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Framework of Mobility Management in Service Stratum for Next Generation Network

Summary

This Recommendation describes the framework of mobility management (MM) in Service Stratum for Next Generation Networks (NGN). This Recommendation identifies the functional architecture of MM in the NGN Service Stratum, and specifies the procedural information flows for location management and handover control based on the IP Multimedia Subsystem (IMS).

Keywords

Framework, Mobility Management, NGN, Service Stratum

Introduction

This Recommendation describes the framework of mobility management (MM) in Service Stratum for NGN. This work has been motivated from the observation that MM is an essential functionality to provide seamless mobility for the NGN users and services. This Recommendation is a part of the MM framework for NGN. Based on the generic framework of Q.1707/Y.2804, the two Recommendations Q.1708/Y.2805 and Q.1709/Y.2806 have addressed the MM schemes in the NGN Transport Stratum, whereas this Recommendation deals with the MM schemes in the NGN Service Stratum.

ITU-T Draft New Recommendation Y.SMF (Y.2809)

Framework of Mobility Management in Service Stratum for Next Generation Networks

1 Scope

This Recommendation describes the framework of mobility management (MM) in service stratum for Next Generation Networks (NGN). This Recommendation addresses the issues on terminal mobility in based on the IP Multimedia Subsystem (IMS). This Recommendation first identifies the functional architecture of MM in the NGN service stratum, and then specifies the procedural information flows for location management and handover control based on the identified functional architecture.

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 Y.2012] Recommendation ITU-T Y.2012 (2010), *Functional requirements and architecture of the NGN*

[ITU-T Y.2091] Recommendation ITU-T Y.2091 (2007), *Terms and definitions for Next Generation Networks*

[ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), *Mobility management requirements for next generation networks*

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

[ITU-T Y.2805] Recommendation ITU-T Y.2805 (2009), *Framework of location management for next generation networks*.

[ITU-T Y.2806] Recommendation ITU-T Y.2806 (2009), *Framework of handover control for next generation networks*.

3 Definitions

This Recommendation uses the terms and definitions given in the Recommendations Y.2012, Y.2091, Y.2804, Y.2805, and Y.2806.

4 Abbreviations and Acronyms

This Recommendation uses the following abbreviations and acronyms:

CSC-FE	Call Session Control FE
CN	Correspondent Node
I-CSC-FE	Interrogating CSC-FE
IMS	IP Multimedia Subsystem
NGN	Next Generation Networks
FE	Functional Entity
HC	Handover Control
IP	Internet Protocol
LM	Location Management
MIH	Media Independent Handover
MM	Mobility Management
MN	Mobile Node
MMCF	MM Control Function
P-CSC-FE	Proxy CSC-FE
SCF	Service Control Function
S-CSC-FE	Serving CSC-FE
S-HC-FE	HC-FE in Service Stratum
SIP	Session Initiation Protocol
UE	User Equipment

5 Conventions

None.

6 Design Considerations

This Recommendation considers the mobility management (MM) in the Service Stratum of NGN. In the network, a user or a UE (user equipment) may change its IP address by movement and thus the user may experience service disruption and session discontinuity. This Recommendation deals with the MM schemes or protocols that can be used to provide seamless services and session continuity against the movement of users. To provide seamless mobility, the link-layer information on the concerned access links might be used in the MM schemes, as shown in the IEEE 802.21 Media Independent Handover (MIH). In this fashion, the so-called cross-layer optimization tasks may need to be taken to provide seamless mobility. However, the details of a specific link-layer technology are outside the scope of this Recommendation.

It is noted that the IMS platform can typically used to support a variety of multimedia services. The ITU-T Recommendation F.700 gives a generic model of multimedia service architecture. Multimedia services are built up by combining ‘communication tasks’ and organizing their interaction. A communication task is considered as a functional entity of a multimedia service, which performs its communication features. Each communication task handles a set of media components in a synchronized way, in order to convey and control information types such as audio or video. Media components are individual (mono-media) components, which handle functions related to each independent medium such as capture, coding and presentation. With regard to communication tasks, the ITU-T F.700 mentions ‘conversing’, ‘conferencing’, ‘distributing’, ‘sending’, ‘receiving’ and ‘collecting’. It shall be noted that this list of communications tasks can be extended by new tasks or by the refinement of given tasks. On the level of media components audio, video, text, graphics and data are identified.

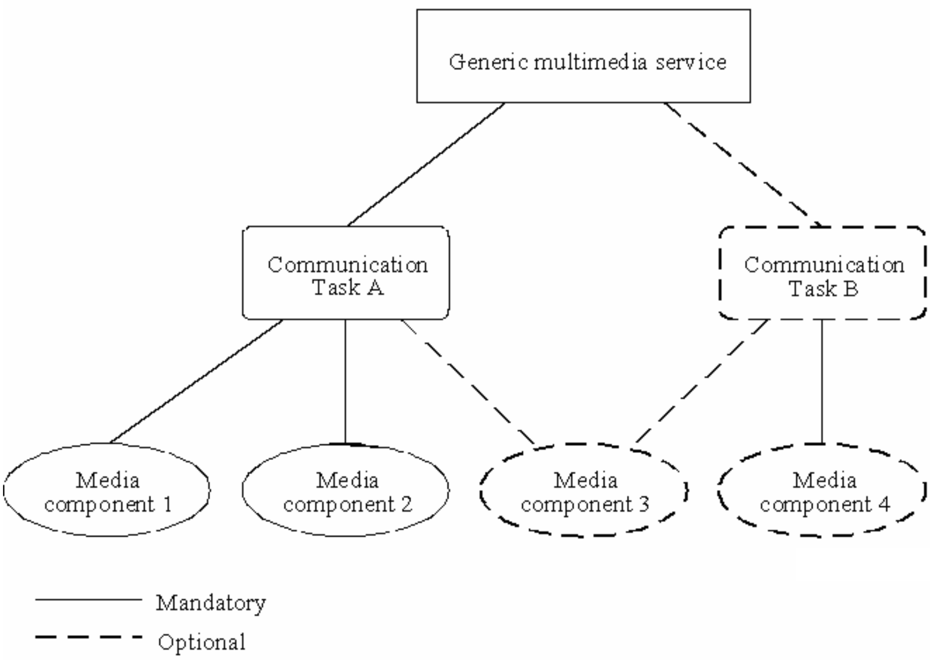

Figure 1. Reference model of generic multimedia services [ITU-T F.700]

Fig. 1 shows the relationship among multimedia services, communication tasks and media components. Communication tasks and media components will form the basic set of a specific multimedia service. For example, by the used media components, the multimedia conversational services can be further divided into:

- Videophone service, with audio and moving pictures and optionally various types of data;
- Voice and data services, with audio and various types of data;
- Text telephony, with real time text, optionally combined with audio;
- Total conversation service, with moving pictures, real time text and audio.

In general, the MM schemes for mobility support in NGN can be classified into the network-layer MM (in Transport Stratum) and application-layer MM (in Service Stratum). The MM issues in the network-layer or in the Transport Stratum are addressed in the Recommendations Y.2805 (Location Management Framework) and Y.2806 (Handover Control Framework). This Recommendation focuses on the MM issues in the application layer or in the Service Stratum. In the application layer, the IP Multimedia Subsystem (IMS) platform will be considered and enhanced to provide seamless mobility.

