwarding plane for providing QoS enabled mobile VoIP service are composed of AR-FE, AN-FE, EN-FE, ABG-FE and IBG-FE. For further details see [ITU-T Y.2012]. In order to support handover execution in the forwarding plane, it is assumed that L3HEF as defined in [ITU-T Y.2018] is supported by the EN-FE, ABG-FE and IBG-FE.

Based on the functional model described in this clause, clause 8 describes the overall assumptions made for describing the different service scenarios, while Appendix I goes into the details of service scenarios descriptions themselves.

8 Key assumptions

This clause identifies the key components assumptions considered in this Recommendation.

8.1 User terminal aspects

The user terminal (UT) is the device that facilitates end user's access to services and applications. User terminals can be classified as single-mode terminals and multi-mode terminals.

- Single-mode terminal: A terminal which provides connection to either fixed or mobile or a wireless network. Connection of a single-mode terminal to the network is identified by a single identity which is the basis to bind all services and applications delivered to the terminal. A single-mode terminal is equipped with various media processing capabilities including various codecs to handle services and applications, such as voice phone call, conference, SMS, video and IPTV.
- Multi-mode terminal: A terminal which provides connections to fixed, mobile or wireless networks. Each network connection of a multi-mode terminal is identified by a different identity according to each network. Therefore, binding of services and applications delivered to a multi-mode terminal is much more complex than for a single-mode terminal. A multi-mode terminal is also equipped with various media processing capabilities, including various codecs to handle services and applications similar to those for single-mode, but forming different sets of service categories with different sets of processing capabilities, such as different sets of codecs according to associated network connection capability.

The user terminals considered in this Recommendation are multi-mode terminals, equipped with WiFi, 3G, and mobile WiMAX functions and for which different voice codecs can be associated.

8.2 Networks aspects

The concept of generalized mobility as defined in [ITU-T Y.2001] introduces the ability to treat all related networks equally as far as mobility is concerned. This aspect raises several issues. First, the QoS capabilities may vary from one access network to another. For example, WiFi networks are able to support much higher bandwidths than mobile WiMAX or 3G networks. Second, a user terminal connected to different access networks may use different service coverages and different transmission speeds. Networks considered in this Recommendation are WiFi, 3G, and mobile WiMAX networks.

These networks have different capabilities due to the different available bandwidths, service coverages, and transmission speeds when a user terminal moves or accesses these different networks. The following identifies the main characteristics of these networks:

- WiFi: This network provides wireless access technology approximately at 10 Mbit/s-100 Mbit/s (802.11x based) transmission speed to user terminals such as personal digital assistants (PDAs) or notebooks within several hundred metres from the user terminal to the access point.
- Mobile WiMAX: This network provides wireless access technology at approximately 1 Mbit/s-2 Mbit/s transmission speed to user terminals such as personal digital assistants (PDAs) or notebooks with 60 km/h mobility support within 100 m-1 km service coverage per cell.
- 3G: This network provides wireless access technology at approximately 10 Mbit/s-50 Mbit/s transmission speed to user terminals such as PDAs or notebooks with 250 km/h mobility support within 1 km-3 km service coverage per cell.

This Recommendation assumes the use of Layer 2 (e.g., MAC) authentication based on triggering of Layer 2 signal strength in the user terminal. In addition, "make-before-break" is also assumed as a functional capability being used for handover in the transport stratum functions. The "make-before-break" functional capability minimizes the packet delay and packet loss which can occur in mobile VoIP. This capability consists in pre-establishing the Layer 2/Layer 3 path before handover and releasing the previous in-service path after connecting to the pre-established Layer 2/Layer 3 path. Figure 3 shows a handover procedure where a user terminal moves from a WiFi in-service network to a mobile WiMAX network.

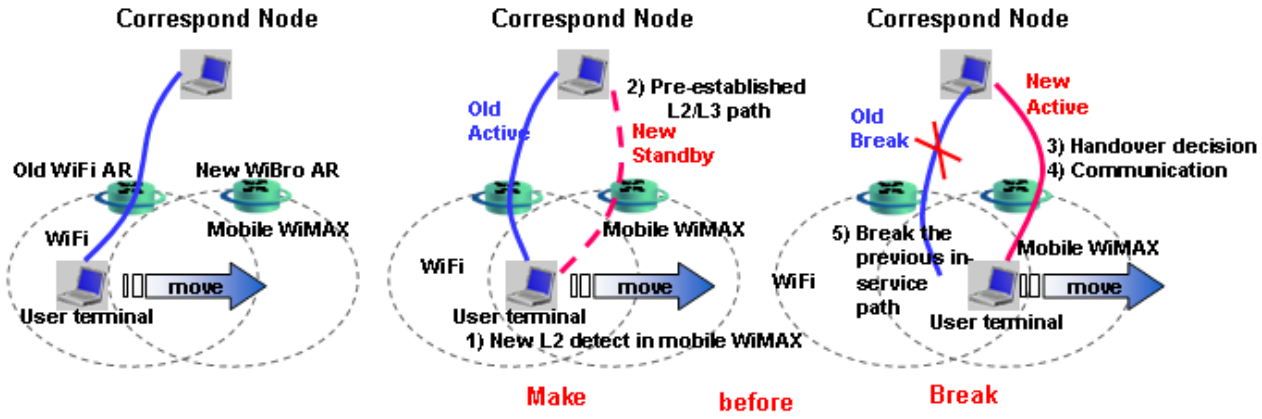

Figure 3 – Handover procedure with "make-before-break" capability

The steps considered in Figure 3 are as follows:

1) The user terminal detects a new L2 link in the mobile WiMAX network.

2) The user terminal sets up the pre-established L2/L3 path before handover to the mobile WiMAX network.

3) The user terminal decides to handover to the WiMAX network based on information triggers such as signal threshold or operator's policy.

4) The user terminal communicates through the pre-established path in the mobile WiMAX network.

5) The user terminal breaks the previous in-service path in the WiFi network.

8.3 Media handling aspects

The following two aspects can be considered when a user terminal moves between different networks:

- Same content quality: Content quality remains the same when the user terminal moves between different networks. In this case, there is no need to change the media processing capability and the network QoS parameters remain the same.
- Different contents quality: This is the case where content quality may change when the user terminal moves between different networks. In this case, there may be a need to change the media processing capabilities as well as network QoS parameters.

This Recommendation assumes that content quality can be changed when a user terminal moves between different networks and as a result, different network QoS parameters may be applied in these different networks.

8.4 End-to-end considerations

Taking into consideration the assumptions made in clauses 8.1, 8.2, 8.3, Figure 4 shows the overall considerations made in this Recommendation regarding user terminal, networks, and content.

