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NNI mobility management requirements for systems beyond IMT-2000

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Supplement 52 to ITU-T Q-series Recommendations

NNI mobility management requirements for systems beyond IMT-2000

Summary

This Supplement identifies the mobility management requirements for Systems Beyond IMT-2000, based on ITU-T Recs Q.1702 [7] and Q.1703 [8] and ITU-R Rec. M.1645 [23]. A number of mobility management protocols are reviewed and analysed according to the identified requirements.

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Mobility, mobility management, mobility management protocols, mobility management requirements, systems Beyond IMT-2000.

FOREWORD

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Supplement 52 to ITU-T Q-series Recommendations

NNI mobility management requirements for systems beyond IMT-2000

1 Scope

The scope of this Supplement is to identify Network-to-Network Interface (NNI) Mobility Management (MM) requirements for Systems Beyond IMT-2000 (SBI2K) and to analyse potential MM protocol candidates based on those requirements.

In developing a common set of MM requirements, the following criteria have been applied:

- they must be compatible with emerging IP-based networks; and
- they must be in line with relevant Vision, Harmonization, and Fixed/Mobile Convergence studies within ITU.

The common set of MM requirements is then used to analyse various MM protocol candidates with the aim of:

- supporting global roaming and advanced services; and
- to the extent possible, re-using the existing specifications from IETF, partner Standards Development Organizations (SDOs), Partnership Projects of 3GPP and 3GPP2, IEEE, and other relevant groups.

In order to realize the Vision for SBI2K in the area of MM, it is essential to work closely with experts from the aforementioned and other relevant bodies to ensure a smooth migration path towards meeting longer-term MM requirements.

2 Definitions

This Supplement defines the following terms:

2.1 mobility: The ability for a user to access subscribed services while in motion, and the capability of the network to identify and locate the user's terminal.

2.2 handover: The ability of a mobile user/terminal/network to change location while media streams are active.

2.3 home network: The network to which a mobile user is normally connected, or the service provider with which the mobile user is associated, and where the user's subscription information is managed.

2.4 visited network: The network outside a home network that provides service to a mobile user.

2.5 mobility management: The set of functions used to manage a mobile user accessing a local network other than that user's home network. These functions include communication with the home network for purposes of authentication, authorization, location updating and download of user information.

2.6 network mobility: The ability of a network, where a set of fixed or mobile nodes are networked to each other, to change, as a unit, its point of attachment to the corresponding network upon the network's movement itself.

2.7 roaming: The ability of a mobile user to get connectivity from a visited network. During roaming, a user is able to change network access points as he moves. However, his current service session is completely stopped at the old location and a new session is started at the new location, i.e., there is no handover.

2.8 seamless handover: The process by which latency and data loss incurred during handover is within a range acceptable to users (e.g., below a certain limit) for real-time services.

2.9 seamless service: A seamless service will prevent users from experiencing any service disruptions while maintaining mobility.

2.10 terminal mobility: This is 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 Abbreviations

This Supplement uses the following abbreviations:

3GPP	3rd Generation Partnership Project
3GPP2	3rd Generation Partnership Project 2
AAA	Authentication, Authorization and Accounting
ACK	Acknowledgement
AE	Application Entity
AGW	Access Gateway
AN	Access Network
ANG	Access Network Gateway
ANP	Anchor Point
ANSI	American National Standards Institute
AR	Access Router
ASE	Application Service Entity
BAR	BRAIN Access Router
BCMP	BRAIN Candidate Mobility Protocol
BR	Border Router
BS	Base Station
CCoA	Co-located Care-of Address
CH	Correspondent Host
CIP	Cellular IP
CN	Core Network(s)
CoA	Care-of Address
DB	Database
DHCP	Dynamic Host Configuration Protocol
EIR	Equipment Identity Register
FA	Foreign Agent
FM	Family Member
FMIP	Fast Handover for MIP

GERAN	GSM EDGE Radio Access Network
GFA	Gateway FA
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
GTP	GPRS Tunnelling Protocol
HA	Home Agent
HLR	Home Location Register
HMIP	Hierarchical MIP
HoA	Home Address
HSS	Home Subscriber Subsystem
I2K	International Mobile Telecommunications-2000
IETF	Internet Engineering Task Force
IMS	IP Multimedia Subsystem
IMT	International Mobile Telecommunications
INIT	INITiation
IOS	Interoperability Specification
IP	Internet Protocol
LMA	Local Mobility Agent
MAP	Mobile Application Part
MAP	Mobility Anchor Point
MIP	Mobile IP
MIPv4	Mobile IPv4
MIPv6	Mobile IPv6
MM	Mobility Management
MMD	Multimedia Domain
MMP	Mobility Management Protocol
MMR	Mobility Management Requirements
MN	Mobile Node
MS	Mobile Station
MSC	Mobile Switching Centre
mSCTP	mobile Stream Control Transmission Protocol
MT	Mobile Terminal
MT	Mobile Termination
NNI	Network-to-Network Interface
PC	Paging Cache
PDF	Policy Decision Function