This Recommendation describes the framework of MM in the NGN Service Stratum. For this purpose, the MM functional architecture based on IMS platform is discussed, in which the Service Control Function (SCF) of IMS will be investigated and further enhanced to support seamless mobility. Based on the functional architecture, the procedural information flows will be described for location management and handover control.

7 Functional Architecture for MM in Service Stratum

7.1 Generic Architectural Model

The generic architectural model for MM in Service Stratum is described in Fig. 2, in which the MM functionality is provided via collaborative interactions between the functional entities (FEs) in Service Control Function and Transport Function.

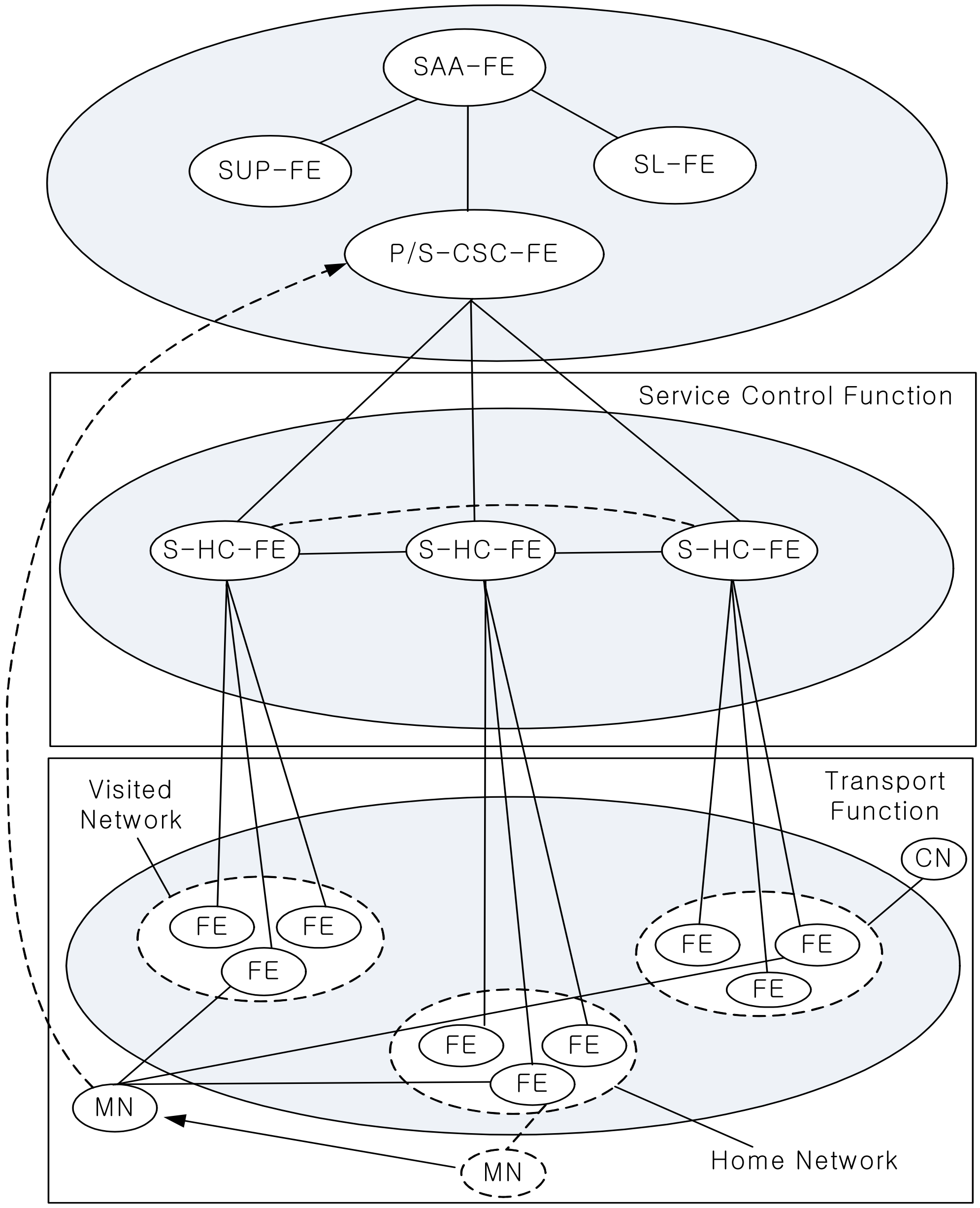

Figure 2. Generic architecture of MM in Service Stratum

The Service Control Function may comprise the following components, which are described in the NGN architecture [Y.2012]:

- Call Session Control FE (CSC-FE);
- Service Authentication Authorization FE (SAA-FE);
- Service User Profile FE (SUP-FE);
- Subscription Locator FE (SL-FE).

In addition, the Handover Control FE in Service Stratum (S-HC-FE) is defined to support the handover of users in Service Stratum. Such S-HC-FEs in the Service Stratum may be differently defined and implemented from the HC-FEs in Transport Control Function, which were described in the Y.2805 and Y.2806.

In Service Stratum, the MM functions are divided into the location management (LM) functionality and handover control (HC) functionality. The CSC-FEs are used to provide LM functionality (e.g., for location registration/update and location query from UE or network agent on behalf of UE). On the other hand, the HC-FEs are defined and used to provide the seamless mobility for NGN users. For handover control, the HC-FEs may exchange the control messages with the FEs in the Transport Stratum, which may be used for management of handover tunnels or for optimization of data paths during handover.

In Transport Stratum, some of the FEs may need to provide the handover enforcement at the network entities. Typical operations for handover control include the encapsulation, de-capsulation and forwarding of data packets based on bearer path under the control of HC-FEs. It is noted that such HC-FEs may be instantiated by some of NGN transport FEs, such as Edge Node FE (EN-FE), Access Border Gateway FE (ABG-FE) and Interconnection Border Gateway FE (IBG-FE), which are described in the NGN architecture [Y.2012].

In the MM model, a user moves from home network to a visited network, which may belong to a different NGN provider (administration domain). The detailed MM scenarios will be described in the succeeding clauses.

7.2 MM Functional Entities in Service Control Function

The FEs in Service Control Function in the IMS-based NGN can be used for MM, which are described in Fig. 3.