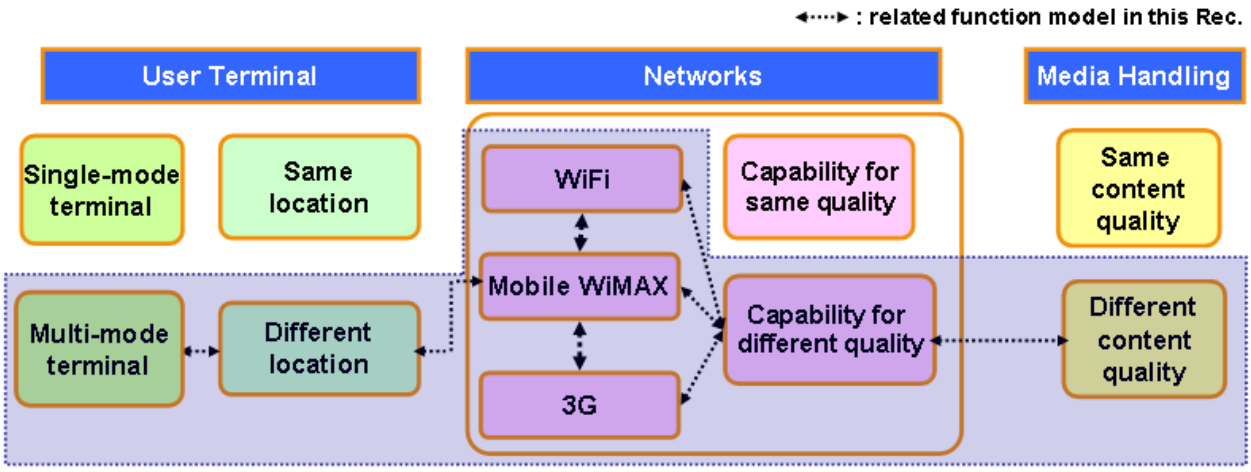

Figure 4 – End-to-end view of key assumptions

Figure 4 illustrates the following considerations:

- a multi-mode user terminal is operating in such a way that its network connection is kept active as long as possible;
- the network connection of a user terminal may change depending on the user terminal behaviour, such as when moving or changing the connection among WiFi, mobile WiMAX, and 3G networks. Changing of access network implies a change in the connecting capabilities like bandwidth, security, QoS, service coverage and others. Therefore, networks can be characterized by two elements: connection change and capability for different quality;
- content quality can stay the same or can change (i.e., downgrade or upgrade) depending on end-to-end QoS conditions involving the user terminal and networks. For example, when a user terminal moves from a WiFi network to a mobile WiMAX network during VoIP service, the QoS enabled VoIP service may continue by QoS profile transfer from WiFi network to mobile WiMAX network.

9 Security considerations

The path between the user terminal and the network could pass over a variety of technologies, many of which are subject of attacks. While the network elements considered in the service scenarios described in this Recommendation could be considered to be in the trusted zone, security regarding the user terminal and the path from user terminals to the network must be considered. The security requirements provided in [ITU-T Y.2701] and [ITU-T Y.2702] are applicable to the support of the QoS enabled mobile VoIP services described in this Recommendation.

Appendix I

Service scenarios for providing QoS enabled mobile VoIP service

(This appendix does not form an integral part of this Recommendation)

This appendix describes service scenarios by using the functional model provided in clause 7 and taking into account the technical assumptions made in clause 8. The described service scenarios consider the case where the user terminal moves:

- in a single operator's network which supports either WiFi, 3G or mobile WiMAX;
- between multiple operators' networks, each supporting a different wireless network, e.g., WiFi, mobile WiMAX or 3G wireless networks;
- in a single operator's network where the user terminal moves between different wireless access networks, e.g., between a mobile WiMAX and a WiFi network.

I.1 User terminal moving in a single operator's network

Service scenarios described in this clause assume that the originating user terminal (OUT) and the terminating user terminal (TUT) are located in the same operator's network, which supports either WiFi, 3G or mobile WiMAX access.

The described scenarios are related to the following phases:

- registration;
- service establishment;
- data transfer configuration;
- service release.

I.1.1 Registration

In this clause, attachment to the network (IP address allocation) and service provider registration (e.g., IMS network registration) are performed.

Registration includes:

- network attachment procedures including temporary IP address allocation and registration of the binding between the persistent IP address and the temporary IP address;
- service stratum authentication and authorization procedures based on information included in the service user profile.

Figure I.1 illustrates the overall procedure related to the registration.

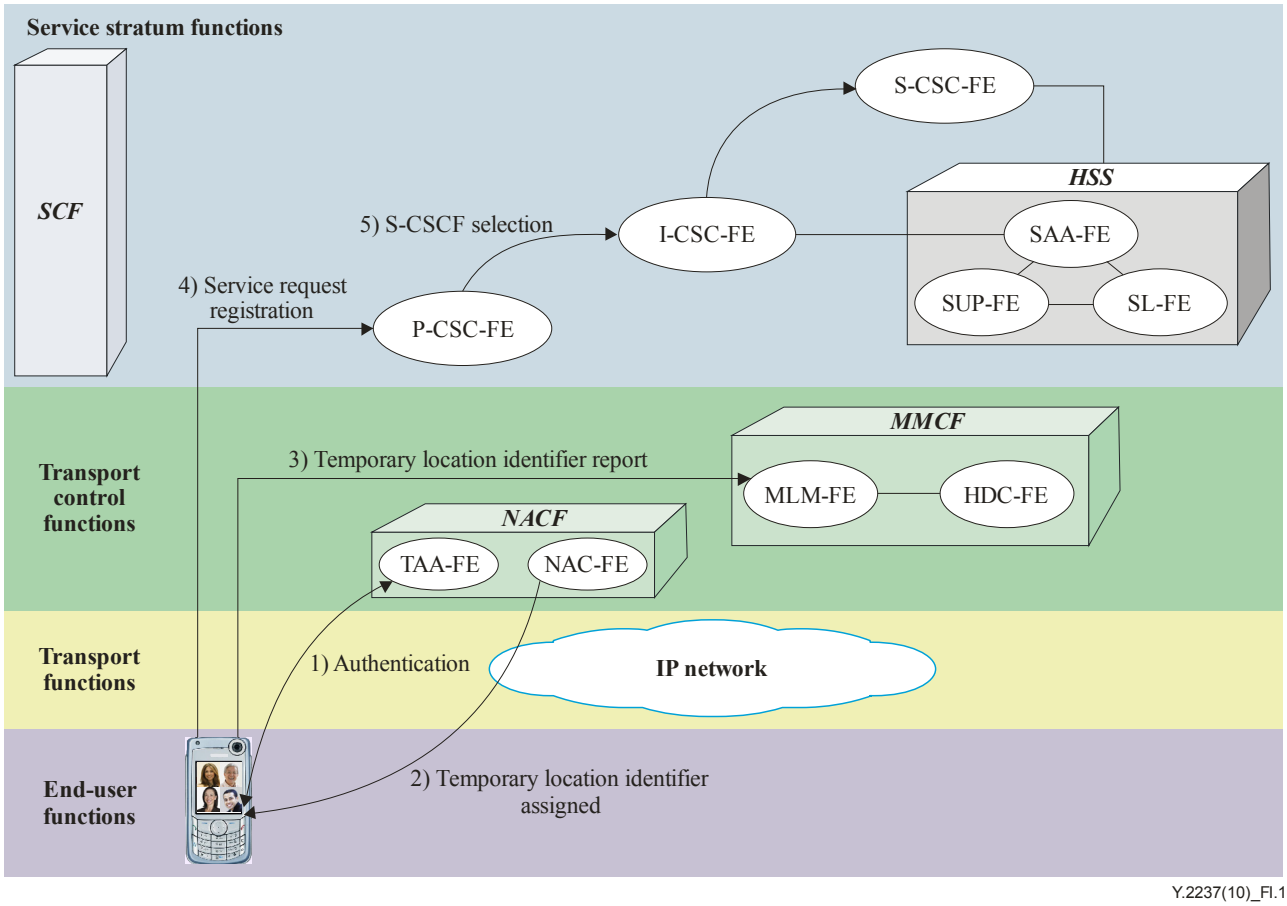

Figure I.1 – Registration

The following describes in more detail the information flows shown in Figure I.1:

1) L2 MAC layer authentication and authentication, authorization, accounting (AAA) associations are executed by the TAA-FE after connecting to the network.

