

## Chapter 3

# Predictive Methods of Always Best-Connected Networks in Heterogeneous Environment

**Bhuvaneswari Mariappan**  
University Chennai, India

### ABSTRACT

*Heterogeneous networks are comprised of dense deployments of pico (small cell) base stations (BSs) overlaid with traditional macro BSs, thus allowing them to communicate with each other. The internet itself is an example of a heterogeneous network. Presently, the emergence of 4G and 5G heterogeneous network has attracted most of the user-centric applications like video chatting, online mobile interactive classroom, and voice services. To facilitate such bandwidth-hungry multimedia applications and to ensure QoS (quality of service), always best-connected (ABC) network is to be selected among available heterogeneous network. The selection of the ABC network is based on certain design parameters such as cost factor, bandwidth utilization, packet delivery ratio, security, throughput, delay, packet loss ratio, and call blocking probability. In this chapter, all the above-mentioned design parameters are considered to evaluate the performance of always best-connected network under heterogeneous environment for mobile users.*

### INTRODUCTION

The advent of telecommunication has greatly reduced the communication distance between users. However, the emergence of cellular generations from 1G to present 5G has attracted a large number of users to enjoy many value added services like mobile multimedia applications, videoconferencing, online classroom besides voice services. The main challenge is to provide seamless and always best connected services to the demanding mobile user in hostile environments (Marques V., et al., 2003). However, the trade-off between bandwidth and delay of Always Best Connected network for bandwidth hungry applications in the vicinity of heterogeneous network is still a research issue.

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In a wireless network, mobile multimedia users face challenges when the user is handed over to an entirely different wireless network from the recently served network. This is due to the incompatibility of the architectural and technical specification of different networks. For instance, consider a mobile user roaming between networks such as 3G cellular and WLAN during an ongoing video streaming session. Here, the most critical parameters of interest for seamless service to the user are minimum delay, efficient bandwidth utilization factor, low call blocking probability and minimum cost factor.

## **Background**

In any wireless network, minimum delay for real time applications is obtained by using a higher data rate interface, merging of network elements to reduce the hop distance and reserving the resources along the shortest path. However as in Xiao, Chen, and Wang (2000) by carefully rearranging the scheduling access of non-real time applications and also by bandwidth up gradation and degradation methods, bandwidth could be efficiently utilized in wireless networks. A network can have low call blocking probability by using load balancing concept. Lastly, the cost of the service could be reduced by proper network planning and management process. In the proposed approach, the behavior of network is predicted based on novel parameter namely recent call history-‘rch’.

The estimation of ‘rch’ reflects the call blocking probability of networks. This anticipation of wireless network status are more pronounceable during handover situations besides conventional channel borrowing strategy. So, by estimating the ‘rch’ of a network, the future behavior of the network is predicted and the prediction is utilized for further planning to achieve the performance evaluation parameters of Always Best Connected networks. As far as heterogeneous network is concerned, the optimal network selection is itself is a research issue (Sehgal & Agrawal, 2010). The authors Sehgal and Agrawal (2010), Lahby, Mohammedia, Morocco and Adib (2013), Shen and Zeng (2008) selected the optimal network based on user preference and QoS parameters such as cost, bandwidth, distance and security but, however the network is not studied overlong term/average period similar to Malanchini, Cesana and Gatti (2012) and Jiang, Li, Hou, et al. (2013).

The popular research work in QoS identified from literature of Bari F & Leung VCM (2007) are European Research Funded Projects, Two IST STREP and 4 MORE-MCCDMA Multiple-Antenna System On Chip for Radio Enhancements. Its main objective is to emphasize on research, develop, integrate and validate a cost effective low power system on chip solution for multi antenna multi carrier CDMA Mobile terminals based on joint optimization of layer 1 and layer 2.

To develop an end to end optimized wireless communication link C. Verikoukis, L. Alonso and T. Giamalis (2005) proposed PHOENIX, a scheme offering the possibility to let the application world (source coding, ciphering) and the transmission world (channel coding, Modulation) talk to each other over an IPV6 protocol stack. Verikoukis, Alonso and Giamalis (2005) also proposed NEWCOM, IST-507325, NEWCOM Project E of IST Network of Excellence on Wireless Communication proposal to identify existing gaps in European Knowledge in cross-layer and also investigated the potential benefits of cross-layer in wireless network design in relation to the methodology of separate layer design. It also considered the coupling of higher layers with physical layer and elaborated the information to be exploited from the physical layer to optimize the network performance.

However, some possible approaches of QoS Enhancement in Multimedia Mobile Networks identified from literature includes IMS [IP Multimedia subsystem] to support multimedia traffic with QoS along

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