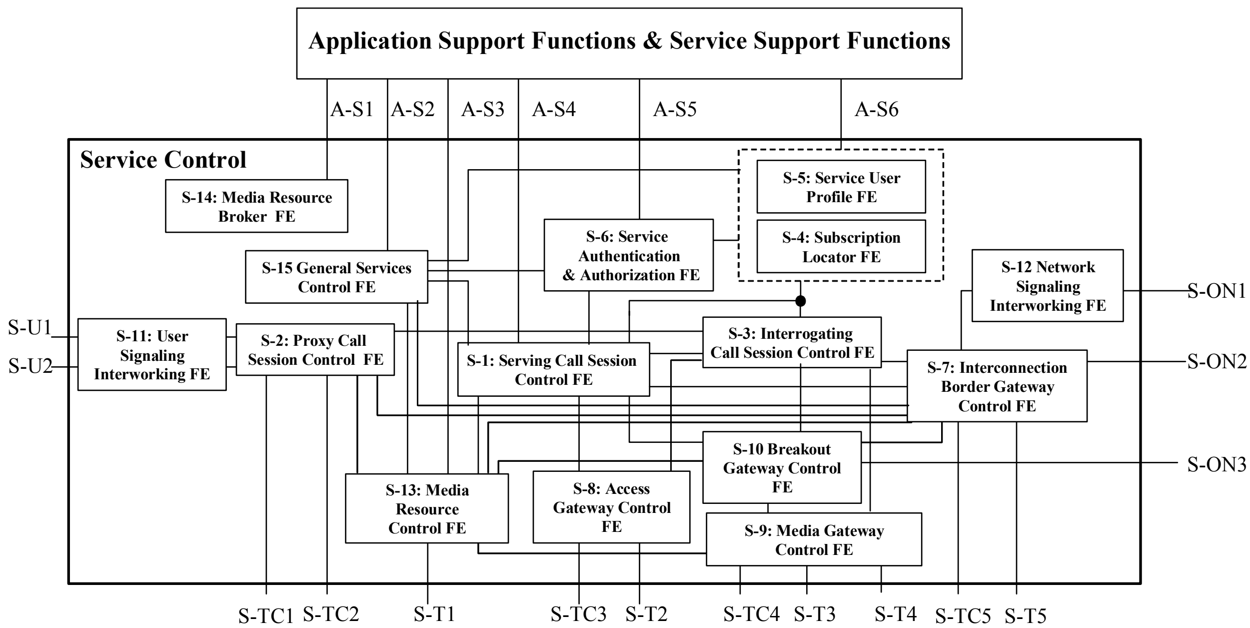

Figure 3. MM Functional Entities in IMS-based NGN [Y.2012]

In the figure, the FEs associated with MM are described below.

7.2.1 S-CSC-FE (S-1)

The serving call session control FE (S-CSC-FE) handles the functionality related to session control, such as registration, session setup/modification/teardown, and routing of session messages. In particular, the S-CSC-FE performs the registration functions for location management

It can determine that a particular user and/or terminal identifier is currently in service and can interact with the SUP-FE (possibly via the SL-FE) to obtain relevant service profile and address information which will act as an input to the service triggering and routing functions of the S-CSC-FE.

7.2.2 P-CSC-FE (S-2)

The proxy call session control FE (P-CSC-FE) acts as the contact point to a user for session-based services. Its IP address is discovered by the user’s terminal using an address configuration mechanism such as static provisioning or dynamic address configuration in the NACF.

P-CSC-FE shall have the capability to forward the registration request from a user to an appropriate I-CSC-FE. The P-CSC-FE shall have the capability to forward the registration request messages received from the terminal to the S-CSC-FE.

7.2.3 I-CSC-FE (S-3)

The interrogating call session control FE (I-CSC-FE) is the contact point within an operator's network for all service connections destined to a user of that network operator. In the LM perspective, the I-CSC-FE performs the registration process by assigning an S-CSC-FE to a user.

7.2.4 Subscription Locator FE (S-4)

The subscription locator FE (SL-FE) may be queried by the S-CSC-FE, I-CSC-FE, or Application Support FE to obtain the address of the SUP-FE for the required subscriber. The SL-FE is used to find the address of the physical entity that keeps the subscriber’s information for a given user identifier.

7.2.5 Service User Profile FE (S-5)

The service user profile FE (SUP-FE) is responsible for storing user profiles, subscriber-related location information, and presence information in the Service Stratum.

7.2.6 Service AA-FE (S-6)

The service authentication and authorization FE (SAA-FE) provides the authentication and authorization in the Service Stratum. The SAA-FE will perform the first step for the MM process via authentication, authorization, and accounting of users/terminals.

7.3 Mappings between IMS Functions and MM Control Functions

It is noted that some of the IMS FEs could be used only for LM functionality in Service Stratum, without supporting the handover control. Some of the example usage or mapping scenarios between IMS functions and MM Control Functions (MMCF), defined in the ITU-T Y.2804 (MM Framework), are described as follows:

- Use of P-CSCF as A-MMCF (or A-LMF) in Service Stratum

  P-CSCF is the first contact point in the IMS, so it could be used for A-MMCF in Service Stratum which is defined in Y.2804. Note that A-MMCF should support MM2 (Inter-AN MM) and MM3 (Intra-AN MM), but the conventional P-CSCF supports only call forwarding function. Therefore, in this case, a new function to support mobility management including MM2 and MM3 should be added to the conventional P-CSCF.

- Use of S-CSCF/HSS as C-MMCF in Service Stratum

  S-CSCF is likely to be located in the core network, which is responsible for accepting the registration request. Also, it makes the registration information available through the location server such (i.e. HSS). Therefore S-CSCF could be mapped into C-MMCF in Service Stratum along with HSS, which provides location information. Even though S-CSCF provides basic functions for mobility management, it may not sufficient to support the full functions of C-MMCF in terms of MM types: MM1 (Inter-CN MM), MM2, and MM3, which are described in the Recommendation Y.2804. Therefore, in this case, some functions to support mobility management including MM2 and MM3 should be added to conventional P-CSCF or cooperate with other functions (or functional entities) in transport/Service Stratum.

- Use of I-CSCF

  I-CSCF is used only for the assignment of S-CSCF in IMS and does not maintain any information related to registration. Therefore it does not seem to have direct relationship with MMCF in Service Stratum. However, I-CSCF may be used for MM1 using its interworking supporting function.

8 Information Flows for IMS-based Location Management

8.1 Location Registration and Location Re-registration

The IMS-based Location registration and update (re-registration) procedures are described in Fig. 4.

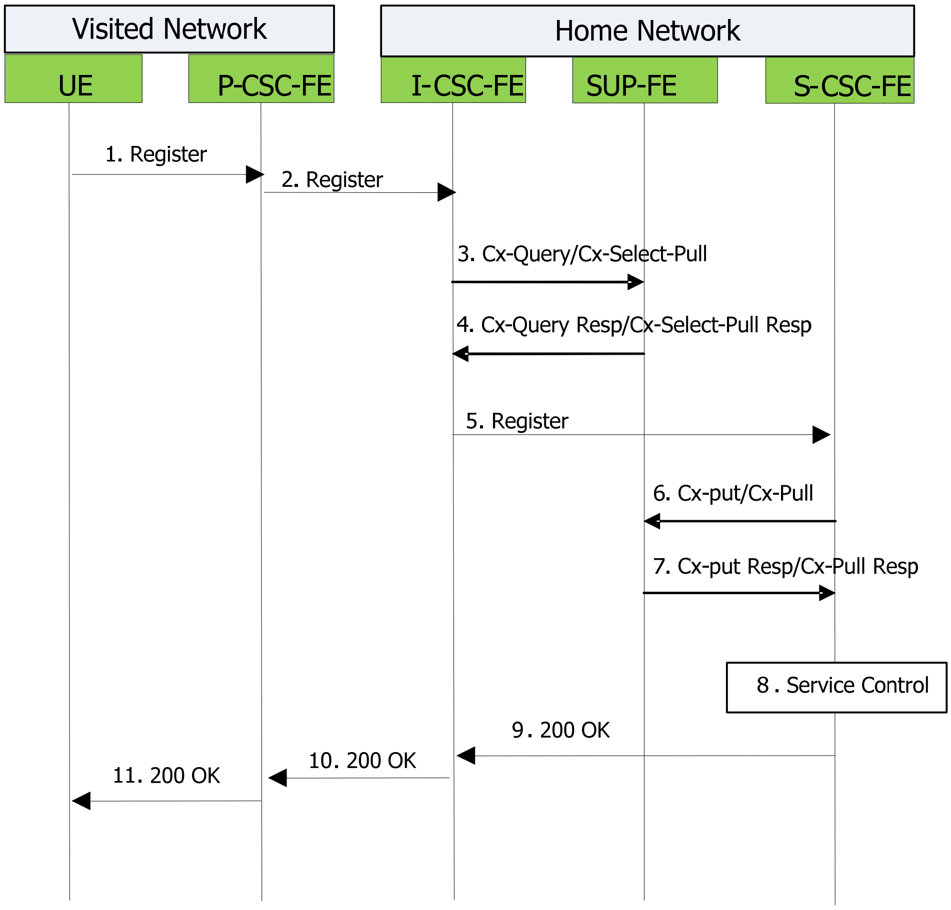

Figure 4. Location Registration and location re-registration

1) After the UE has obtained its IP connectivity, it can perform the IMS registration. To do so, the UE sends the Register information to the P-CSC-FE.