PDN	Packet Data Network
PDP	Packet Data Protocol, e.g., IP
PDS	Packet Data Subsystem
PDSN	Packet Data Serving Node
PLMN	Public Land Mobile Network
PMM	Packet Mobility Management
PS	Packet Service
QoS	Quality of Service
RAN	Radio Access Network
RC	Routing Cache
RFC	Request For Comments
SBI2K	Systems Beyond IMT-2000
SCCP	Signalling Connection Control Part
SCTP	Stream Control Transmission Protocol
SDO	Standards Development Organization
SGSN	Serving GPRS Support Node
SIP	Session Initiation Protocol
SMS	Short Message Service
SS7	Signalling System No. 7
TCAP	Transaction Capabilities Application Part
TCP	Transmission Control Protocol
UA	User Agent
UAC	User Agent Client
UAS	User Agent Server
UDP	User Datagram Protocol
UMTS	Universal Mobile Telecommunication System
URI	Uniform Resource Identifier
UTRAN	Universal Terrestrial Radio Access Network
VLR	Visitor Location Register
WLAN	Wireless LAN
xDSL	x Digital Subscriber Lines

4 Introduction

The rationale behind Systems Beyond IMT-2000 (SBI2K) is the convergence of fixed and wireless networks and, ultimately, migration to interoperable and harmonized network architectures. This network trend is becoming an industry requirement and one of the purposes of such thrust is to provide services transparently to the users across different access arrangements. This Supplement,

therefore, asks: "What new mobility management protocols or enhancements to the existing mobility management protocols are needed to support global user mobility and services in SBI2K?"

In this context, this Supplement identifies the NNI mobility management requirements for SBI2K, based on ITU-T Recs Q.1702 and Q.1703 and ITU-R Rec. M.1645. According to the identified requirements, a number of mobility management protocols are reviewed and analysed with the aim of defining the scope of potential Mobility Management Protocol (MMP) solutions.

The ability of mobile users to communicate anytime and from anywhere is a key inherent feature of mobile systems. This is facilitated through the use of radio access to allow users to communicate over radio frequencies, and through the use of mobility management protocols to keep track of mobile users' locations at all times.

Over the years, sophisticated MM techniques have been developed and deployed in mobile systems to effectively manage the registration, authentication, and movement of mobile users. These techniques, however, have been specific to each system deployed, and manage the movement of users within similar cooperating mobile systems (e.g., an IMT-2000 family member). Therefore, the provision of seamless service and mobility across heterogeneous systems has been problematic due to several factors:

- Differences in radio access technologies used;
- Differences in available services and their non-portability;
- Differences in MM techniques deployed; and
- Lack of appropriate interoperability mechanisms to resolve the above differences between disparate mobile systems.

With the massive growth in the number of mobile users and the continuing deployment of heterogeneous systems (i.e., multiple IMT-2000 family members, Wireless LANs (WLANs), Bluetooth), the demand to provide seamless service to mobile users gets stronger with time, and such pursuit presents new challenges and requirements for new types of MM interoperable across heterogeneous systems.

Moreover, future mobile networks are envisioned to have their core networks Internet Protocol (IP)-based, as noted in ITU-T Rec. Q.1702 and ITU-R Rec. M.1645 where the long-term visions for future mobile systems named SBI2K are described from network and radio aspects, respectively. Hence, the future thrust is towards mobile and Internet convergence. In order to achieve this convergence, new interoperable MM techniques are required.

ITU-T Rec. Q.1702 says that: "There is a definite trend towards integration of access networks (e.g., cellular, wireless local area network, personal area wireless network, satellite systems, and Internet). Based on this trend, it is envisioned that the network environment of SBI2K will consist of a packet-based network infrastructure offering a plethora of converged services."

A promising solution for the new type of MM in SBI2K should take into account the long-term trends for future networks, the need for a smooth evolution of the infrastructure, and also the issue of backward compatibility with existing networks, particularly those following the standards of the IMT-2000 family.

Long-term trends (as specified in ITU-T Rec. Q.1702) applicable to MM can be summarized as follows:

- The core network is fully Internet Protocol (IP)-based;
- Large numbers of users require seamless service;
- MM will need to be able to do more than supporting demanding services in higher-speed objects such as vehicles: it will need to support applications with very large IP multimedia traffic needs, and with diversified communications including person-person, machine-to-machine, and machine-to-person and vice versa;

- The concept of seamless service will be extended beyond handover and roaming services within homogeneous networks: seamless service across heterogeneous networks will be provided;
- Support of moving networks (e.g., on airplanes, trains or ships); and
- Separation of control and transport functions.

The proposed architecture must support a variety of user mobility modes across disparate access networks, including global roaming and nomadic/seamless mobility.

