



A Study of Mobility Management: Overview with Global and Nomadic Status

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Abstract: Mobility management is one of the major functions of a GSM network that allows mobile phones to work. The aim of mobility management is to track where the subscribers are, allowing calls, SMS and other mobile phone services to be delivered to them. Mobile management enables mobile wireless network to locate roaming terminals for call delivery and to maintain connections as the terminal is moving into a new service area. Thus, Mobile management supports mobile terminals (MTs), allowing users to roam while simultaneously offering them incoming calls and supporting calls in progress. Location Management enables the system to track the attachment points of MTs between consecutive communications. Handoff Management enables the network to maintain a user's connection as the MT continues to move and change its access points to the networks. In addition, Quality – of – Service (QoS) requirements, scalability and robustness are also important.

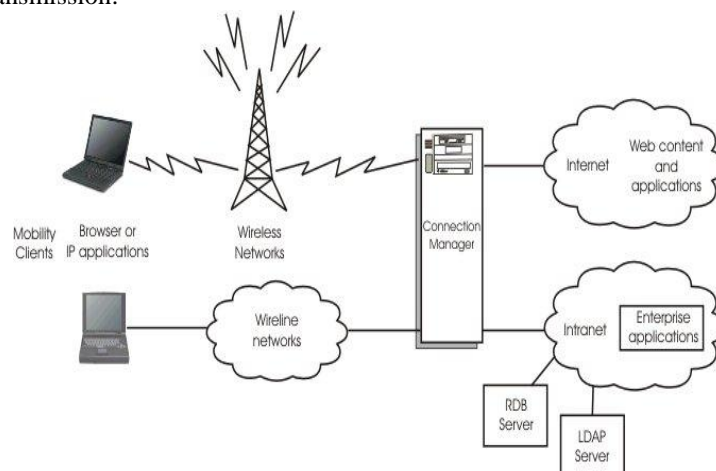
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I. MOBILITY MANAGEMENT

In this paper, we will discuss on Mobility management concept. Mobility is the essential technology that supports roaming users with mobile terminals to enjoy their services through wireless networks when they are moving into a new service area. A simple model to illustrate the basic scenario of mobile communication. The serving networks can be of any type, e.g. the Internet or intranet, mobile ad hoc networks, personal communications systems (PCS), or the mix of these networks. The mobile node can freely change its point of attachment to the networks. The main function of mobility management is then to efficiently support the seamless roaming of the mobile users and/or devices within the whole serving networks. From the viewpoint of functionality, mobility management mainly enables communication networks to:

- Locate roaming terminals in order to deliver data packets, i.e. function for static scenario.
- Maintain connections with terminals moving into new areas, i.e. function for dynamic scenario.

According to the concept above, mobility management contains two distinct but related components: location management and handoff management. The former concerns how to locate a mobile node, track its movement, and update the location information, while the latter focuses mostly on the control of the change of a mobile node's access point during active data transmission.



Wireless Network in Mobility Management

One usage scenario may invoke either one or both of the two managements. There are still many other aspects concerning the network management of mobility, e.g. mobile QoS and resource management, mobile security and privacy, billing, power management, etc. In this paper we focus mainly on issues in location and handoff management,

since these two are the kernel techniques to support seamless roaming of mobile nodes and form the basis of mobile applications.

II. CHARACTERISTIC OF MOBILITY MANAGEMENT

Mobility Management is the fundamental technology, a user may be considered by a network to have moved even if the user has not changed its physical location. There are following points importance of Mobility Management:-

- **User Mobility**

User ability to move from one physical location to other physical location and use the same service. The service should be in home network or remote network.

- **Network Mobility**

User ability to move from one network to another network and use the same service.

- **Bearer Mobility**

User should be able to move from one bearer to another and use the same service etc. could be a user was using the service through WAP bearer from his home network in Bangalore. He moves to Coimbatore where WAP is not supported he switch over to voice or SMS bearer to access the same application.

- **Device Mobility**

User should be able to move from one device to other device and use the same service.

- **Service Mobility**

User can move from one service to another could be a user writing a mail, to complete the mail the user needs to refer some other information. In a desktop PC the user easily opens another browser and moves between them using the task bar. User should be able to switch amongst services in small footprint wireless devices like in a desktop.