2) Upon receipt of this register information, the P-CSC-FE shall examine the "home domain name" to discover the entry point to the home network (i.e. I-CSC-FE). The proxy shall send the Register information to the I-CSC-FE, which include P-CSC-FE address/name, Public User Identity, Private User Identity, P-CSC-FE network identifier, and UE IP address. A name-address resolution mechanism is utilised in order to determine the address of the home network from the home domain name. Note that the P-CSC-FE network identifier is a string that identifies the network where the P-CSC-FE is located (e.g., the P-CSC-FE network identifier may be the domain name of the P-CSC-FE network).

3) The I-CSC-FE shall send the Cx-Query/Cx-Select-Pull information to the SUP-FE, which may include Public User Identity, Private User Identity, and P-CSC-FE network identifier. The SUP-FE shall then check whether the user is registered already. The SUP-FE shall indicate whether the user is allowed to register in that P-CSC-FE network (identified by the P-

CSC-FE network identifier) according to the user subscription and operator limitations/restrictions, if any.

4) The Cx-Query Resp/Cx-Select-Pull Resp information is sent from the SUP-FE to the I-CSC-FE. It shall contain the S-CSC-FE name. When capabilities are returned, the I-CSC-FE may perform the new S-CSC-FE selection function. If the checking in SUP-FE was not successful, the Cx-Query Resp shall reject the registration attempt.

5) The I-CSC-FE, using the name of the S-CSC-FE, shall determine the address of the S-CSC-FE through a name-address resolution mechanism. The I-CSC-FE also determines the name of a suitable home network, possibly based on information received from the SUP-FE. I-CSC-FE shall then send the register information (e. g., P-CSC-FE address/name, Public User Identity, Private User Identity, P-CSC-FE network identifier, UE IP address to the selected S-CSC-FE). Then, the S-CSC-FE shall store the P-CSC-FE address/name, as supplied by the visited network. This represents the address/name that the home network forwards the subsequent terminating session signalling to the UE. The S-CSC-FE shall store the P-CSC-FE Network ID information.

6) The S-CSC-FE shall send Cx-Put/Cx-Pull (Public User Identity, Private User Identity, S-CSC-FE name) to the SUP-FE.

7) The SUP-FE shall store the S-CSC-FE name for the user and return the Cx-Put Resp/Cx-Pull Resp information to the S-CSC-FE. The information that was passed from the SUP-FE to the S-CSC-FE shall include one or more names/addresses which can be used to access the platform(s) used for service control while the user is registered at this S-CSC-FE. The S-CSC-FE shall store the information for the indicated user.

8) Based on an appropriate filtering criterion, the S-CSC-FE shall send the register information to the service control platform and perform the service control procedures.

9) The S-CSC-FE shall return the 200 OK information (e. g., home network contact information, a GRUU set) to the I-CSC-FE.

10) The I-CSC-FE shall send the 200 OK (home network contact information, a GRUU set) information to the P-CSC-FE. Then, the I-CSC-FE shall release all registration information.

11) The P-CSC-FE shall store the home network contact information, and shall send the 200 OK information to the UE.

8.2 Location Query

The IMS-based location query procedures with the call setup signalling operations are described in Fig. 5.

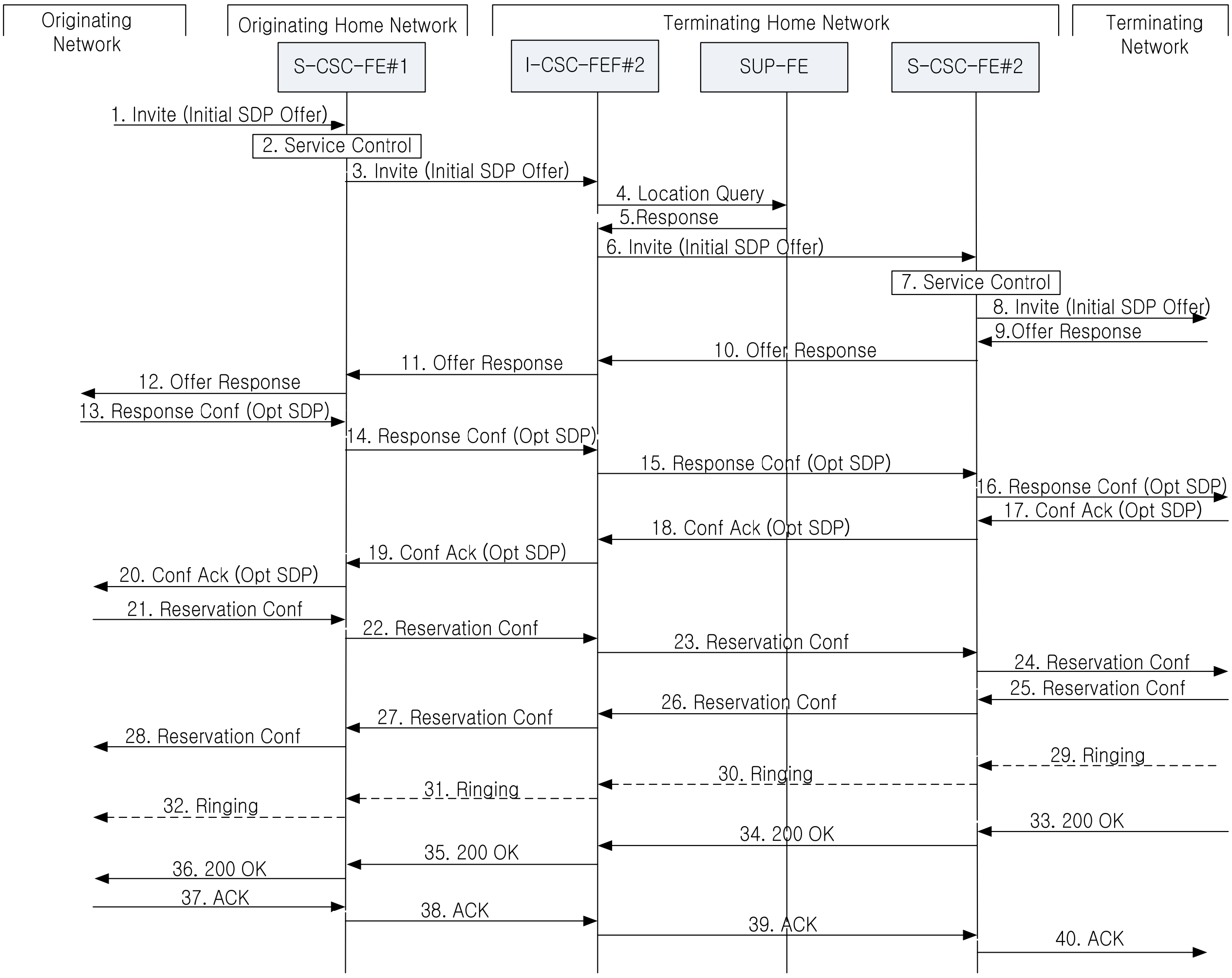

Figure 5. Location query with session setup signalling

1) The IMS INVITE request is sent from the UE to S-CSC-FE#1. This message should contain the initial media description in the Session Description Protocol (SDP) Offer.

