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SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for IMT-2000

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**INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS
AND NEXT-GENERATION NETWORKS**

Next Generation Networks – Generalized mobility

Framework of handover control for NGN

Recommendation ITU-T Q.1709/Y.2806



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Recommendation ITU-T Q.1709/Y.2806

Framework of handover control for NGN

Summary

Recommendation ITU-T Q.1709/Y.2806 specifies the framework of handover control for next generation networks. The handover control functionality is responsible for providing seamless services for mobile users by minimizing service disruptions during handover. The handover control schemes are classified into the host-based and network-based schemes. This Recommendation describes the design considerations, functional architecture and information flows for handover control.

Source

Recommendation ITU-T Q.1709/Y.2806 was approved on 14 October 2008 by ITU-T Study Group 19 (2005-2008) under Recommendation ITU-T A.8 procedure.

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Handover control, mobility management, NGN.

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Introduction

This Recommendation describes a framework of handover control (HC) for mobility management (MM) in next generation networks (NGN). This work has been motivated from the observation that NGN continues to evolve toward the convergence of fixed and wireless/mobile networks, and thus the mobility management is an essential functionality to provide seamless services to NGN users.

This Recommendation is a part of the MM framework for NGN. The MM framework for NGN will be designed as a series of Recommendations rather than a single Recommendation. This is because the design of the MM framework includes a variety of technical issues to be addressed. Furthermore, those design issues are associated with a wide variety of mobility scenarios and protocols. In this respect, the MM framework for NGN will be described within the following family of Recommendations:

- Recommendation ITU-T Q.1707/Y.2804: Generic framework of mobility management for next generation networks;
- Recommendation ITU-T Q.1708/Y.2805: Framework of location management for NGN;
- Recommendation ITU-T Q.1709/Y.2806: Framework of handover control for NGN.

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Recommendation ITU-T Q.1709/Y.2806

Framework of handover control for NGN

1 Scope

This Recommendation describes the framework of IP-based handover control (HC) for NGN, which includes design considerations, functional architecture, and procedural information flows for handover control. This Recommendation focuses on the terminal mobility where mobile terminals move around and change their IP address in the NGN. This Recommendation also focuses on the mobility management (MM) schemes that operate in the network layer (or IP layer), whereas the issues on the mobility support in the service stratum will be addressed in another ITU-T MM Framework Recommendation.

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), <i>Mobility management requirements for NGN</i> . |
| [ITU-T Q.1707] | Recommendation ITU-T Q.1707/Y.2804 (2008), <i>Generic framework of mobility management for next generation networks</i> . |
| [ITU-T Q.1708] | Recommendation ITU-T Q.1708/Y.2805 (2008), <i>Framework of location management for NGN</i> . |
| [ITU-T Y.2001] | Recommendation ITU-T Y.2001 (2004), <i>General overview of NGN</i> . |
| [ITU-T Y.2011] | Recommendation ITU-T Y.2011 (2004), <i>General principles and general reference model for next generation networks</i> . |
| [ITU-T Y.2012] | Recommendation ITU-T Y.2012 (2006), <i>Functional requirements and architecture of the NGN release 1</i> . |
| [ITU-T Y.2014] | Recommendation ITU-T Y.2014 (2008), <i>Network attachment control functions in next generation networks</i> . |
| [ITU-T Y.2091] | Recommendation ITU-T Y.2091 (2007), <i>Terms and definitions for next generation networks</i> . |
| [ITU-T Y.2111] | Recommendation ITU-T Y.2111 (2006), <i>Resource and admission control functions in next generation networks</i> . |

3 Definitions

3.1 Terms defined in [ITU-T Q.1707]

This Recommendation uses the following terms defined in [ITU-T Q.1707]:

3.1.1 location identifier (LID): A topological location identifier of a UE. An IP address can be used as a location identifier. Refer also to [ITU-T Y.2091].

3.1.2 user identifier (UID): A series of digits, characters and symbols or any other form of data that are used to identify a subscriber (user) or user equipment in the NGN. Refer also to [ITU-T Y.2091].

3.2 Terms defined in [ITU-T Q.1708]

This Recommendation uses the following terms defined in [ITU-T Q.1708]:

3.2.1 LID binding update (LBU): An operation of location management to manage the mapping between persistent LIDs (PLIDs) and temporary LIDs (TLIDs).

3.2.2 persistent LID (PLID): A LID that does not change even when an MUE moves across different access networks or IP subnets.

3.2.3 temporary LID (TLID): A LID that changes when an MUE moves across different access networks or IP subnets.

