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BY

Dr. Md. Shohrab Hossain

Dr.

Dr.

Dedication

This dissertation is dedicated to .

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Abstract

Today mobile computing has become a necessity and we are witnessing explosive growth in the number of mobile devices accessing the Internet. To facilitate continuous Internet connectivity for nodes and networks in motion, mobility protocols are required and they exchange various signaling messages with the mobility infrastructure for protocol operation. Proliferation in mobile computing has raised several research issues for the mobility protocols. First, it is essential to perform cost and scalability analysis of mobility protocols to find out their resource requirement to cope with future expansion. Secondly, mobility protocols have survivability issues and are vulnerable to security threats, since wireless communication media can be easily accessible to intruders. The third challenge in mobile computing is the protection of signaling messages against losses due to high bandwidth requirement of multimedia in mobile environments. However, there is lack of existing works that focus on the quantitative analysis of cost, scalability, survivability and security of mobility protocols.

In this dissertation, we have performed comprehensive evaluation of mobility protocols. We have presented tools and methodologies required for the cost, scalability, survivability and security analysis of mobility protocols. We have proposed a dynamic scheduling algorithm to protect mobility signaling message against losses due to increased multimedia traffic in mobile environments and have also proposed a mobile network architecture that aims at maximizing bandwidth utilization. The analysis presented in this work can help network engineers compare different mobility protocols quantitatively, thereby choose one that is reliable, secure, survivable and scalable.

Chapter 1

Introduction

Next generation networks are gradually converging towards the all-IP networks which can enable true global mobility and Internet connectivity to mobile devices.

1.1 Introduction

Internet Protocol (IP) is the underlying communication protocol that allows an end host to get connected to other hosts over the public Internet. Therefore, to facilitate continuous Internet connectivity for mobile nodes, Internet Engineering Task Force (IETF) proposed Mobile IPv6 [1], an IP-based mobility protocol.

This aggregated mobility management can significantly reduce signaling requirement and power consumption.

1.2 Motivation and Problem Statement

In a mobile computing environment, a number of *network parameters* (such as, network size, mobility rate, traffic rate) influence the signaling costs related to mobility management. With the rapid growth and popularity of mobile and wireless networks,

Finally, mobility protocols can be vulnerable to security threats.

1.3 Objectives

The *objectives* of this research are as follows:

- The first objective of this research is to perform a comprehensive cost and scalability evaluation of the
- The second objective of this research is the quantitative evaluation of survivability of the mobility infrastructure and the associated components.
- The fourth objective of this research is to protect mobility protocols from security threats.
- Finally, mobility protocols require a realistic mobility model that can mimic the movement pattern of nodes in motion.

1.4 Contributions

The *contributions* of the dissertation are summarized as follows:

- Perform entity-wise cost evaluation of host and network mobility protocols.
- Perform quantitative scalability analysis of host and network mobility protocols.
- Perform multi-class queuing analysis and propose a dynamic scheduling algorithm to protect crucial control messages (of mobility management) against losses.

1.5 Organization of the Dissertation

The rest of the dissertation is organized as follows. Chapter **??** presents a review of host and network mobility protocols.

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Appendix A

Acronyms

AH Authentication Header

AR Access Router

AZS Anchor Zone Server

BA Binding Acknowledgement

BSP Basic Support Protocol

BU Binding Update

CGA Cryptographically Generated Address

CN Correspondent Node

CoA Care of Address

CoT Care-of Test

CoTI Care-of Test Init

DDoS Distributed Denial of Service

DHCP Dynamic Host Configuration Protocol

DNS Domain Name System

DoS Denial of Service

ESP Encapsulating Security Payload

FTP File Transfer Protocol

HA Home Agent

HiSIGMA Hierarchical SIGMA

HIP Host Identification Protocol

HMIPv6 Hierarchical Mobile IP vesrion 6

HoA Home Address

HoT Home Test

HoTI Home Test Init

HZS Home Zone Server

ICMP Internet Control Message Protocol

IETF Internet Engineering Task Force

IKE Internet Key Exchange

IP Internet Protocol

IPsec IP security

LCoA Local Care of Address

LFN Local Fixed Node

LLM Local Location Manager

LM Location Manager

LMA Local Mobility Anchor

MAP Mobility Anchor Point

MH Mobile Host

MIP Mobile IP

MIPv6 Mobile IP vesrion 6

MITM Man In The Middle

MNN Mobile Network Node

MNP Mobile Network Prefix

MR Mobile Router

MSF Mobility Scalability Factor

NEMO NEtwork MObility

NRT Non-Real Time

PDA Personal Digital Assistant

RA Router Advertisement

RBU Refreshing Binding Update

RCoA Regional Care of Address

RR Return Routability

RT Real Time

RTT Round Trip Time

SA Security Association

SCTP Stream Control Transport Protocol

SIGMA Seamless IP-diversity based Generalized Mobility Architecture

SINEMO Seamless IP-diversity based Network Mobility

SPI Security Parameters Index

TCP Transmission Control Protocol

TNRL Telecommunications and Networks Research Lab

UDP User Datagram Protocol

VMN Visiting Mobile Node