2) S-CSC-FE#1 invokes the service logic that is appropriate for this session setup attempt.

3) S-CSC-FE#1 performs an analysis of the destination address, and determines the network operator to whom the subscriber belongs. Since it is local, the request is passed to a local I-CSC-FE.

4) I-CSC-FE shall query the SUP-FE for current location information.

5) SUP-FE responds with the address of the current S-CSC-FE for the terminating user.

6) I-CSC-FE forwards the INVITE request to the S-CSC-FE (S-CSC-FE#2) that will handle the session termination.

7) S-CSC-FE#2 invokes the service logic that is appropriate for this session setup attempt.

8) The sequence continues with the message flows determined by the termination procedure.

9-12) The terminating end point responds with an answer to the offered SDP and this message is passed along the established session path.

13-16) The originator decides on the offered set of media streams, confirms receipt of the Offer Response with a Response Confirmation, and forwards this information to S-CSC-FE#1 by the origination procedures. This message is forwarded via the established session path to the terminating end point. The Response Confirmation may also contain SDP. This may be the same SDP as in the Offer Response received in Step 12 or a subset.

17-20) Terminating end point responds to the offered SDP and the response, if forwarded to the originating end point via the established session path.

21-24) Originating end point sends successful resource reservation information towards the terminating end point via the established session path.

25-28) Terminating end point sends successful resource reservation acknowledgement towards the originating end point via the established session path.

29-32) Terminating end point sends a ringing message toward the originating end point via the established session path.

33-36) The SIP final response, 200-OK, is sent by the terminating endpoint over the signalling path. This is typically generated when the user has accepted the incoming session setup attempt. The message is sent to S-CSC-FE#2 per the termination procedure.

37-40) The originating endpoint sends the final acknowledgement to S-CSC-FE#1 by the origination procedures, and it is then sent over the signalling path to the terminating end point.

9 Information Flows for IMS-based Handover Control

9.1 Handover by interaction between P-CSCF and S-CSCF

As shown in Fig. 6, in this handover control scheme, UE is originating a voice call with correspondent UE in the home network. When UE is attached to the new visited network, it performs the location re-registration with the S-CSC-FE through a new P-CSC-FE in the visited network. The new P-CSC-FE and the S-CSC-FE will notify the new Border Gateway Function (BGF) in the visited network and the BGF in the home network to install the new tunnel entry points through the new HC-FE in the visited network and the C-HC-FE, respectively. After that, the S-CSC-FE will interact with the old P-CSC-FE to notify the old BGF to release the tunnel resource through the A-HC-FE in the visited network and the C-HC-FE in the home network.

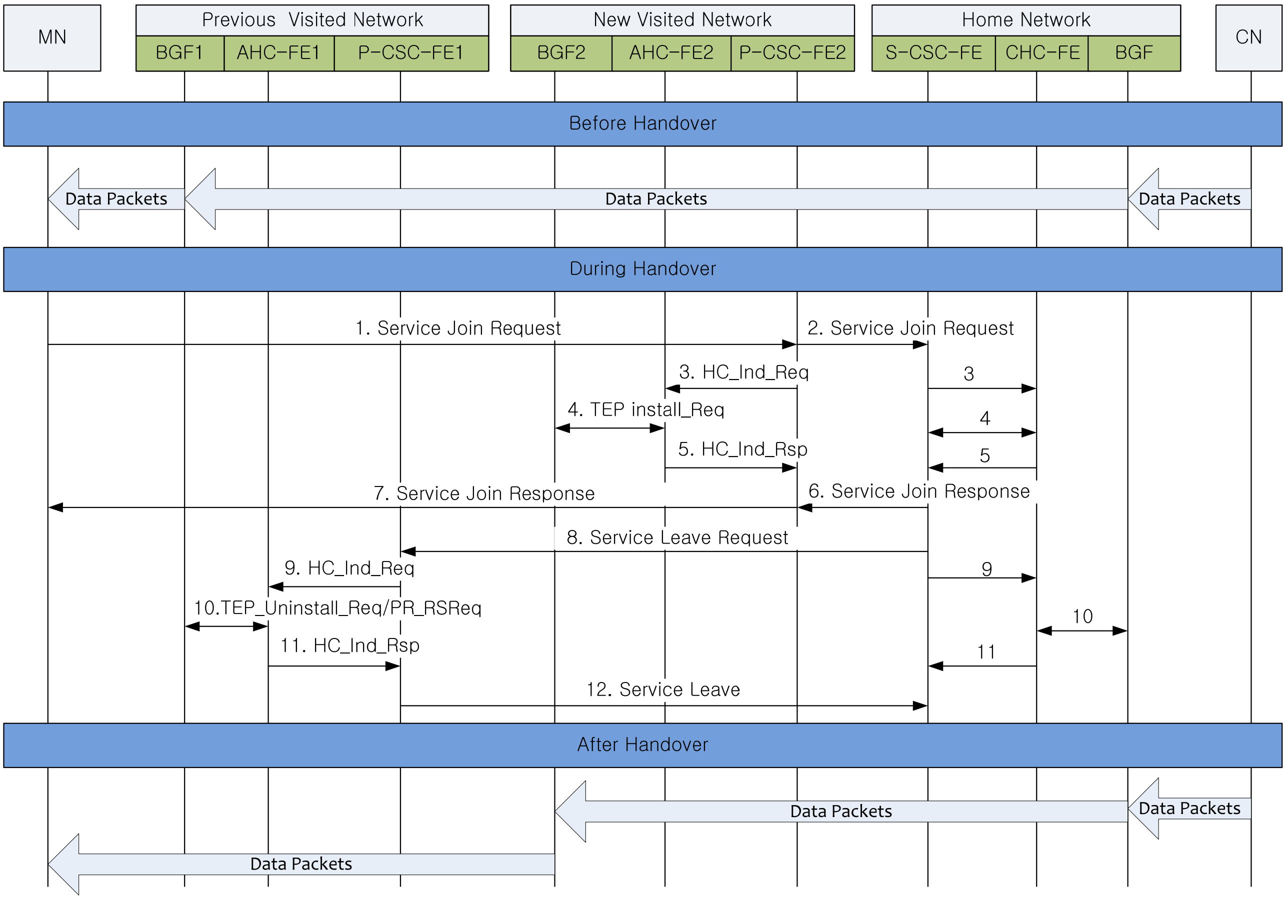

Figure 6. IMS-based handover using P-CSC-FE and S-CSC-FE

The detailed signalling flows are described as follows:

a) Before handover

Before handover, the data packets from the corresponding node (CN) will be intercepted by the BGF in the home network and then encapsulated and tunnelled to the BGF in the previous visited network.

b) During handover

When the mobile node (MN) moves to the new visited network, it acquires a new address prior to receiving the data packet from CN and performs the location re-registration (i.e., join service) with S-CSC-FE in the home network via P-CSC-FE in the new visited network (step 1 and 2). Upon the request of service join from MN, the proxy registrar and home registrar will send a handover indication request so as to trigger AHC-FE in the new visited network and CHC-FE in the home network to perform the tunnel entry point installation on BGF in the new visited network (step 3 – 7). When a new tunnel is set up between the new BGF in the visited network and the BGF in the home network, S-CSC-FE will interact with the old P-CSC-FE to make the old AHC-FE and the CHC-FE release the tunnel resource in the old BGF and BGF in the home network (step 8 – 12).

c) After handover

After handover, the data packet from CN will be intercepted by the BGF in the home network and then encapsulated and tunnelled to the BGF in the new visited network.

