ENSC 835-3: Network Protocols and Performance
CMPT 885-3: Special Topics: High Performance Networks

FINAL PROJECT PRESENTATIONS
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Route Optimization of Mobile IP over IPv4

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http://www.sfu.ca/~lcheu/885-project.htm

Road Map

- Introduction & Overview
  - Mobile IP (MIP)
  - Route Optimization of Mobile IP (ROMIP)
- Project Objectives & Scope
- Implementation
  - Current MIP in *ns*
  - Extension of ROMIP in *ns*
  - Simulation
- Conclusion
- References

Introduction: Mobile IP overview

- What is Mobile IP?
  - Mobility support in IP [rfc3220]
  - Portable IP address
  - Terminology:

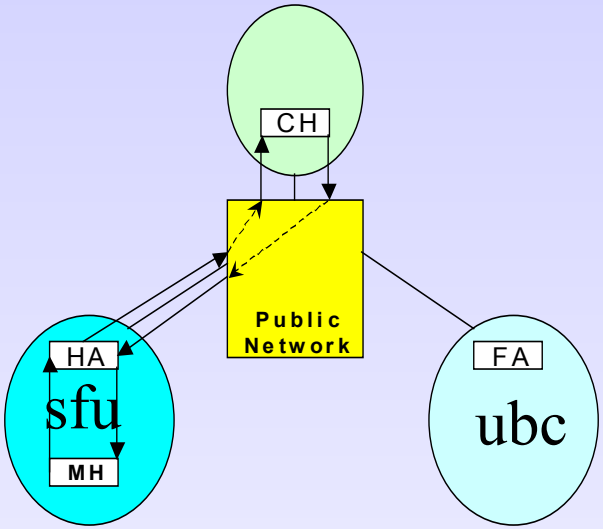


Figure 1. MH in its home network.
Communications between CH and MH are shown by arrows in this figure.

- Mobile Host (MH)
- Home Address (Haddr)
- Correspondent Host (CH)
- Care-of-Address (COA)
- Home Agent (HA)
- Foreign Agent (FA)
- IP Tunneling
- Encapsulate/Decapsulate

Introduction: Triangle Routing in MIP

- Triangle Routing problem in Mobile IP
  - Routing when MH is in FA's domain (Figure 2)

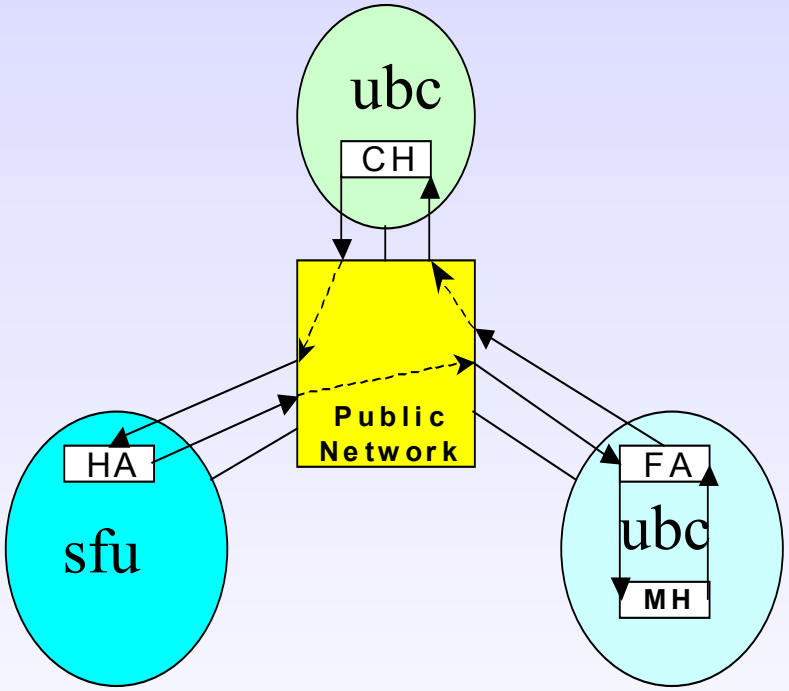


Figure 2. MH in foreign network.
Communications between CH and MH are shown by arrows in this figure.