III. MOBILITY MANAGEMENT OPERATIONS

The operation of mobility management is divided into two related parts, location management and handoff management. The following in this section discusses the main processes and key research issues included in the two techniques. No specific design scheme in any specific mobile communication system is introduced here. A survey on different mobility management schemes for PLMN (PCS), wireless ATM, wireless Internet (Mobile IP), and satellite networks GSM can be found in [6].

A. Location Management

Location management equals locating roaming terminals in order to deliver data packets to them despite the fact that their locations may change from time to time. The essence of location management is constituted by the mechanisms for mapping the name of a mobile node to its address. Operations of location management include:

- **Location registration**, it is location update or tracking, i.e. the procedure that the mobile node informs the network and other nodes of its new location through special messages by updating the corresponding location information entries stored in some databases in the networks.

- **Location paging**, also known as locating or searching. In most cases location information stored in databases is only the approximate position of a mobile device. Location paging is then the procedure that, when calls/packets need to be delivered to the target mobile device, the network tries to find the mobile device's exact locality.

Some key research issues for location management include:

- **Addressing**, it shows how to represent and assign address information to mobile nodes. The problem is becoming more severe since the future mobile communication systems will be based on the internetworking and interoperability of diverse and heterogeneous networks of different operators and/or technologies. A global addressing scheme is needed, e.g. IPv6 address, to locate the roaming nodes.

- **Database structure**, it represents how to organize the storage and distribution of the location information of mobile nodes. Database structure can be either centralized or distributed, or the hybrid of these two schemes. Tradeoff is needed between access speed, storage overhead, and traffic overhead due to the access to the related databases. Caching is also an important technique for the improvement of access performance.

- **Location update time**, it shows when a mobile node should update its location info by renewing its entries in corresponding databases. Schemes for location update can be either static or dynamic. In a static scheme location update is triggered by some fixed conditions like time period or network topology change. A dynamic scheme is more personalized and adaptive, and based on some situations such as counter, distance, timer, personal profile, or even predicted factors.

- **Paging scheme**, shows how to determine the exact location of a mobile node within a limited time. Obviously an adequate tradeoff is needed between time overhead and bandwidth overhead. There are also both static and dynamic schemes for location paging. In static cases paging is simply done to the whole certain area where the mobile node must be in. For a dynamic method, the main problem is to firstly organize the paging areas into groups and then recognize the best sequence of the separated areas for paging, based on information like distance, probability, moving velocity, etc.

B. Hand off Management

Handoff refers to a process of transferring an ongoing call or data session from one channel connected to the core network to another. The channel change due to handoff may be through a time slot, frequency band, codeword, or

combination of these for time-division multiple access (TDMA), frequency-division multiple access (FDMA), code-division multiple access (CDMA), or a hybrid scheme. Handoff is also called as 'Handover'. Handoff is very important for managing the different resources in Cellular Systems. Handoffs should not lead to significant interruptions even though resource shortages after a handoff cannot be avoided completely. Thus handling handoffs is very much important for a desired interruption free cellular communication.

Types of Handoffs

Handoff is the mechanism which transfers an ongoing call from one cell to another cell as users are near to the coverage area of the neighbouring cell. If handoff does not occur quickly, the Quality of Service (QoS) will degrade below an acceptable level and the connection will be lost. Handoffs are classified into two categories – *hard and soft handoffs*, which are further divided among themselves.

Hard handoff

A hard handoff is essentially a “*break before make*” connection. Here the link to the prior base station is terminated before or as the user is transferred to the new cell's base station. This means that the mobile is linked to no more than one base station at a given time. A hard handoff occurs when users experience an interruption during the handover process caused by frequency shifting. A hard handoff is perceived by network engineers as event during the call. These are intended to be instantaneous in order to minimize the disruption of the call. Hard handoff can be further divided as intra and inter-cell handoffs.