9.2 Handover control by interaction between two neighbouring P-CSCFs

In this handover control scheme, UE is originating a voice call with the correspondent UE in the home network. When UE is attached to the new visited network and performs the location re-registration with the S-CSC-FE through the P-CSC-FE in the new visited network. The S-CSC-FE will notify the new P-CSC-FE about the location of the old P-CSC-FE. Here, it is assumed that the two adjacent P-CSC-FEs in the visited network are allowed to communicate with each other. Then, the new P-CSCF will interact with the old P-CSC-FE to make the AHC-FE install a tunnel entry point between the old BGF and the new BGF in the two adjacent visited networks. When a voice call session is terminated, the S-CSC-FE will request all the P-CSC-FEs along the path from the first visited network to the last visited network to release the tunnel resources.

Figure 7 describes the information flows of handover control by interaction between neighboring P-CSCFs. The detailed signalling flows are described as follows:

a) Before handover

Before handover, the data packets from CN will be intercepted by the BGF in the home network and then tunnelled to the BGF in the previous visited network.

b) During handover

When MN moves to the new visited network, it acquires a new address prior to receiving data packet from CN and performs the location re-registration (i.e., service join) with the S-CSC-FE in the home network via the P-CSC-FE in the visited network (step 1, 2). Upon receiving the service request from MN, the S-CSC-FE will notify the new P-CSC-FE about the location of the old P-CSC-FE by sending the service response message (step 3). Then, the new P-CSC-FE will interact with the old P-CSC-FE to make the new AHC-FE and the old AHC-FE install a tunnel entry point between the old BGF and the new BGF in the visited network (step 4 – 9).

c) After handover

After handover, the data packet from CN will be firstly intercepted by the BGF in the home network and tunnelled to the BGF in the previous network. When the BGF in the previous visited network receives the datagram, it will forwarded the data packet to the UE through BGF in the new visited network.

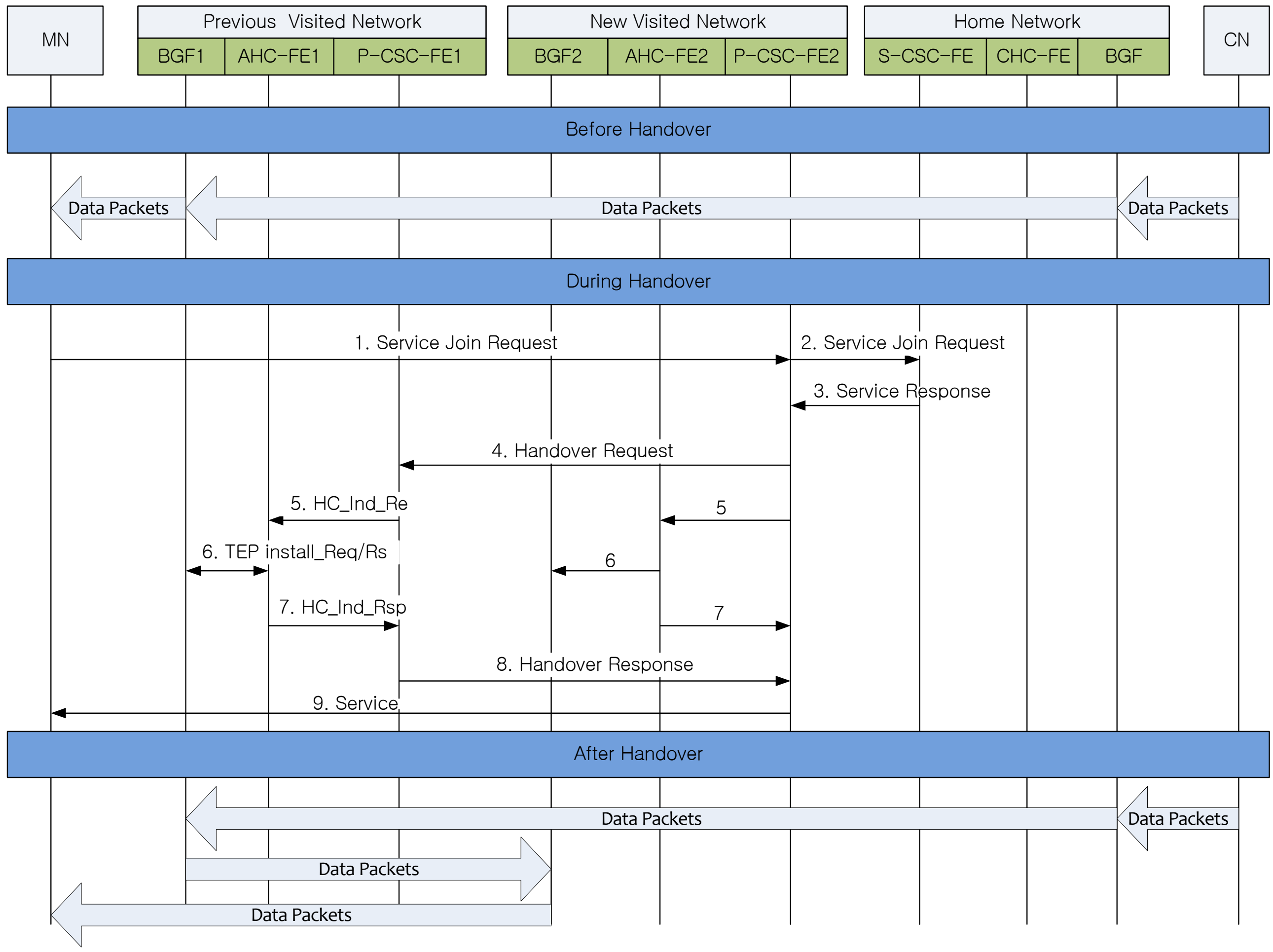

Figure 7. IMS-based handover using two neighboring P-CSC-FEs

10 Security Considerations

This Recommendation does not require any specific security considerations and aligns with the security requirements in [ITU-T Y.2701].

Appendix I

Use Cases of IMS-based MM with IEEE 802.21

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

This Appendix provides some scenarios of IMS-based MM schemes using IEEE 802.21 (MIH). Figure I.1 depicts a simplified IMS network, while Figure I.2 shows the migration of 802.21 as an Application Server (AS) in the context of IMS.