2) A temporary IP address (network IP address) is assigned to the user terminal by the NAC-FE of NACF.

3) The received temporary IP address from the local network is reported by the user terminal to the MLM-FE.

4) A service request registration message which contains the user's URL is sent to the P-CSC-FE by the user terminal.

5) The P-CSC-FE sends a service request registration message which contains the user's URL and the P-CSC-FE URL to the SL-FE via the I-CSC-FE.

I.1.2 Service establishment

Service establishment includes the signalling information flows required for the establishment of a communication between the originating user terminal and the terminating user terminal.

Figure I.2 illustrates the overall procedure related to the service establishment.

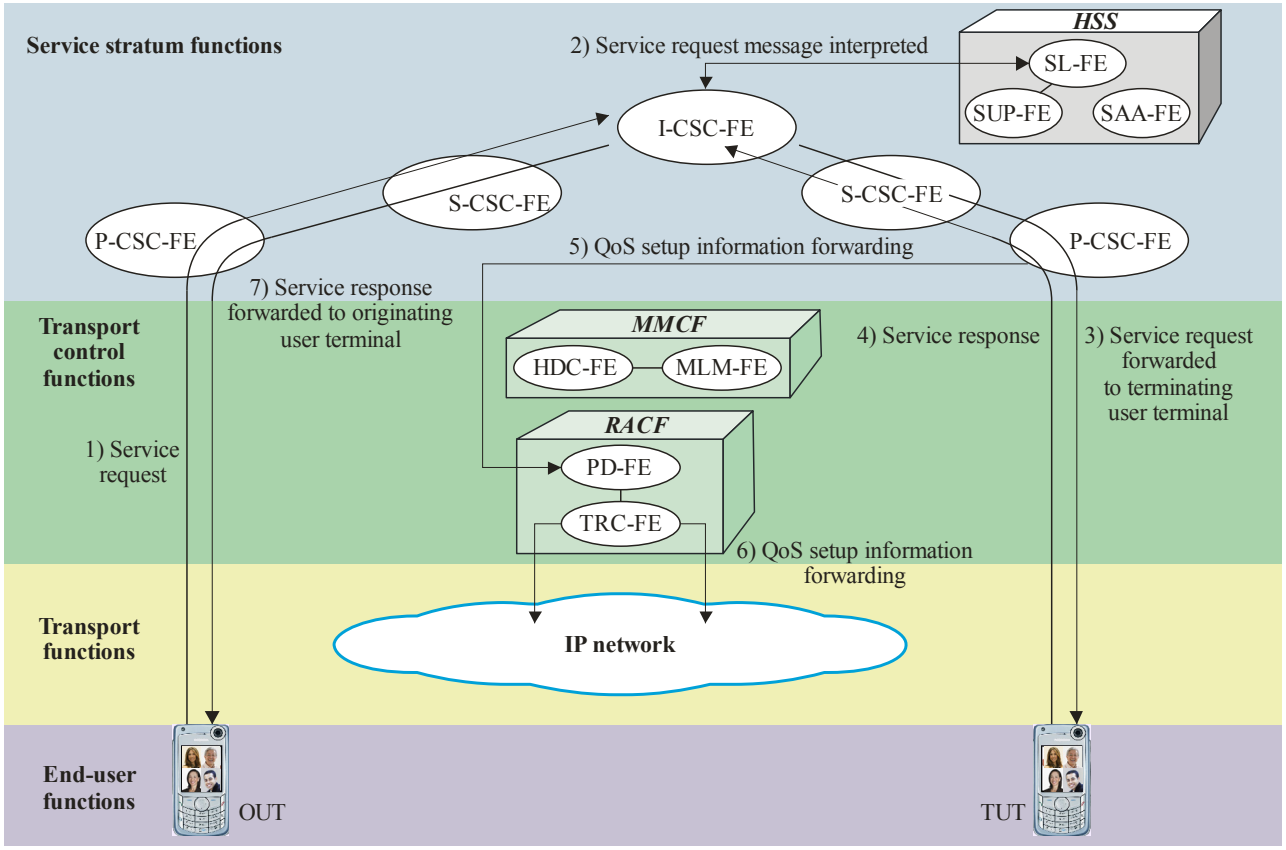

Figure I.2 – Service establishment

The following describes in more detail the information flows shown in Figure I.2:

1) The service request message sent to the P-CSC-FE by the originating user terminal contains the URL information of both the originating and terminating user terminals, codec information and UDP port number of the originating user terminal.
2) The I-CSC-FE interprets the service request message from the originating user terminal.
3) The service request message from the originating user terminal is forwarded to the terminating user terminal.
4) The terminating user terminal forwards the service response message to the P-CSC-FE. This message contains the URL information of the originating and terminating user terminals, codec information and UDP port number of the terminating user terminal.
5) The P-CSC-FE forwards QoS set-up information to the PD-FE. This information includes network bandwidth.
6) The TRC-FE forwards QoS set-up information to the IP network elements.
7) The originating user terminal receives a service response message from the P-CSC-FE.

I.1.3 Data transfer configuration

Data transfer configuration covers the use of the real-time transport protocol (RTP) for the transfer of voice over IP.

Figure I.3 illustrates the overall procedure related to the data transfer configuration.

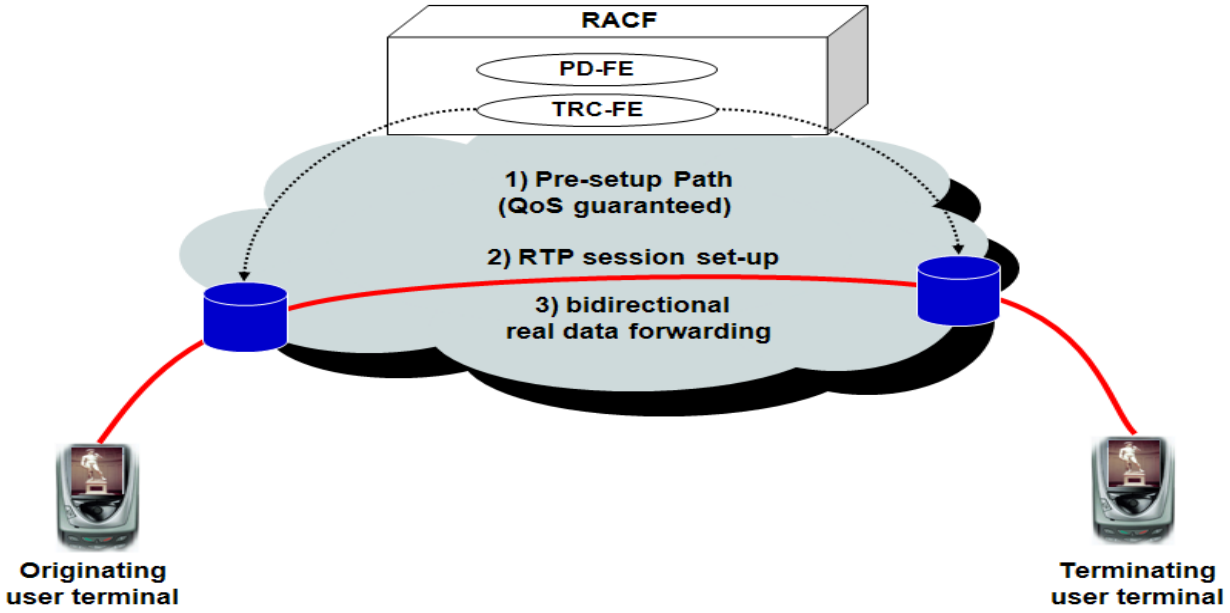

Figure I.3 – Data transfer configuration

The following describes in more detail the information flows shown in Figure I.3:

1) The RACF sets up a pre-established path with the same QoS characteristics as established between the OUT and TUT during the service establishment phase.

