Chapter 7

Optimizations for simultaneous mobility

In this chapter, I analyze the problem due to non-receipt of binding update that results when both the mobile nodes move simultaneously and propose optimization techniques that increase the successful handover probability under the simultaneous mobility scenario. These optimization techniques could be applied to mobility protocols at several layers - network layer mobility protocols such as MIPv6 [JPA04] and MIP-LR [JRY+99] and application layer mobility protocol such as SIP-based mobility [SW00].

7.1 Summary of key contribution and indicative results

Without any thorough analysis of the simultaneous mobility problem that arises due to non-receipt of binding updates when both the hosts that are in communication move, it is difficult to predict the parameters that affect the simultaneous mobility and propose solutions to mitigate these problems. Prior to my work, there was no comprehensive study that analyzes the simultaneous mobility problem nor there is any existing solution to mitigate these problems in an infrastructure-based mobility environment.

I analyze the simultaneous mobility problem and develop an analytical framework to study the effect of inter-handoff rate of the mobile and binding update latency on
the probability of occurrence of simultaneous mobility problem. I proposed timer-based retransmission, forwarding and redirecting mechanisms using binding update and location update proxies and use of simultaneous bindings by the mobile to eliminate the vulnerability of binding update due to simultaneous mobility. I applied these solution mechanisms to several application layer and network layer mobility protocols namely, SIP-based mobility, MIPv6 and MIP-LR.

My proposed analytical framework for simultaneous mobility can predict the probability of simultaneous mobility based on the mobile’s inter handoff time and binding update latency. Each of my proposed techniques can be applied either at the sender side or receiver side and work for both network layer and application layer mobility protocols unlike protocol specific mechanisms proposed by Tilak and Ghazaleh [TAG01] and Dreibholz et al. [DJT03] that use TCP migrate and SCTP extensions. Each of my proposed solution mechanisms reduces the vulnerability interval of simultaneous binding update.

In the rest of the chapter, I introduce the simultaneous mobility problem and illustrate this problem for different mobility protocols, develop the analytical framework, prove lemmas covering two cases of simultaneous mobility and propose solution mechanisms that can be applied to few network layer and application layer mobility protocols, namely MIP-LR, MIPv6 and SIP.

7.2 Introduction

Stoica et al. [ZLS*05] propose seven properties that are needed to fully realize the promise of ubiquitous mobility. These properties also include simultaneous mobility. It is expected that non-simultaneous mobility in most scenarios would occur more frequently than simultaneous mobility. Non-simultaneous mobility refers to mobility of one end host while the other remains stationary. Nevertheless, simultaneous mobility would happen once in a