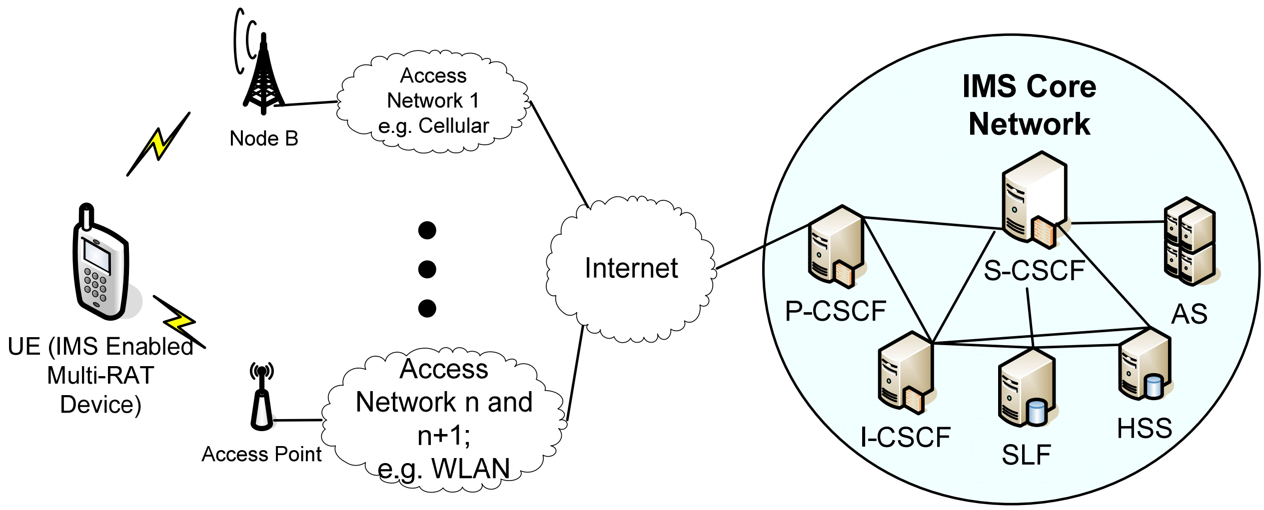

Figure I.1 Simplified IMS Network

The IMS network relies on high-level security, reliable QoS, and a standardized framework for easy Application Server (AS) service deployment.

The migration of 802.21 to an IMS platform requires that the 801.21 MIH be an IMS client application in the UE (IMS enabled multi-RAT device) and the inclusion of 802.21 as an IMS application server. This solution also brings the advantages of having minimal HO interruption time, and there is no user involvement in the HO process, thus it provides the enhanced user experience.

Figure I.2 Migration of 802.21 to an IMS Platform

Figure I.3 High-level description of 802.21 for IMS Model

Figure I.3 shows a high-level description of the IEEE 802.21-IMS model. The left box describes the related components within the terminal, while the right box shows the 802.21 AS functionality. The bi-directional flow arrows through the IMS core platform and the IP network illustrate the message exchange, as described below.

In the IEEE 802.21-IMS model, the UE (IMS enabled multi-RAT device) triggers the SIP functionality. The SIP messages are used to set up an 802.21 session, as shown in the lowest flow between the terminal, the IMS core network, and the 802.21 AS's SIP function. Directly after session setup, 802.21 messages are exchanged over IP between the terminal's MIH Function (MIHF) and the 802.21 AS's functionality, as shown in the upper flow. The 802.21 functionality in the AS will trigger the SIP module to send the requests during the HO process.

In Figure I.3, the Home Subscribe System (HSS) in the IMS Core Network provides the 802.21 AS with the user preferences and subscription information to perform intersystem handovers optimized decisions.

Figure I.4, I.5 and I.6 describe these interactions in more detail, which show the detailed message flows for IMS registration, Session setup in the control/signalling plane, MIH registration, VoIP session setup, VoIP session data exchange, Handover initiation, Inter-system handover and standardized 802.21 commands to control links, Handover execution, and Handover completion to resume the on-going VoIP session.

Figure I.4 VoIP Session Setup with 802.21 Application Server

Figure I.5 Handover initiation by 802.21 Application Server

Figure I.6 Handover Completion: 802.21 triggers SIP Messaging

The mobility controller, depicted in the flow diagrams, decides whether to switch the subscriber to WLAN, or any other radio access technology (RAT). It requires the user subscription profile and user preferences stored in the HSS. The IMS S_h interface is used to transfer information between the 802.21 AS, using the Mobility Controller, and the HSS.

In Figure I.4, after receiving the MIH_Register Request message from the IMS device enabled UE, the Mobility Controller starts the standardized Sh-Pull procedure with the HSS. It sends the User Identity and requests data related to the specific user. The HSS answers to the Mobility Controller with the Sh-Pull Response message containing User Data; including Networks IDs – with whom the home network has agreements, and/or the user has subscribed to, and therefore a roaming is allowed. The Networks IDs may provide to the 802.21 AS user preferences to decide upon handover execution based on current characteristics, as network connection costs, network speed, etc.

Figure I.5 shows the VoIP session setup procedure with involved messages. The VoIP media exchanges are continued until the UE detects the radio signal degradation and decides to prepare a notification to the network for inter-system handover.

In Figure I.6, the UE sends the REFER request to the 802.21 AS to trigger the SIP functionality. In turn, the Mobility Controller starts the Sh-Update procedure to which the HSS responds with a Sh-Update Response message. The 802.21 AS thus informs the HSS about the IP address change, and the VoIP session resumes.

Appendix II

Examples of IMS Handover with Network Agents

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

This Appendix gives the two examples of IMS handover using network agents, Resource Admission Control Function (RACF) and GPRS Gateway Supporting Node (GGSN), as possible examples of IMS-based handover.

II.1 RACF applicability in the IMS Handover

The handover control scheme can be performed with support of agents in the network. The following figure shows the overview of handover control scheme in the session or application layer, within this handover control scheme, P-CSCF and C-CSCF play the role of location management and handover control. RACF acts as arbitrator between IMS component (e.g. CSCF) and transport function (e.g., BGF).