Introduction: Route Optimization in MIP

- Binding Update Message (phase 1) [2]
- Binding Caches
- Smooth Handoff (phase 2)

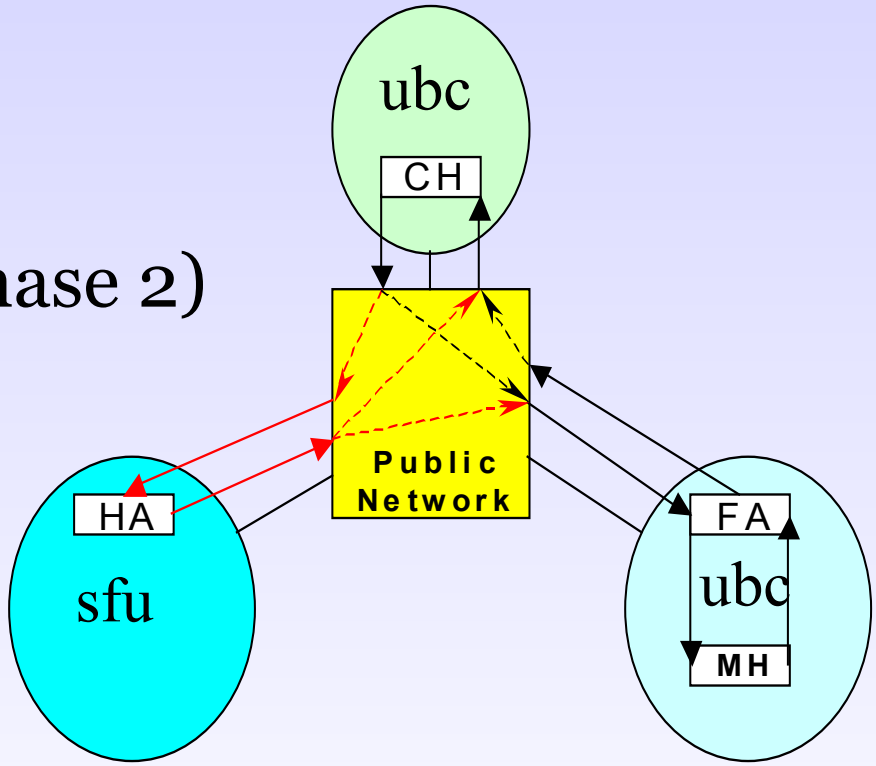
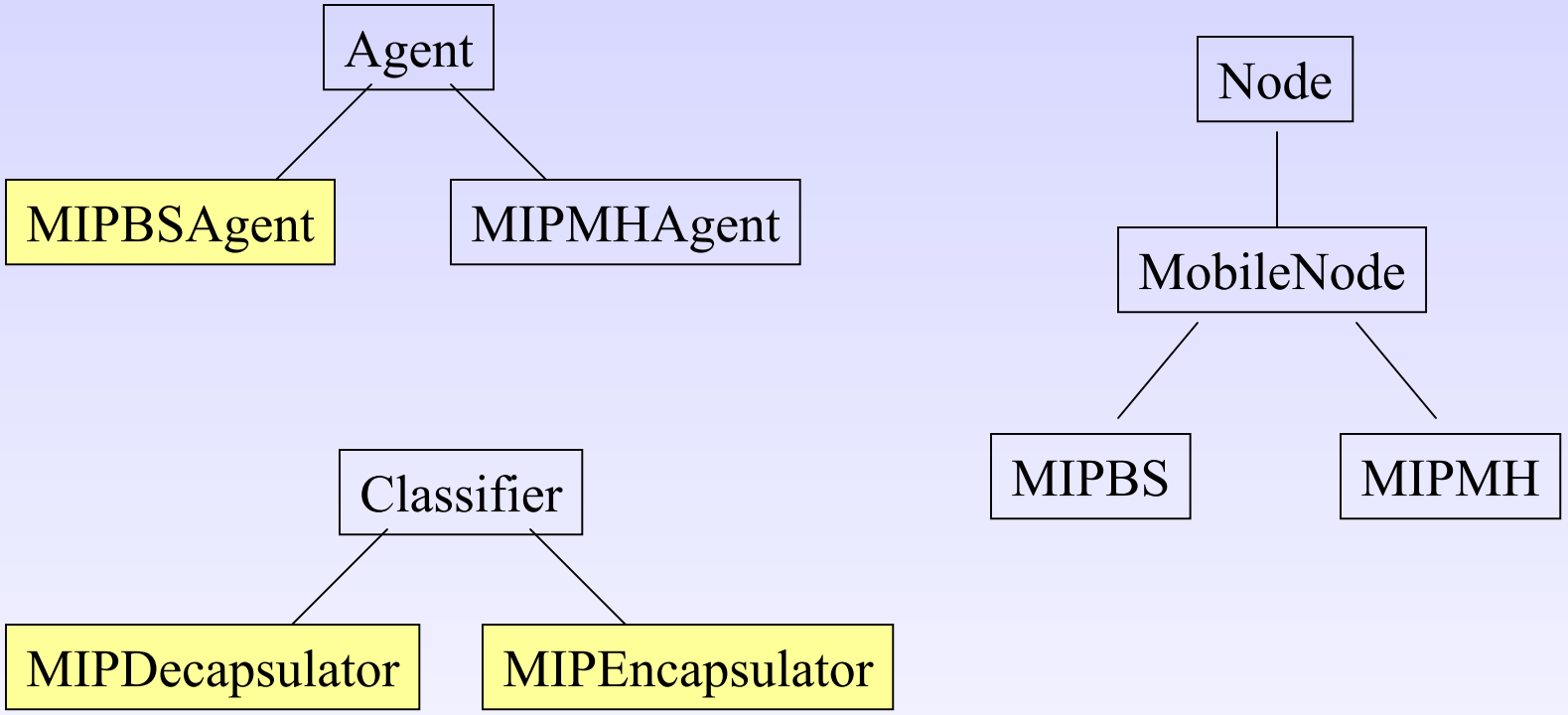