2) An RTP session is set up between the originating and terminating user terminals.

3) Bidirectional data is forwarded between the originating and terminating user terminals.

I.1.4 Service release

Service release includes the necessary information in order to release an established VoIP session between two user terminals.

Figure I.4 illustrates the overall procedure related to service release.

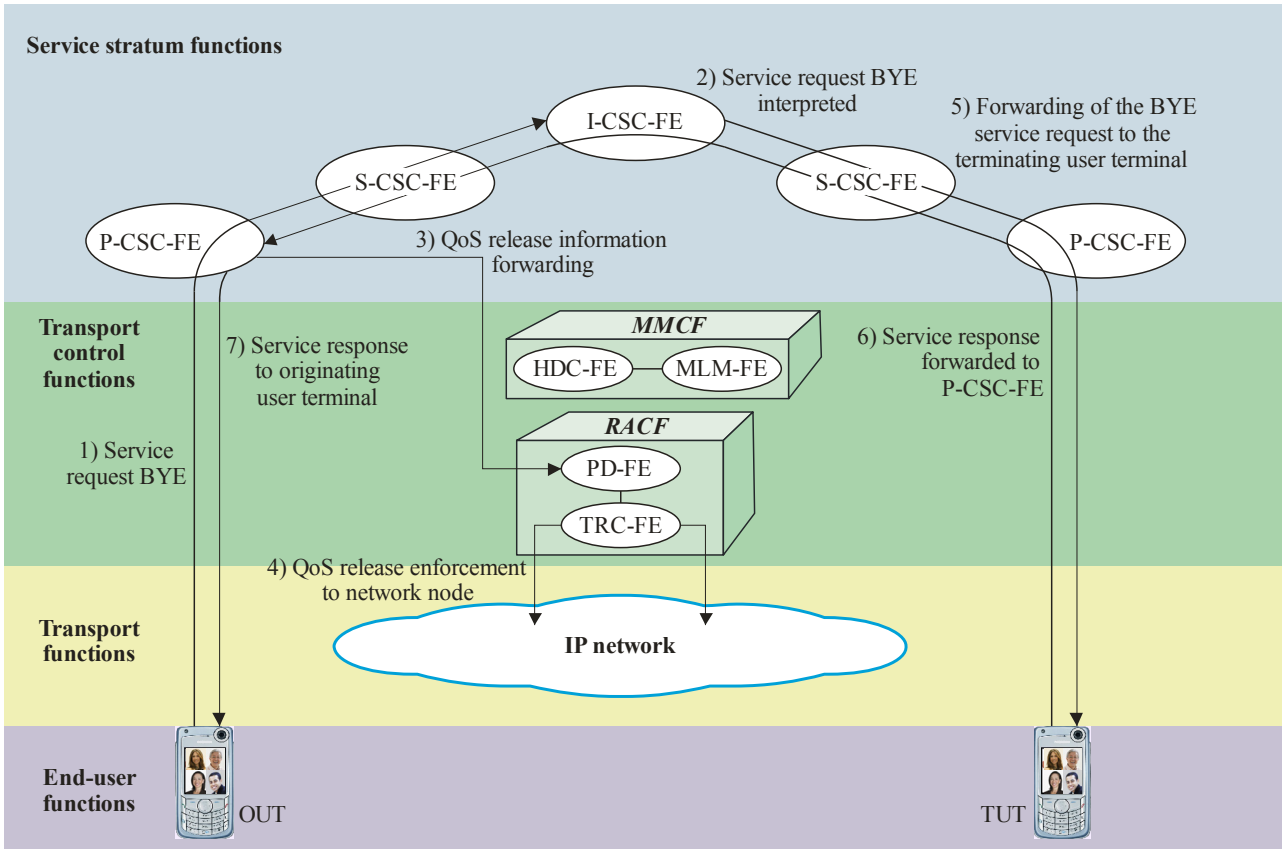

Figure I.4 – Service release

The following describes in more detail the information flows shown in Figure I.4:

1) In order to release the VoIP session, the originating user terminal sends a BYE service request message to the P-CSC-FE.

2) The I-CSC-FE interprets the BYE service request received from the originating user terminal.

3) The P-CSC-FE forwards the QoS release information to the PD-FE.

4) The TRC-FE transmits the QoS release message to the IP network elements.

5) The P-CSC-FE forwards the BYE service request to the terminating user terminal.

6) The terminating user terminal sends a service response message to the P-CSC-FE.

7) The P-CSC-FE transmits the service response message to the originating user terminal. The RTP (real-time transport protocol) session is closed.

In case the terminating user terminal initiates release of the VoIP session, the following changes apply:

- in step 1), the terminating user terminal transmits a BYE service request message to the P-CSC-FE, instead of the originating user terminal;
- in step 5), the P-CSC-FE forwards the BYE service request to the originating user terminal, instead of to the terminating user terminal;
- and in step 7), the P-CSC-FE transmits the service response message to the terminating user terminal, instead of to the originating user terminal.

I.2 Interworking between different operators' networks

The scenarios described in this clause are related to service interworking between different operators' networks, each with its own access technology, such as between a WiFi network and a 3G network. These scenarios include registration, service establishment, data transfer configuration, and service release.

I.2.1 Registration

Registration is described in clause I.1.1, and is executed once a terminal registers to a given operator's network.

I.2.2 Service establishment

Service establishment covers the required signalling information for call establishment.

Figure I.5 illustrates the overall procedure related to service establishment.