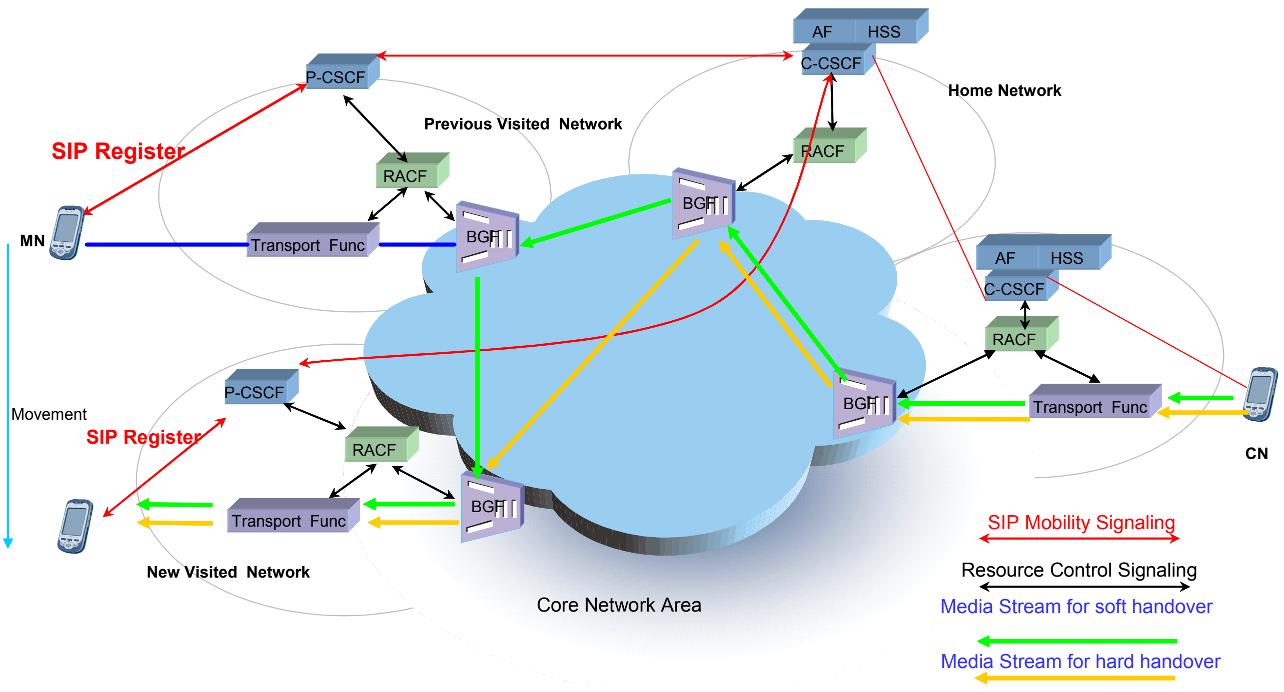

Figure II.1. Application-layer handover control with mobile agent support

On the request of service join from mobile host, the proxy registrar (i.e., P-CSCF) will send a service request to trigger RACF to perform resource admission control on the corresponding transport functions in the visited network. Also, the BGFs in the visited network and home network interacts with proxy registrar and home registrar to establish relationship between BGFs. Thereby the datagram from corresponding host could be redirected to the BGF in the current visited network from BGF in the previous visited network or BGF in the home network gracefully. In this way, mobility continuity and transport independent from handover control can be achieved. The only difficult part is the detection ability is required at the application layer to identify when the IP address has changed. The ability to have applications subscriber to be notified of such changes would be preferable.

II.2 GGSN applicability in the IMS handover

The existing IMS handover scheme operates at the application layer, and thus the overall handover latency can be significantly increased during handover, depending on the network conditions such as movement detection, IP address configuration, and new signalling of INVITE messages. The IMS handover latency could be reduced by using the fast handover with support of the link-layer triggers and the network agents such as GGSN nodes.

The following figure shows the overall procedures of the IMS fast handover with the support of network agent, in which the 3GPP network system is considered for example.

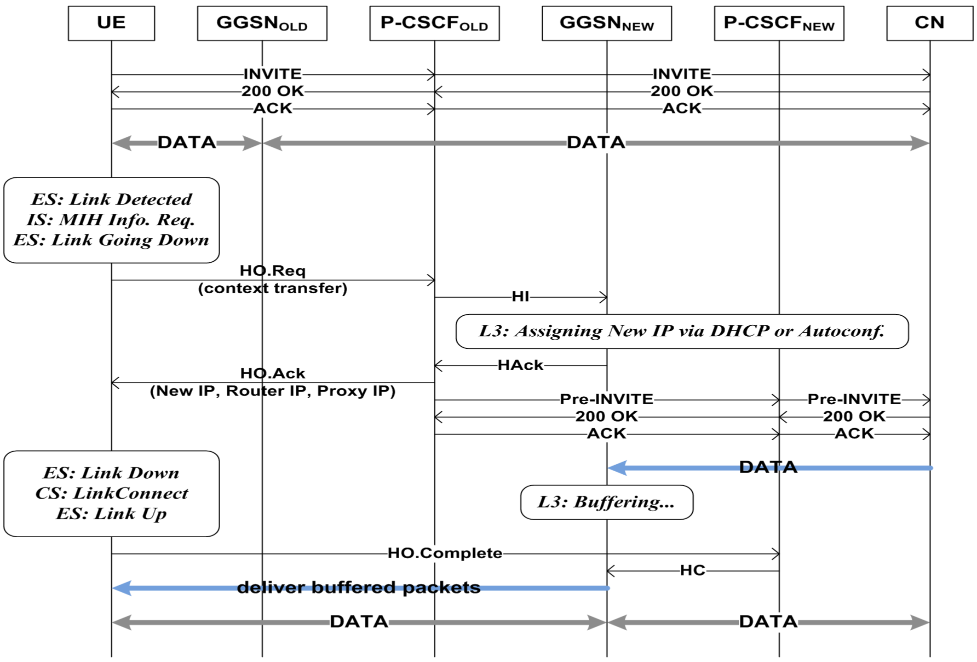

Figure II.2. IMS Fast Handover with Network Agent Support

The overall handover steps can be classified into four steps: (1) detecting new network and preparing required information using MIH, (2) triggering handover procedure and acquiring new IP address, (3) making a new session and buffering application data and (4) completing the procedure and receiving the buffered data.

In the figure, UE has connected to the old network and communicates with CN. When it receives Link Detected event from the MIH layer, it can retrieves information about available neighbor networks using the MIH Information service. Although the MIH specification defines many elements in this neighbor information, we use the minimum functionalities like an IP address of the candidate next router ($GGSN_{NEW}$). The Information Server and the detailed procedures for information query are not presented in the figure.

When the signal strength of the old link gets weaker than the predefined threshold, UE detects Link Going Down event from the MIH layer and triggers the handover procedure by sending HO.Req message to the old SIP proxy server (P-CSCF$_{OLD}$). The context information of UE must be included in HO.Req such as the identifier, MAC address, IP address of GGSNNEW, security information like a session key, etc.

After received HO.Req, P-CSCF$_{OLD}$ sends HI message to the GGSN$_{NEW}$ with the received context information. And then GGSN$_{NEW}$, instead of UE, configures the new IP address for UE by DHCP or Auto-configuration mechanism. We assume that P-CSCF$_{OLD}$ can configure UE's address. We also assume that GGSNNEW knows the IP address of the next SIP proxy server (P-CSCF$_{NEW}$). Configured IP address and IP address of P-CSCF$_{NEW}$ are delivered to the UE through HAck and HO.Ack message.

When UE gets its new address and P-CSCF$_{NEW}$ address, it attaches the new address into its network interface. It is noted that most operating systems allow attaching multiple IP addresses to one network interface card. After successful address attachment, UE can switch underlying network. At the same time, GGSN$_{NEW}$ makes a new session for UE using Pre-INVITE message. If UE requested handover with data buffering option, GGSN$_{NEW}$ should keep application data from CN until receiving HC message from P-CSCF$_{NEW}$.

Now, UE can associate to the new network link by using MIH LinkConnect command when it detects Link Down event. As soon as possible UE detects Link Up event, it have to send HO.Complete message to P-CSCF$_{NEW}$. Finally, it can receive all the buffered data and new application data from CN through the new network.

The protocol messages required for IMS fast handover are for further study.

Bibliography

The following documents are useful to understand this Recommendation:

[b-1] ITU-T Recommendation F.700, Framework Recommendation for multimedia services

[b-2] ITU-T Recommendation F.702, Multimedia conference services

[b-3] ITU-T Recommendation F.703, Multimedia conversational services

[b-4] IEEE 802.21, Media Independent Handover (MIH)

[b-5] IETF RFC 3261, Session Initiation Protocol