3.3 Terms defined in this Recommendation

This Recommendation defines the following term:

3.3.1 LID binding query (LBQ): An operation performed by a correspondent UE or network to find the current TLID of a mobile UE.

4 Abbreviations

This Recommendation uses the following abbreviations:

2G	2nd Generation
3G	3rd Generation
3GPP	3rd Generation Partnership Project
A-MMCF	Access MMCF
AAA	Authentication, Authorization, and Accounting
AHC-FE	Access HC-FE
ALM-FE	Access LM-FE
AP	Access Point
C-MMCF	Central MMCF
CHC-FE	Central HC-FE
CLM-FE	Central LM-FE
CN	Core Network
CPE	Customer Premises Equipment
CPE-BE	CPE-Border Element
CS	Command Service

CUE	Correspondent UE
ES	Event Service
FE	Functional Entity
FMIP	Fast handover for MIP
GPS	Global Positioning System
HC	Handover Control
HCF	Handover Control Function
ID	Identifier
IMSI	International Mobile Station Identity
IP	Internet Protocol
IPTV	IP TeleVision
IS	Information Service
ISP	Internet Service Provider
LBQ	LID Binding Query
LBU	LID Binding Update
LID	Location ID
LM	Location Management
LM-FE	Location Management Functional Entity
LMF	Location Management Function
LTE	Long Term Evolution
MIH	Media Independent Handover
MIHF	MIH Function
MIMO	Multiple-Input Multiple-Output
MIP	Mobile IP
MIPSHOP	MIPv6 Signalling and Handoff Optimization
MM	Mobility Management
MMCF	Mobility Management Control Function
MUE	Mobile User Equipment
NACF	Network Attachment Control Function
NGN	Next Generation Network
OFDM	Orthogonal Frequency Division Multiplexing
PD-FE	Policy Decision-FE
PE-FE	Policy Enforcement-FE
PLID	Persistent LID
PoA	Point of Attachment
QoS	Quality of Service
RACF	Resource Admission Control Function



RF	Radio Frequency
TCP	Transmission Control Protocol
TLID	Temporary LID
UDP	User Datagram Protocol
UE	User Equipment
UID	User Identifier
VoD	Video on Demand
VoIP	Voice over IP
WiMAX	Worldwide Interoperability for Microwave Access
WLAN	Wireless Local Area Network

5 Design considerations

This Recommendation describes the framework of handover control (HC) for NGN. The goal of the HC functionality is to provide a mobile user equipment (MUE) with seamless services whenever it moves around in NGNs. For this purpose, the seamless handover should be supported for the MUE, through which any ongoing session or services can continue without service disruption, regardless of the change of location ID (LID).

As described in [ITU-T Q.1708], MM identifiers are divided into user ID (UID) and location ID (LID). The LID is further classified into persistent LID (PLID) and temporary LID (TLID). This Recommendation focuses only on the case in which IP addresses are used as LID. The UID binding operation is responsible for mapping between UID and PLID, whereas the LID binding operation is used to map between PLID and TLID. The LID binding operation is realized through the LID binding update (LBU) operation.

It is noted that the LBU operation is performed for LM as well as for HC. The LBU operation itself will be performed by LM functional entities (LM-FEs) with the help of HC functional entities (HC-FEs). This Recommendation will focus on the LBU operation from the viewpoint of HC functionality.

By moving into a new IP subnet, which is called a layer 3 (L3) handover, an MUE changes its TLID. The configuration of the TLID will be performed differently depending on whether the HC is host-based or network-based. The LID binding information shall be updated with the new TLID by the LBU operation.

5.1 Handover and seamless handover

The L3 handover occurs when an MUE changes its IP address (i.e., TLID) by moving between different IP subnets. This Recommendation focuses on IP handover or L3 handover. It is noted that L3 handover also accompanies layer 2 (L2) handover. The HC operations can be further classified into those for handover and seamless (or fast) handover, as described in clause 6.2.2 of [ITU-T Q.1706].

For the handover operations, when an MUE moves into a new IP subnet and thus gets a new TLID, the LBU operation will be performed. In the LBU operation, the information of mapping between PLID and TLID will be updated by interworking among suitable LM-FEs and HC-FEs.

The seamless (or fast) handover operation will be performed to minimize the service disruption during handover (e.g., packet loss and delay). For this purpose, some optimization schemes may be introduced such as handover tunnel establishment, fast access authentication, pre-emptive HC signalling, etc.

5.2 Handover operations

The L3 handover of an MUE is typically associated with the operations described in the following clauses.