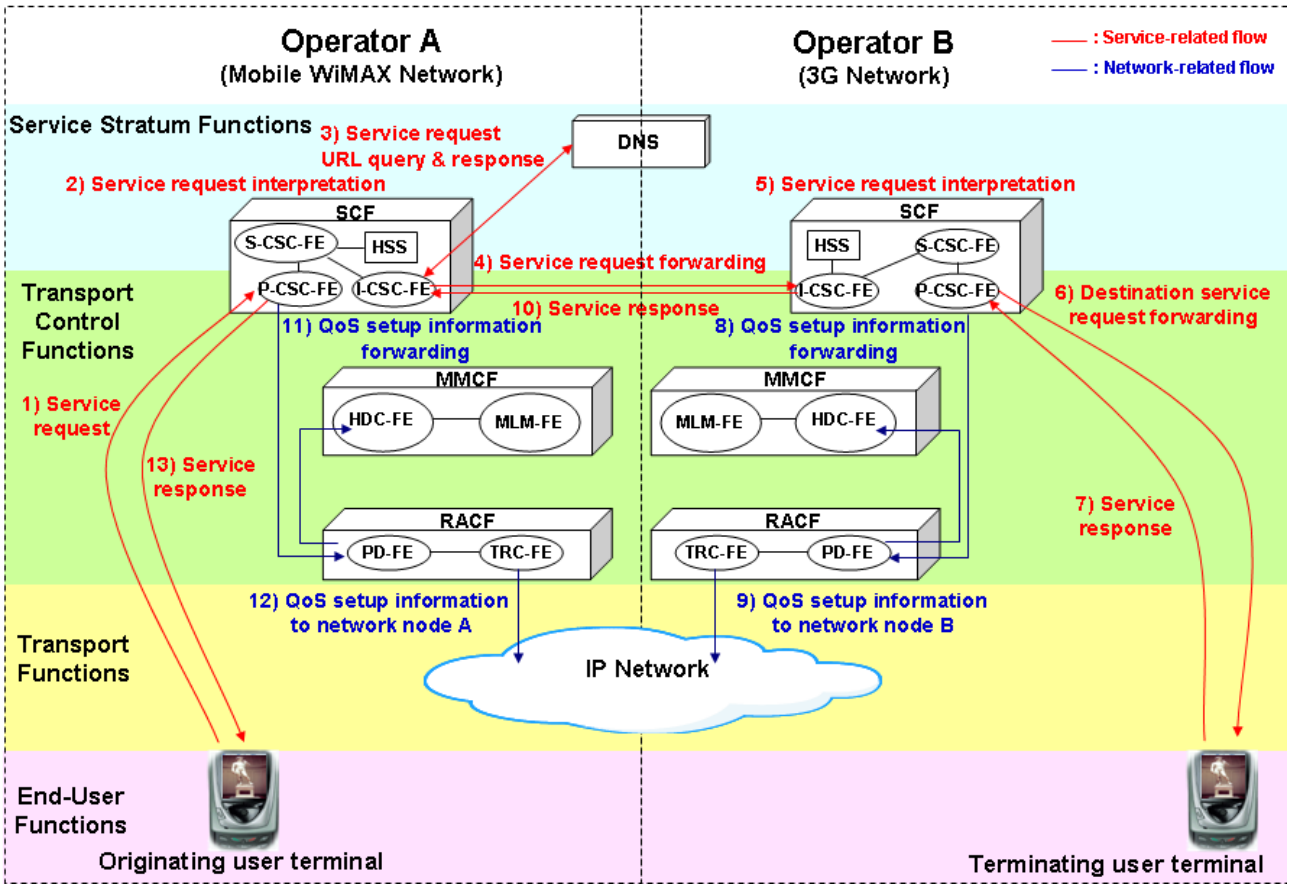

Figure I.5 – Service establishment

The following describes in more detail the information flows shown in Figure I.5:

1) The originating user terminal forwards a service request message to the P-CSC-FE of operator A. This message contains the URL information of the originating and terminating user terminals, codec information and UDP port numbers.

2) The I-CSC-FE of the SCF of operator A interprets the service request message received from the originating user terminal.

3) After recognizing that the URL (uniform resource locator) of the terminating user terminal does not belong to its own domain name, the I-CSC-FE of SCF of operator A forwards the URL of the service request message to the DNS (domain name server) and receives in the response the network IP address information of the terminating user terminal.

4) The I-CSC-FE of operator A forwards the service request message to the I-CSC-FE of operator B after getting the SIP URL of operator B.

5) The I-CSC-FE of operator B interprets the service request message received from the I-CSC-FE of operator A.

6) The service request message from the originating user terminal is forwarded to the terminating user terminal.

7) The terminating user terminal forwards the service response message to the P-CSC-FE of the SCF of operator B. This message contains the URL information of the originating and terminating user terminals, the codec information and the UDP port number of the terminating user terminal.

8) In the operator B network, the P-CSC-FE forwards the QoS set-up information (which contains network bandwidth information) to the PD-FE.

9) The TRC-FE of operator B requests QoS set-up information to the IP network elements of operator B.

10) The I-CSC-FE of operator B forwards the service response message to the I-CSC-FE of operator A.

11) The P-CSC-FE of operator A forwards the QoS set-up information to the PD-FE of operator A.

12) The TRC-FE of the RACF of operator A requests QoS set-up information to the IP network elements of operator A.

13) The originating user terminal receives the service response message from the P-CSC-FE of operator A.

I.2.3 Data transfer configuration

Data transfer configuration includes the use of the real-time transport protocol (RTP) for the support of voice service.

Figure I.6 illustrates the overall procedure related to the data transfer configuration.

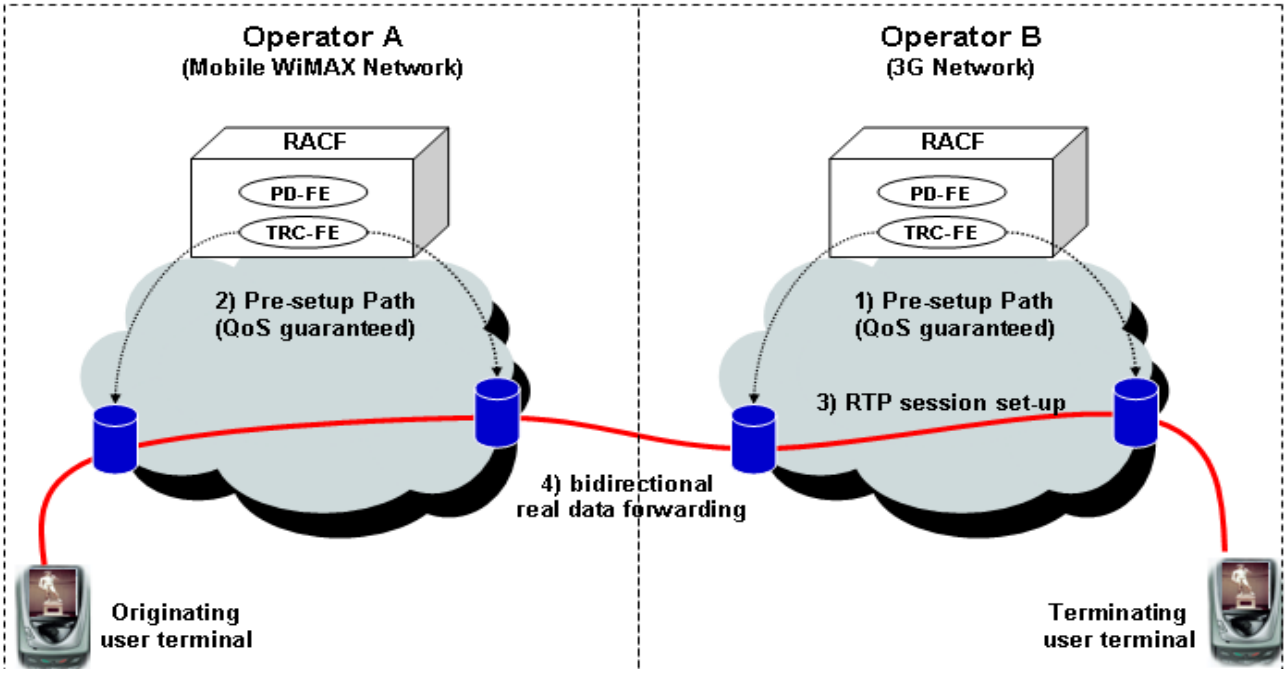

Figure I.6 – Data transfer configuration

The following describes in more detail the information flows shown in Figure I.6:

1) The RACF of operator B sets up the pre-established path in order to maintain the same QoS level as the one requested during the initial call establishment.

