ABSTRACT

Following the explosive growth of the Internet during the last two decades, the current unprecedented expansion of wireless technology promises an even greater effect on how people communicate, interact and enjoy their entertainment. The growing advances in research and development of wireless communication technologies and the increasing capabilities of electronic devices are driving an evolution towards ubiquitous services to mobile users. Wireless networks become increasingly interoperable with each other and with the high-speed wired networks. This reflects a paradigm shift towards new generations of mobile networks where seamless mobility across heterogeneous networks becomes fundamental. This generation is referred to as fourth generation (4G). Future users will be always best connected through different available access networks when they move from one place to another. For example, a video teleconference can transparently switch from an enterprise Wireless Local Area Network (WLAN) to the traditional cellular environment when driving home and to the fixed home network when arrived. In fact, users can access and maintain a seamless connectivity anywhere, anytime via any access technology owned by any operator to use any available service.

Handovers between the technologies are transparent to users, allowing a simplified and seamless on the move experience. In summary, ‘seamless mobility is predicated on enabling a user to accomplish his or her tasks without regard to technology, type of media, or device, facilitating freedom of movement while maintaining continuity of applications experience’. This thesis contributes to the evolution of technology convergence by improving
different aspects of the inter-system handover management to make seamless mobility a reality. The trend towards communication engineering especially in data exchange had made a revolution in the 2K decade. Due to the enormous growth of the industry and also the change in the life style of the people even the general communication had become paperless. From the trend of voice communication, later incorporated with data communication, then voice + data and now it had become a mobile video transmission. As this trend is considered, the amount of data and information that is being transmitted is voluminous. As we consider the transfer technique it is an understanding between the bandwidth and the frequency of the network. As we consider the traffic and flow rate of the network, it is very important to take care of the parameters which are closely related with the transmission of the information such as signal strength, traffic density of the network, flow rate, bandwidth and the list grows.

Customer base is largely dependent on the quality of the service of the network provider where uninterrupted communication is highly desired. In today's era of advanced technologies, there is a need for constant upgradation. The proliferation of radio access technologies, wireless networking devices and mobile services have encouraged intensive nomadic computing activity. When travelling, mobile users experience connectivity disturbances, particularly when they handover between two access points that belong to the same wireless network and when they change from one access technology to another. Nowadays, an average mobile user might connect to different wireless networks in the course of a day to obtain diverse services, whilst demanding transparent operation. Current protocols offer portability and transparent mobility. However they fail to cope with huge delays caused by different link-layer characteristics when roaming between independent disparate networks. This work addresses this deficiency by introducing and evaluating practical methods and solutions that minimize connection
disruptions and support transparent mobility in future communication systems.

As the network is initiated with any request, immediately the type of request is identified as voice, data, image, data and image, motion pictures, online videos, store and forward information etc., If the transmission involves voice, data, image, data and image, the 3G cellular network is chosen. If the transmission involves huge voluminous data transmission and the distance of transmission is short the WLAN is chosen. If the transmission involved is online information exchange and if the sender and receiver are remote, the integration of the networks are very essential which has been carried out as heterogeneous networks. Heterogeneous networks is the integration of all available networks based on their common network controls such as request, response, acknowledgement, connection establishment, control transfer under a single logical environment as “Network Anywhere and Every Where”. Today the information and communication industry has grown without limits and says “Sky is the only Limit”. Now anything is possible anywhere with a small device in hand.

As far as the design and deployment of the heterogeneous network model is considered, no changes have been carried out in the existing technology but enables seamless roaming between the most popular existing wireless and wired technologies. Each and every service provider has occupied a bandwidth and are providing service to certain areas based on their bandwidth coverage and the subscribers population. As each network providers has invested a huge amount for developing their service and satisfying the customer needs, each and everyday a change cannot be made on the established environmental setup. As the customer requirement is also changing as the Information and Communication industry, it is the mandatory one for the network service providers to provide the changing need of the customers, or else the service providers face a huge loss which may be
unbearable at a certain stage. As the change is unavoidable, the operational changes can be done with minor changes in the basic level by increasing the bandwidth, diverting to the nearby network etc.

This work concentrates on mobility management for accommodating continuous service to mobile users through estimating resource requirements of potential handoff connections. A diverse mix of heterogeneous traffic with diverse resource requirements is considered. Also this investigates static and dynamic resource allocation schemes. The dynamic scheme probabilistically estimates the potential number of connections that will be handed off from neighboring cells, for each class of traffic. The performance of these strategies in terms of connection blocking probabilities for handover and local new connection requests are evaluated.

To support seamless handover, the mobile device should be able to perform the inter-system measurement without affecting the on-going communications and complete the handover decision before moving out of the serving cell coverage. The latter requires a sufficient overlap area between adjacent cells. If the overlap area is unnecessarily large, it increases the operators’ building cost. If the cell overlap area is too small, the network’s connection loss ratio is increased because mobile terminals at the edge of a cell cannot receive support from neighboring cells in time to prepare the handover. In the vision of open access networks where users can connect to any available access network of any operator, a more flexible and open solution is required to inter-work the networks to offer real global interworking and roaming facilities. This aims to design a Roaming Interworking Intermediary (RII) platform which supports all combinations of different radio technologies in a multi-operator environment. The RII will support secured roaming and seamless mobility across two independent access networks. It also aims to investigate the role of user terminals in the inter-system mobility management.
To enable a complete terminal-controlled handover procedure, the following aspects are analyzed under the control of the user terminal: access network selection, handover initiation, multiple radio interface management and handover preparation. The coordination of these steps within mobility management architecture is needed to provide a seamless terminal-controlled vertical handover. In the converged network trend, the complementary characteristics of different access technologies promote their interworking. Balancing the traffic load across the integrated networks is both a motivation and a challenge. An efficient load balancing will lead to best utilization of the pooled resources and thereby to improve the user satisfaction level. In fact, the load balancing is related to the mobility management since it involves the user’s network selection and the network-controlled vertical handover enforcement. The load balancing problem will be also analyzed in this thesis.

In short, the objective of this thesis is to optimize the inter-system mobility management, mainly between 3GPP and WLAN/WiMAX networks, by addressing the following aspects:

a. interworking and roaming architecture
b. access network selection
c. inter-system measurement
d. required cell overlap
e. handover initiation
f. handover prediction-based adaptive streaming application and
g. load balancing.

The ultimate goal is to explore different directions to achieve the seamless mobility in the future converged 4G networks and propose efficient solutions.