Figure 3. MH in foreign network.
Communications between CH and MH are shown by arrows in this figure.

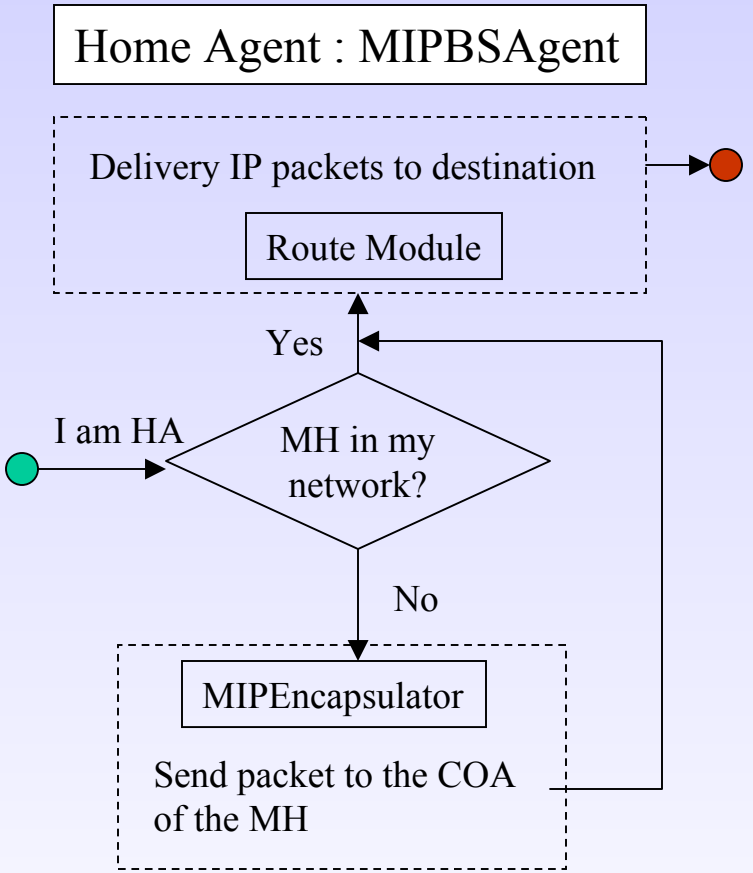
Project Objectives & Scope

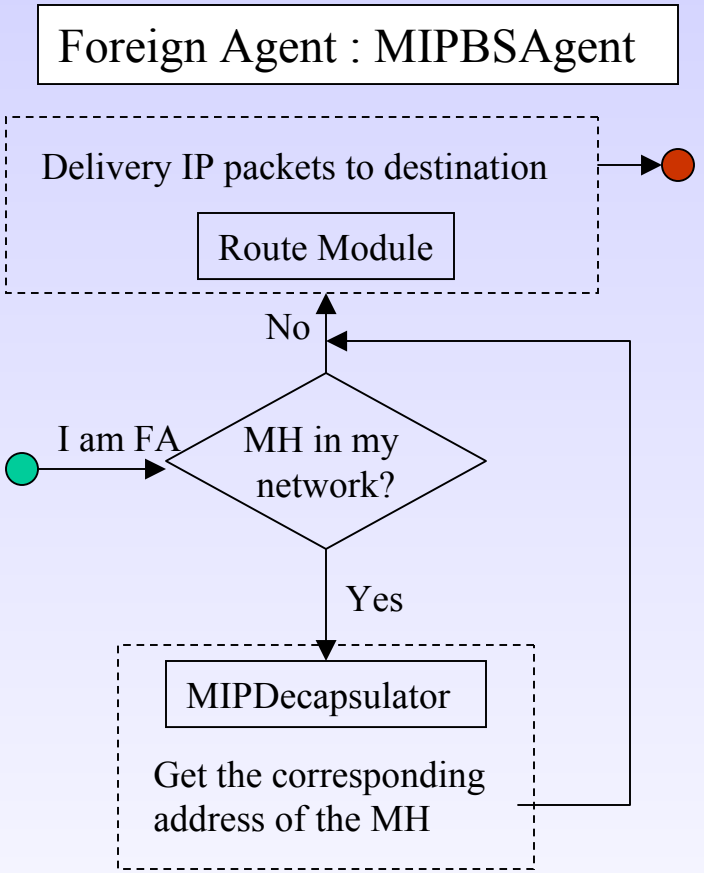
- Understand the MIP and ROMIP
- Figure out the current *chaotic* implementation of Mobile IP in *ns*
- Modify MIP in *ns* to extend the Route Optimization support – Binding Update Message, Correspondent Host (C++, OTcl)
- Simulate Mobile IP in *ns* with/without Route Optimization
- Analyze the wireless trace file and compare the result