2) The RACF of operator A sets up the pre-established path in order to maintain the same QoS level as the one requested during the initial call establishment.

3) An RTP session is set up between the originating and terminating user terminals.

4) Bidirectional real data is forwarded between the originating and terminating user terminals.

I.2.4 Service release

Service release includes the information required for call termination.

Figure I.7 illustrates the overall procedure related to the service release.

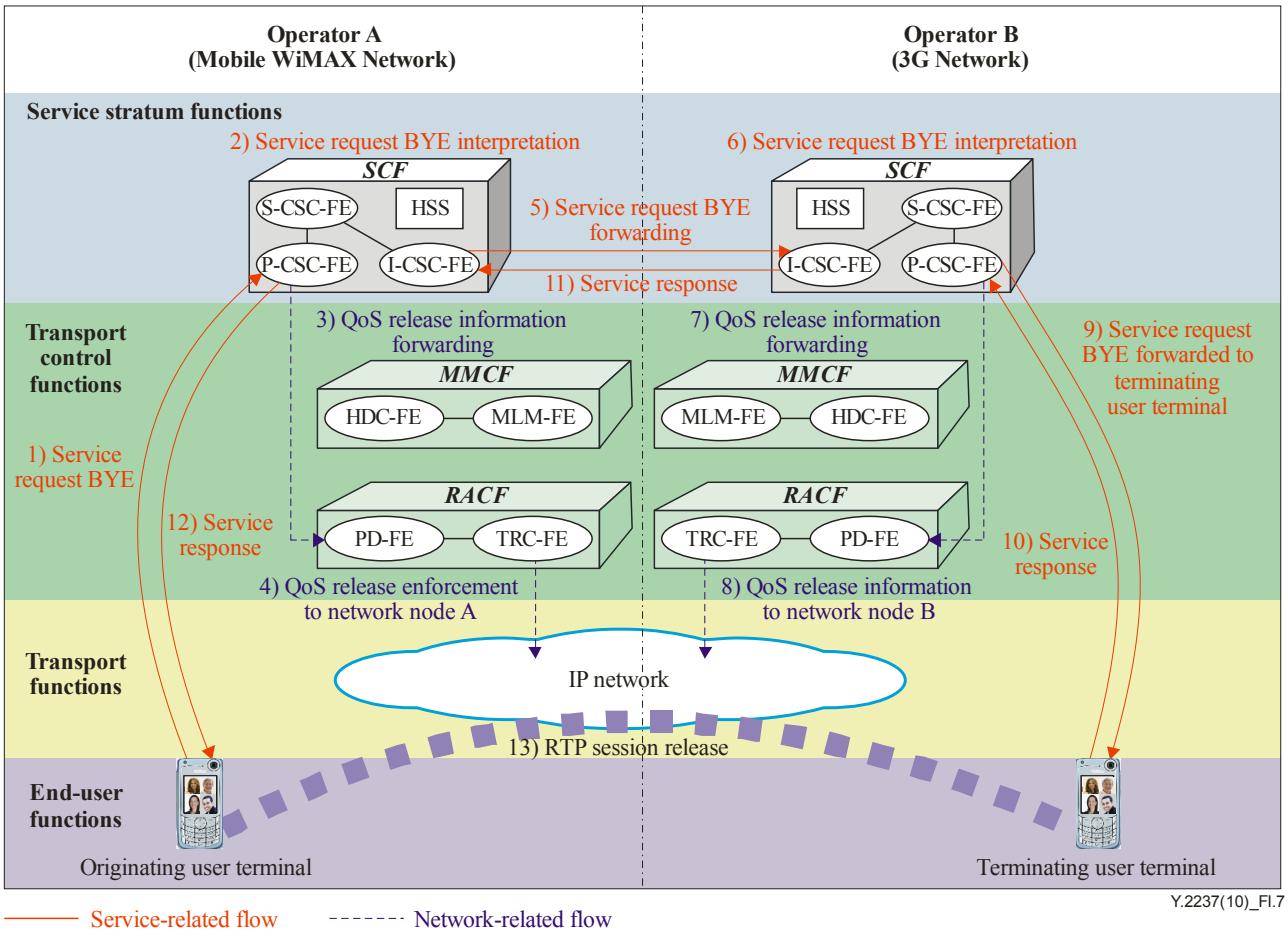

Figure I.7 – Service release

The following describes in more detail the information flows shown in Figure I.7:

1) The originating user terminal sends a BYE service request message to the P-CSC-FE of operator A.

2) The I-CSC-FE of operator A interprets the BYE service request message which was received from the originating user terminal.

3) The P-CSC-FE of operator A forwards the QoS release information to the PD-FE of operator A.

4) The TRC-FE of operator A forwards the QoS release message to the IP network elements of operator A.

5) The I-CSC-FE of operator A forwards the BYE service request message to the I-CSC-FE of operator B.

6) The I-CSC-FE of operator B interprets the BYE service request message which was received from the I-CSC-FE of operator A.

7) The P-CSC-FE of operator B forwards the QoS release information to the PD-FE of operator B.

8) The TRC-FE of operator B forwards the QoS release message to the IP network elements of operator B.

9) The P-CSC-FE of operator B forwards the BYE service request message to the terminating user terminal.

10) The terminating user terminal sends a service response message to the P-CSC-FE of operator B.

11) The I-CSC-FE of operator B forwards the service response message to the I-CSC-FE of operator A.

12) The P-CSC-FE of operator A forwards the service response message to the originating user terminal.

13) The RTP (real-time transport protocol) session is closed.

In case the terminating user terminal initiates the off-hook, the following changes apply:

- in step 1), the terminating user terminal transmits a BYE service request message to the P-CSC-FE, instead of the originating user terminal;
- in step 9), the P-CSC-FE forwards the BYE service request message to the originating user terminal, instead of to the terminating user terminal;
- and in step 11), the I-CSC-FE transmits the service response message to the terminating user terminal, instead of to the originating user terminal.

I.3 User terminal moving between different access networks within the same operator's network

The service scenarios described in this clause cover the case where a user terminal moves between different access networks within the same operator's network. In these scenarios, handover using the "make-before-break" concept is required in order to support service continuity. These scenarios are composed of the registration, service establishment, data transfer configuration, handover establishment and service release phases.

I.3.1 Registration

This service scenario is as described in clause I.1.1.

I.3.2 Service establishment

This service scenario is as described in clause I.1.2.

I.3.3 Data transfer configuration

This service scenario is as described in clause I.1.3, with handover being required to support service continuity between different networks.

I.3.3.1 Handover establishment

Handover establishment covers the required signalling based on the "make-before-break" concept. Figure I.8 illustrates the overall procedure related to the handover establishment.