Intra and inter-cell handoffs: In intra-cell handoff the source and target are one and the same cell and only the used channel is changed during the handoff. The purpose of intra-cell handoff is to change a channel, which may be interfered, or fading with a new clearer or less fading channel. In inter-cell handoff the source and the target are different cells (even if they are on the same cell site). The purpose of the inter-cell handoff is to maintain the call as the subscriber is moving out of the area of the source cell and entering the area of the target cell. Finally, Hard handoff is permitted between members of different softzones, but not between members of the same softzone. This is primarily used in FDMA and TDMA.

Soft handoff

Soft handoff is also called as Mobile Directed Handoff as they are directed by the mobile telephones. Soft handoff is the ability to select between the instantaneous received signals from different base stations. Here the channel in the source cell is retained and used for a while in parallel with the channel in the target cell. In this the connection to the target is established before the connection to the source is broken, hence this is called “*make-before-break*”. The interval during which the two connections are used in parallel, may be brief or substantial because of this the soft handoff is perceived by the network engineers as state of the call. Soft handoffs can be classified as Multiways and softer handoffs.

Multiways and softer handoffs: A soft handoff which involves using connections to more than two cells is a multiways handoff. When a call is in a state of soft handoff the signal of the best of all used channels can be utilized for the call at a given moment or all the signals can be combined to produce a clear signal, this type is called softer handoff.

In soft handoffs the chance that the call will be terminated abnormally are lower. Call could only fail if all the channels are interfered or fade at the same time. But this involves the use of several channels in the network to support just a single call. This reduces the number of remaining free channels and thereby reducing the capacity of the network. Soft handoff is permitted between members of a particular softzone, but not between members of different softzones.

IV. REASONS FOR A HANDOFF TO BE CONDUCTED

- To avoid call termination when the phone is moving away from the area covered by one cell and entering the area covered by another cell.
- When the capacity for connecting new calls of a given cell is used up.
- When there is interference in the channels due to the different phones using the same channel in different cells.
- When the user behaviors change etc.

V. TYPES OF PROTOCOLS

In cellular wireless networks, it is very important to deal with Mobile Station (MS) handoff between cells in order to maintain a continuous and QOS-guaranteed service. There are four basic types of handoff protocols which help in providing continuous and QOS-guaranteed service. There are followings:-

- Network-controlled handoff (*NCHO*)
- Mobile-assisted handoff (*MAHO*)
- Soft handoff (*SHO*)
- Mobile-controlled handoff (*MCHO*)

NCHO is a centralized handoff protocol, in which the network makes handoff decision based on measurements of the signal quality of mobile station (MS) at a number of based stations (BS). Sometimes the network sets up a bridge connection between the old and new BSs and thus minimizes the duration of handoff. This type of handoff is not suitable for a rapidly changing environment and a high density of users due to the associated delay.

An **MAHO** protocol distributes the handoff decision process. The MS makes measurements, and the MSC makes decisions.

SHO is a “make before break” connection. SHO is often used in conjunction with MAHO. Rather than immediately terminating the connection between a MS and a BS, the connection to the old BS is not broken until a connection to the new BS is made.

In **MCHO**, the MS is completely in control of the handoff process. This type of hand off has a short reaction time and is suitable for microcellular systems. A MS keeps on measuring signal strength from all the surround base stations. If the MS find that there is a new BS who has a stronger signal than that of an old BS, it may consider to handoff from the old BS to the new BS given a certain signal threshold is reached.

VI. CONCLUSION AND FUTURE DIRECTION

Mobility management has widely been recognized as one of the most important and challenging problems for a seamless access to wireless networks and mobile services. This paper makes a general framework for the study of the basic concepts of mobility and mobility management. The impacts of mobility to networks are analysed. Features of the future mobile systems are introduced and mobility of various granularities is discussed. Two main operations of mobility management are defined as location and handoff managements and the processing stages of the two operations are introduced respectively, together with the discussions of key research issues and possible solutions. Some important issues involved in the performance evaluation of mobility management scheme are discussed. The conceptual framework constructed forms a clear layout to outline the research area of mobility management for mobile communications and can direct systematic research on mobility management issues for the future mobile. With the rapid technological advancements in Artificial Intelligence, Integrated Circuitry and increases in Computer Processor speeds, the future of mobile computing looks increasingly exciting.

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