5.2.1 Movement detection

The movement detection (or handover detection) implies an operation that detects a handover situation or predicts an imminent handover. The movement detection can be further classified into L2 and L3 movement detections. The way of performing the L2 movement detection is outside the scope of this Recommendation. However, the notification of L2 movement events needs to be delivered to a HC function (HCF) to trigger the immediate L3 movement detection and to initiate the subsequent HC procedure.

5.2.2 Network selection

To control a handover between different access networks, the HCF needs to identify the candidate list of point of attachments (PoAs) currently accessible by an MUE. Based on this information, the MUE can choose one of the reachable PoA to establish a new communication link.

In the network selection operation, the HC function may get some useful information such as signal quality or available resources of the candidate PoAs. For this purpose, the HCF may interact with the resource and admission control function (RACF) defined in [ITU-T Y.2111].

The network selection operation can be performed with the help of the [b-IEEE 802.21] media independent handover (MIH) scheme, as described in Appendix I.

5.2.3 TLID configuration

When an MUE moves into a new access network (or IP subnet), its TLID shall be newly configured. To do this, the MUE may get an IP address as a new TLID from the network, or the IP address of a specific network component can be used as a TLID of the MUE.

5.2.4 LID binding update

To complete the HC procedure, the new TLID should be registered with the suitable LM-FE through the LBU operation. This LBU operation shall be performed between MUE and LM-FE in the host-based HC scheme. It can be also performed only between LM-FEs in the network-based HC scheme, as described in [ITU-T Q.1708].

For handover optimization, the LBU operation needs to be performed as soon as a handover (movement) is detected. For this purpose, the HC-FE shall trigger the LBU operation performed by the relevant LM-FE. Communications between the HC-FE and the LM-FE for the LBU operation may be performed by way of an internal reference point (interface) depending on the implementation method.

5.3 Operations for handover optimization

To provide seamless services for an MUE during handover, a variety of schemes for handover optimization can be used. Some of those optimization schemes for seamless handover are described below.

5.3.1 LBU triggering by HC-FE

L3 movement is usually detected by using the router advertisement and solicitation messages. This may imply quite long handover latency. To provide seamless handover, the HC-FEs can trigger the LBU operation of LM-FEs as early as possible.

5.3.2 Routing path optimization

For efficient data packet delivery or for seamless handover, the routing path between the MUE and the CUE needs to be optimized. Specifically, it can be beneficial for the CUE to send data packets using TLID rather than PLID. For this purpose, the LID binding query (LBQ) operation may be used. The LBQ operation can be classified into the following two cases:

- LBQ from CUE to MUE; and
- LBQ between HC-FEs.

The LBQ operation between CUE and MUE are shown in the example of the IETF mobile IP (MIP) route optimization scheme between a mobile node and its correspondent node. This operation can be performed directly between end UEs without the help of the network. This type of the LBQ operation is for further study and the details will not be described in this Recommendation.

In the LBQ between HC-FEs, the HC-FE associated with the CUE finds the TLID of the MUE by contacting the relevant LM-FE. Then the data packets to the MUE will be delivered using the TLID. This Recommendation will describe the details of this type of LBQ operation.

5.3.3 Handover tunnel establishment

To provide seamless handover, a handover tunnel may be established between two access routers (or two tunnel endpoints controlled by HC-FEs) concerned with the handover of the MUE. The handover tunnel is used to minimize the data packet loss during handover.

5.3.4 Other schemes for handover optimization

In addition, other schemes may be used for handover optimization, which include bicasting, pre-emptive LBU, etc. The details of the other optimization schemes are for further study.

5.4 Host-based and network-based handover control

The HC schemes can be classified into the following two categories:

- host-based scheme in which HC signalling is performed based on (or controlled by) MUE; and
- network-based scheme in which HC signalling is performed (or controlled) by HC-FE.

In the host-based HC, when an MUE moves into another network region (or IP subnet), it activates the HC operations with the concerned LM-FEs and HC-FEs. The MUE may perform some handover signalling operations. In the network-based handover control, an HC-FE takes the role of MUE. The HC-FE may perform most of the handover signalling operations such as LBU initiation and handover tunnel establishment.

6 Functional reference architecture

This clause describes the functional entities for HC in NGN. The reference points used to illustrate the information flows for HC are also described.

6.1 Functional entities

As described in [ITU-T Q.1707], the mobility management control function (MMCF) consists of the location management function (LMF) and the handover control function (HCF). The HCF can be achieved with the following functional entities (FEs):

- access HC-FE (AHC-FE); and
- central HC-FE (CHC-FE).