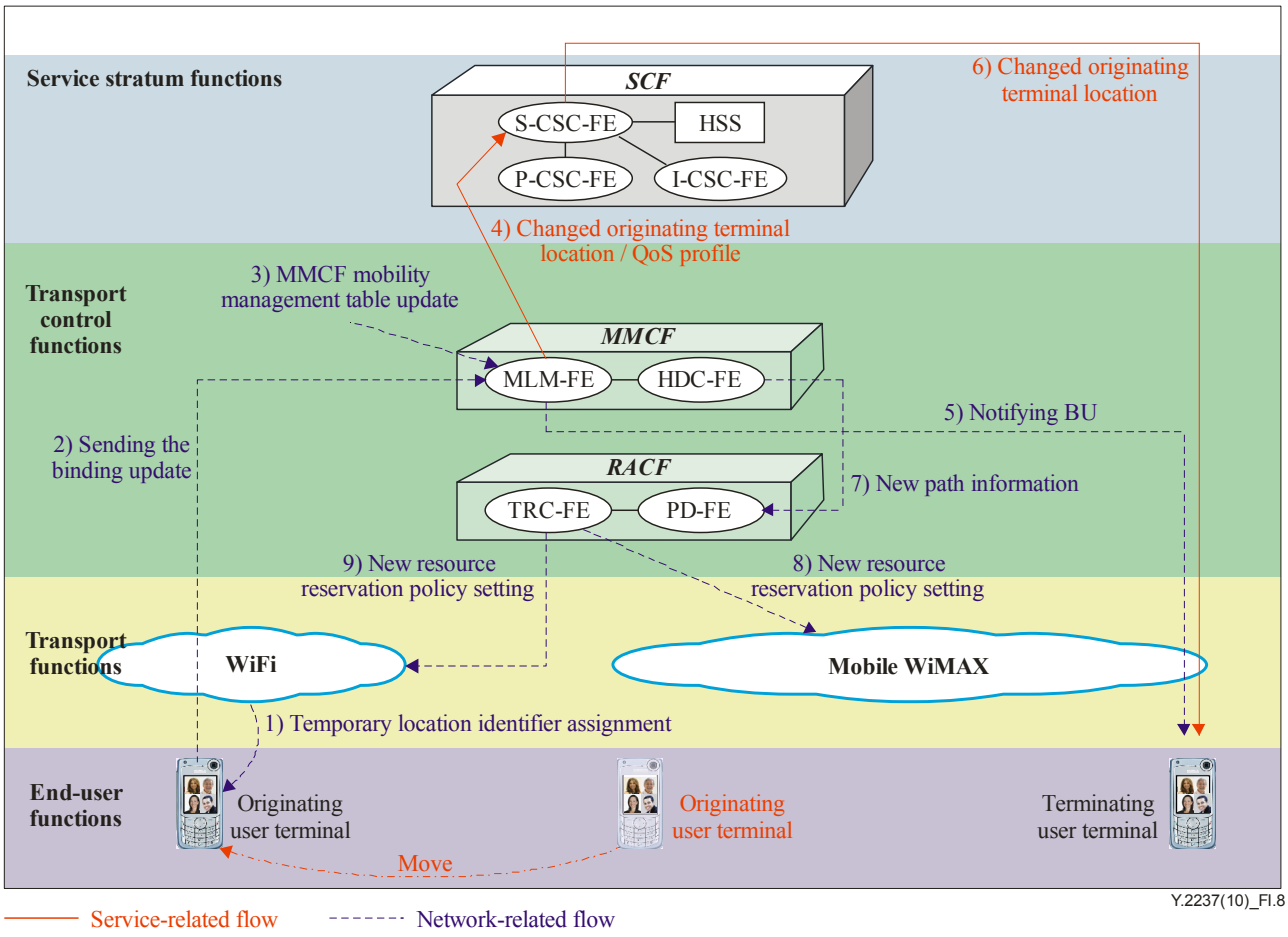

Figure I.8 – Handover establishment

The following describes in more detail the information flows shown in Figure I.8:

1) A temporary IP address (network IP address) is assigned to the originating user terminal by the NAC-FE (e.g., via DHCP) after L2 MAC layer authentication and AAA associations are performed by the TAA-FE.

2) The originating user terminal informs his moving status to the MLM-FE by sending a binding update message. In this case, the originating user terminal signals its movement from the mobile WiMAX network to the WiFi network.

3) The MLM-FE updates the mobility management table as a measure for location management of the originating user terminal.

4) The MLM-FE informs the SCF of the updated location and QoS profile information of the originating user terminal.

5) The MLM-FE forwards the binding update (BU) message received from the originating user terminal to the in-service terminating user terminal in order to inform the changed location information of the originating user terminal.

6) The S-CSC-FE forwards the updated location information of the originating user terminal to the terminating user terminal.

7) The HDC-FE informs the PD-FE of the creation of a new path between the originating user terminal and the terminating user terminal.

8) The TRC-FE sends a resource reservation request for a new path to the mobile WiMAX network to which the terminating user terminal is connected.

9) The TRC-FE sends a resource reservation request for a new path to the WiFi network to which the originating user terminal is connected.

I.3.4 Service release

Service release covers the required information for call termination.

Figure I.9 illustrates the overall procedure related to the service release.

