Chapter 9
Handoff Management in Macro–Femto Cellular Networks

Muhammad Faheem Mustafa
COMSATS University Islamabad – Wah, Pakistan

Ayaz Ahmad
COMSATS University Islamabad – Wah, Pakistan

Raheel Ahmed
COMSATS University Islamabad – Wah, Pakistan

ABSTRACT
With the rapid increase in data traffic and high data rate demands from cellular users, conventional cellular networks are becoming insufficient to fulfill these requirements. Femto cells are integrated in macro cellular network to increase the capacity, coverage, and to fulfill the increasing demands of the users. Time required for handoff process between the cells became more sensitive and complex with the introduction of femto cells in the network. Public internet which connect the femto base station with the mobile core network induces higher latency if conventional handoff procedures are also employed in macro-femto cell network. So, handoff process will become slower and network operation will become insufficient. Some standards, procedures, and protocols should be defined for macro-femto cell network rather than using existing protocols. This chapter presents a comprehensive survey of handoff process, types of handoff in macro-femto cell network, and proposed methods and schemes for frequent and unnecessary handoff reduction for efficient network operation.

INTRODUCTION
Over the last few years, there is a tremendous increase in the ratio of smart phones and tablets etc. As a result, the number of users in the network are increasingly aggressively and their requirements of bandwidth and throughput are increasing exponentially in recent times. Cisco research group has shown a 39 fold increase in the data traffic and throughput demand from year 2009 to 2014 (Reardon 2010). Due to this rapid increase in the data traffic and users demand of higher throughput for their multime
dia application like video streaming, video conferencing and online gaming etc. Should we keep small
cells or femto cells? Conventional wireless cellular network was becoming short of resources which
was severely degrading the QoS of the users. To cope up with these limitations of the network, concept
of heterogeneous network was evolved which integrates the small cells like femto, micro and pico cell
in the conventional network and forming multi-tier communication. The next generation wireless com-
munication networks are promising in terms of providing the larger bandwidth and higher throughput
while assuring the quality of service (QoS) to the users for both voice and different data and multimedia
services. Femtocell networks provides good quality of services with enhanced throughput to the users
in the indoor environment with lower cost. Transmitter and receiver deployed closer to the user increase
the capacity of wireless link as well as it creates dual benefits of better quality of links and more spatial
reuse of spectrum resources (Liu et al. 2010). So, femtocell is one of the best approaches for the hetero-
genous convergence networks for coverage area extension and capacity maximization.

A femtocell is a small base station with shorter communication range and low transmit power also
referred to as home-enhanced NB (H(e)NB). This base station supports fewer users as compared to
macro base station and employs the frequency reuse concept to enhance the system capacity. Femto
cells are normally installed indoor to provide communication coverage to the users affected penetration
losses and low SINR of macro cell signals (Chandrasekhar, Andrews, and Gatherer 2008a). One of the
most important feature of a cellular communication system is the freedom of mobility but in this system,
this service will be provided by supporting handoff process also known as handover from one cell to
another without any interruption. Handoff is the process of changing the frequency, time slot, channel,
spreading code, or combination of them from one base station to another while communication session
is in progress. It is often initiated when any user crosses the cellular region or degradation of QoS in
current channel. Different types of handoff algorithms are investigated by research community which are
based on received signal strength (RSS), user’s velocity, dwell time, SINR value and users association
with predefined threshold have been studied in (Halgamuge et al. 2005). The threshold sets a minimum
handoff criteria for handoff initiation but hysteresis model adds a margin H(hysteresis threshold) to the
threshold of RSS or dwell time from the serving BS.

The integration of femtocell with conventional macrocell networks is not very simple and easy because
it leads several types of problems i-e, radius size of femtocell is very small which means, we required a
large number of femto cells up to several hundred within a macrocell. If a UE attempts handoff between
macrocell and femtocell then it will experience more severe SINR degradation than UE moving between
macrocell at the speed. In otherwords, we can say that interference also increases by deploying the femo-
tocells within a macrocell. Interference also increase as we increase the femtocells within a macrocell.

An effective and comprehensive solution for these problems may lead towards efficient femtocell
network operation (Bae, Ryu, and Park 2011). The key advantage of femto cell technology from user’s
perspective is that, users required no any other equipment for communication setup. Due to this advan-
tage, provision of high data rate and the deployment cost of femto cell is very low increasing the capacity
of the system. This makes the femto cells feasible for deployment at a large scale which is the ultimate
objective of this technology (Nasser, Hasswa, and Hassanein 2006) (Akiyama et al. 2003). Femto cells
are connected with core network through internet broadband backhaul connection whereas macro cell
are connected with core network through dedicated lines. Handoff time between macro-macro cell is
maximum up to 100ms whereas handoff between macro-femto cell or femto-femto cell takes more than
200ms due to longer transmit time required for packet transfer in broadband internet (Dimou et al. 2009).
Related Content

CHEERBOT: A Step Ahead of Conventional ChatBot
www.igi-global.com/chapter/cheerbot/221437?camid=4v1a

Weaving Web 2.0 and Facial Expression Recognition into the 3D Virtual English Classroom
www.igi-global.com/chapter/weaving-web-20-and-facial-expression-recognition-into-the-3d-virtual-english-classroom/138338?camid=4v1a

Evolution in Broadband Technology and Future of Wireless Broadband
www.igi-global.com/chapter/evolution-broadband-technology-future-wireless/58877?camid=4v1a

Co-Operative Load Balancing in Vehicular Ad Hoc Networks (VANETs)
www.igi-global.com/article/operative-load-balancing-vehicular-hoc/64624?camid=4v1a