As an example, a user attaches to a fixed access network (e.g., x Digital Subscriber Lines (xDSL)) and is authenticated via an appropriate mechanism provided by this access system. He then starts a multimedia session. Later in the same session, the same user moves to a cellular system (e.g., Universal Mobile Telecommunication System (UMTS), cdma2000) and is authenticated via the access-specific security mechanism. He may then also try to start a multimedia session and this session will be handled by the access network according to the pre-negotiated user profile known in that cellular network. Several problems may arise in the course of this scenario to work in a proper and seamless manner:

- One may need to cope with as many authentication mechanisms as access technologies, for example, respective identities with different login names and passwords;
- The fixed access network has to keep the user's session alive in order to track the movement of the user, thereby consuming resources; and
- Because of possibly different user profiles across heterogeneous domains, seamless mobility management and service offering across disparate systems may not be properly and sufficiently provided due to differences across the systems.

The new type of mobility management functions, which would be interoperable across heterogeneous networks, will be able to efficiently address such problems as identification, authentication, and mediation across access technologies arising while accessing the same level of services in a seamless manner across different networks.

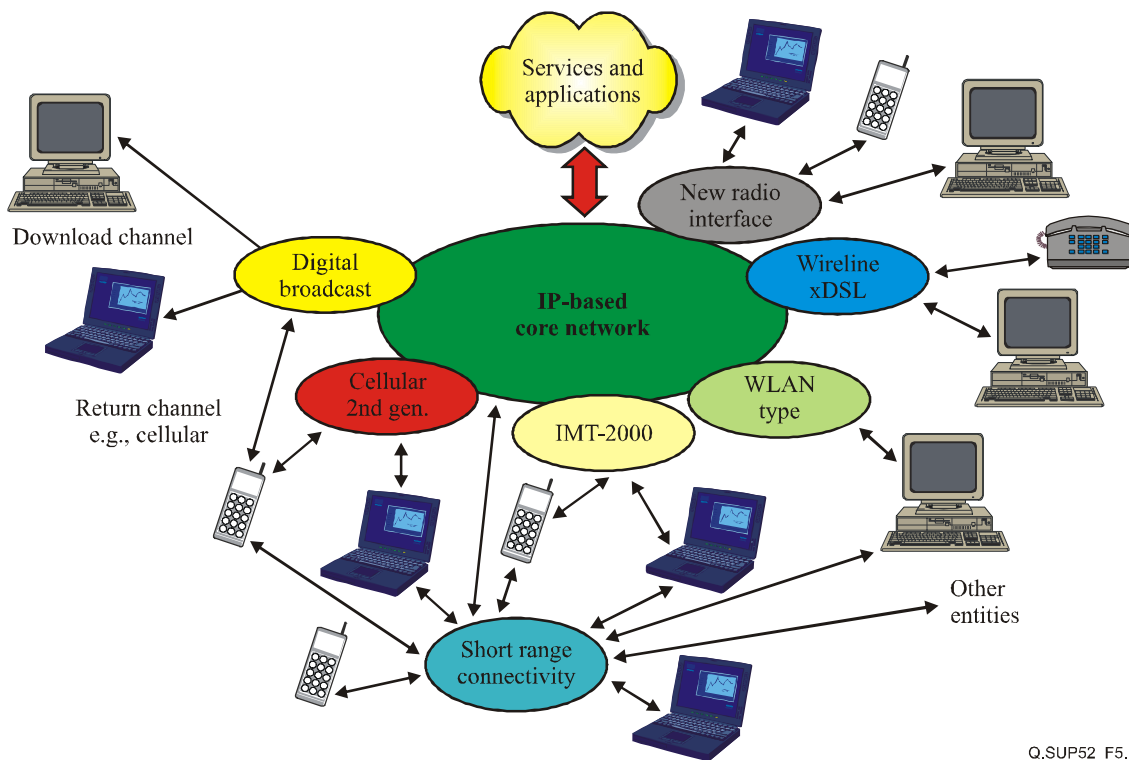
This Supplement describes a set of requirements for mobility management protocols in SBI2K. For this purpose, clause 5 considers general features and issues for mobility management in SBI2K. In clause 6, the requirements for MMPs are identified and characterized in SBI2K. Clause 7 reviews a set of the candidate MMPs for SBI2K. In clause 8, the candidate MMPs are analysed and compared in terms of the MMP requirements identified in clause 6.

5 Considerations for mobility management in SBI2K

This clause describes the generic features and considerations associated with mobility management so as to facilitate the identification of MM requirements and protocols for Systems Beyond IMT-2000.

5.1 Envisaged network environments for SBI2K

In ITU-R Rec. M.1645, ITU-R has developed a vision for SBI2K. It envisages the SBI2K architecture as shown in Figure 5-1. In this architecture, it is assumed that an operator could have a core network and one or more access networks inclusive of either wireline or wireless access networks and to provide its customers with a seamless service across these heterogeneous access networks.



Q.SUP52_F5.1

Figure 5-1 – Figure 4/ITU-R Rec. M.1465: Future network of Systems Beyond IMT-2000 (SBI2K) including a variety of potential interworking access systems

5.2 Interworking scenarios for SBI2K network

In order to identify the MM requirements for SBI2K, it would be helpful to envisage the overall network architecture of SBI2K. From the MM perspective, an overall network interworking framework for SBI2K is illustrated as shown in Figure 5-2.