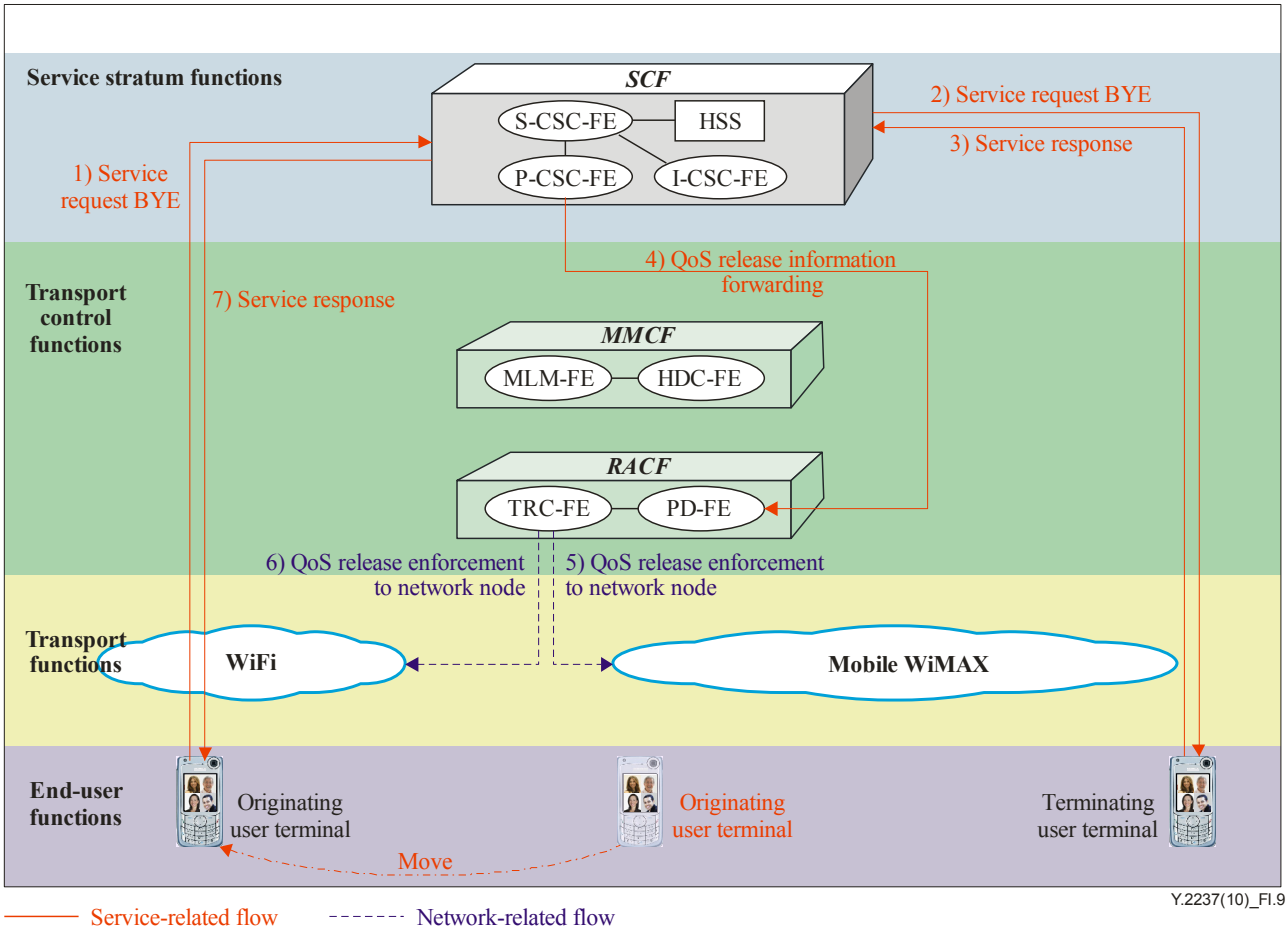

Figure I.9 – Service release

The following describes in more detail the information flows shown in Figure I.9:

1) The originating user terminal transmits a BYE service request message to the P-CSC-FE.
2) The P-CSC-FE forwards the BYE service request message to the terminating user terminal.
3) The terminating user terminal forwards the service response message to the P-CSC-FE.
4) The P-CSC-FE forwards the QoS release information to the PD-FE.
5) The TRC-FE transmits the QoS release message to the IP network elements within the mobile WiMAX network.
6) The TRC-FE transmits the QoS release message to the IP network elements within the WiFi network.
7) The P-CSC-FE transmits the service response message to the originating user terminal, and the RTP (real-time transport protocol) session is closed.

In case the terminating user terminal initiates the off-hook, the following changes apply:

- in step 1), the terminating user terminal transmits a BYE service request message to the P-CSC-FE, instead of to the originating user terminal.

- in step 2), the P-CSC-FE forwards the BYE service request message to the originating user terminal, instead of to the terminating user terminal.
- in step 3), the originating user terminal forwards the service response message to the P-CSC-FE, instead of to the terminating user terminal.
- and in step 7), the P-CSC-FE transmits the service response message to the terminating user terminal, instead of to the originating user terminal.

Appendix II

Mapping between functions defined in NGN and 3GPP, Mobile WiMAX, WiFi entities

(This appendix does not form an integral part of this Recommendation)

II.1 Mapping of 3GPP entities to NGN functional entities

Table II.1 lists key entities in the 3GPP EPS architecture, their functions, and the NGN functional entities responsible for those functions (see [ITU-T Y.2012]).

Table II.1 – Mapping of 3GPP entities to NGN functional entities

3GPP entity	Functions performed	NGN functional entity responsible
eNodeB	Functions for radio resource management: Radio bearer control, radio admission control, connection mobility control, dynamic allocation of resources to UEs in both uplink and downlink (scheduling)	AN-FE
	IP header compression and encryption of user data stream	AN-FE
	Selection of an MME at UE attachment when no routing to an MME can be determined from the information provided by the UE	AR-FE
	Routing of user plane data towards serving gateway	AN-FE
	Scheduling and transmission of paging messages (originated from the MME)	AN-FE
	Scheduling and transmission of broadcast information (originated from the MME or O&M)	AN-FE
	Measurement and measurement reporting configuration for mobility and scheduling	AN-FE
	Scheduling and transmission of ETWS messages (originated from the MME)	AN-FEz
Mobility management entity (MME)	NAS signalling	NACF
	NAS signalling security	NACF
	AS Security control	NACF
	Inter CN node signalling for mobility between 3GPP access networks	NACF
	Idle mode UE reachability (including control and execution of paging retransmission)	TBD
	Tracking area list management (for UE in idle and active mode)	TBD (logically, could be TLM-FE)
	PDN GW and Serving GW selection	TBD (TUP-FE)
	MME selection for handovers with MME change	NACF

Table II.1 – Mapping of 3GPP entities to NGN functional entities

3GPP entity	Functions performed	NGN functional entity responsible
	SGSN selection for handovers to 2G or 3G 3GPP access networks	NACF
	Roaming	NACF (TAA-FE)
	Authentication	NACF (TAA-FE)
	Bearer management functions including dedicated bearer establishment	HDC-FE
	Support for ETWS message transmission	NACF
Serving Gateway	The local mobility anchor point for inter-eNB handover	L2HE-FE
	Mobility anchoring for inter-3GPP mobility	L2HE-FE
	E-UTRAN idle mode downlink packet buffering and initiation of network triggered service request procedure	L2HE-FE
	Lawful interception	EN-FE
	Packet routing and forwarding	EN-FE
	Transport level packet marking in the uplink and the downlink	EN-FE
	Accounting on user and QCI granularity for inter-operator charging	EN-FE
	UL and DL charging per UE, PDN, and QCI	EN-FE
	Originator of PMIP signalling. Proxy point for PMIP signalling (chained PMIP)	MLM-FE(P)
	Lower IP tunnel end point	L3HEF
Packet data network (PDN) gateway	Per-user based packet filtering (by, e.g., deep packet inspection)	ABG-FE
	Lawful interception	ABG-FE
	UE IP address allocation	NACF
	DHCPv4 (server and client) and DHCPv6 (client and server) functions	NACF
	UL and DL service level charging, gating and rate enforcement	ABG-FE
	DL rate enforcement based on AMBR	ABG-FE
	Transport level packet marking in the downlink	ABG-FE
	Terminator of PMIP signalling	MLM-FE(C)
	Upper tunnel end point	L3HEF
	Terminator of DSMIPv6 signalling from the UE	MLM-FE(P) collocated with MLM-FE(C)

II.2 Mapping of mobile WiMAX entities to NGN functional entities

Table II.2 lists key entities in the mobile WiMAX architecture, their functions, and the NGN functional entities responsible for those functions (see [ITU-T Y.2012]).

Table II.2 – Mapping of Mobile WiMAX entities to NGN functional entities

Mobile WiMAX entity	Functions performed	NGN functional entity responsible
RAS	Wireless resource management and control function	AN-FE
	Handover function between cell and sector	L2HE-FE
	Authentication and authorization function of user terminal	NACF (TAA-FE)
	QoS control function between user terminal and RAS	AN-FE
ACR	IP routing and L3 mobility management function	EN-FE, L3HEF
	Authentication and security function of user terminal	NACF
	Network connection control, traffic connection control, connection release control functions	ABG-FE
	L2 mobility (handover) control function between RAS in ACR	L2HE-FE
	Interworking function between different networks	NACF
	IPv4/IPv6 Dual stack support function	NACF (NAC-FE)
	Charging function according to the service characteristics of users	EN-FE
	QoS control function for differential quality supply per service	RACF

II.3 Mapping of WiFi entities to NGN functional entities

Table II.3 lists key entities in the WiFi architecture, their functions, and the NGN functional entities responsible for those functions (see [ITU-T Y.2012]).

Table II.3 – Mapping of WiFi entities to NGN functional entities

WiFi entity	Functions performed	NGN functional entity responsible
AP	Wireless resource management and control function	AN-FE
	Data delivery and buffering function	AN-FE
	Authentication and authorization function	AN-FE
	DHCP function	NACF
AR	Concentration and management function of APs	ABG-FE
	IP routing management and control function	EN-FE

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