MIP Architecture in *ns*

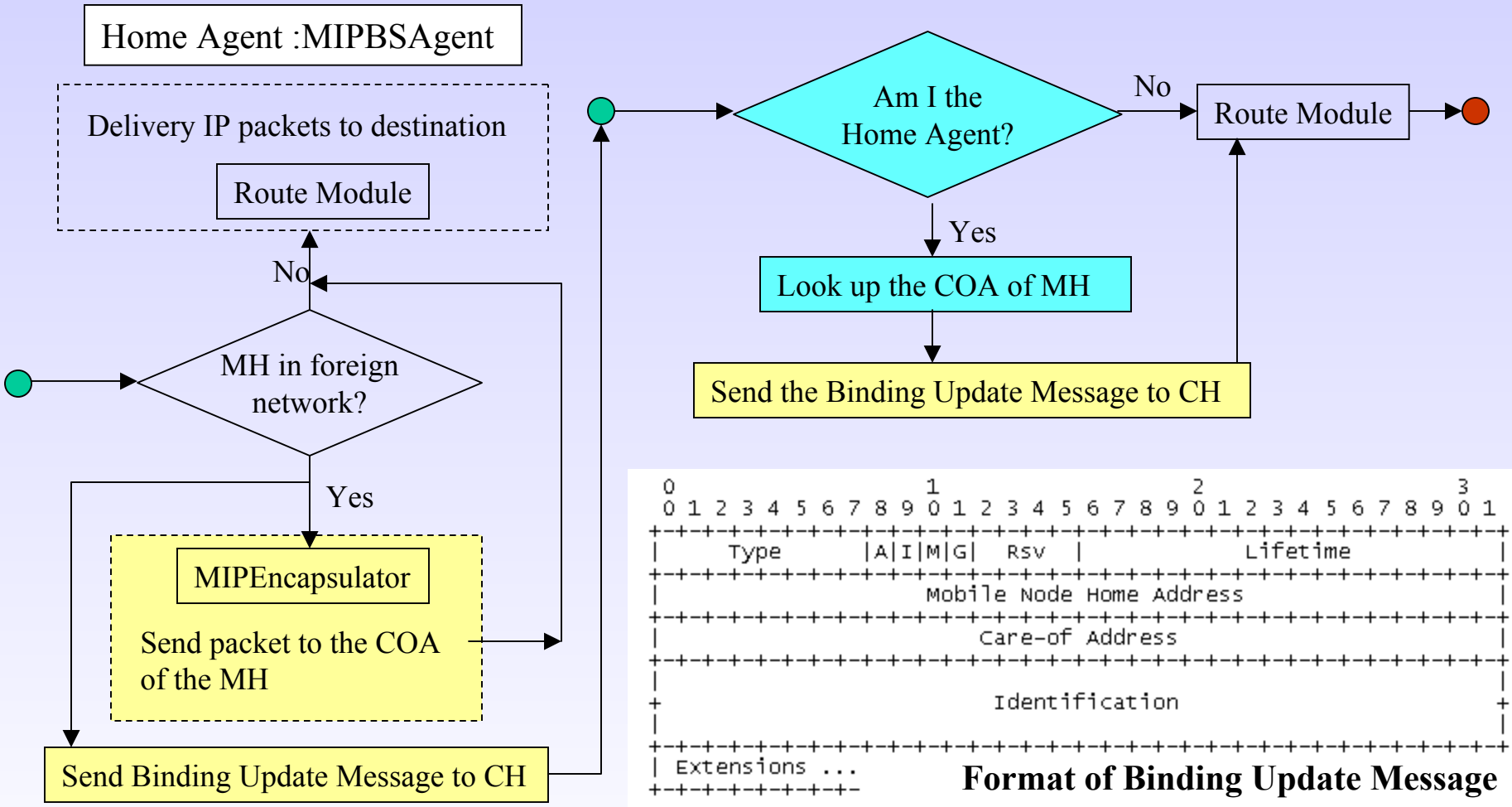


Current Mobile IP in *ns*





Implementation – Send Binding Update

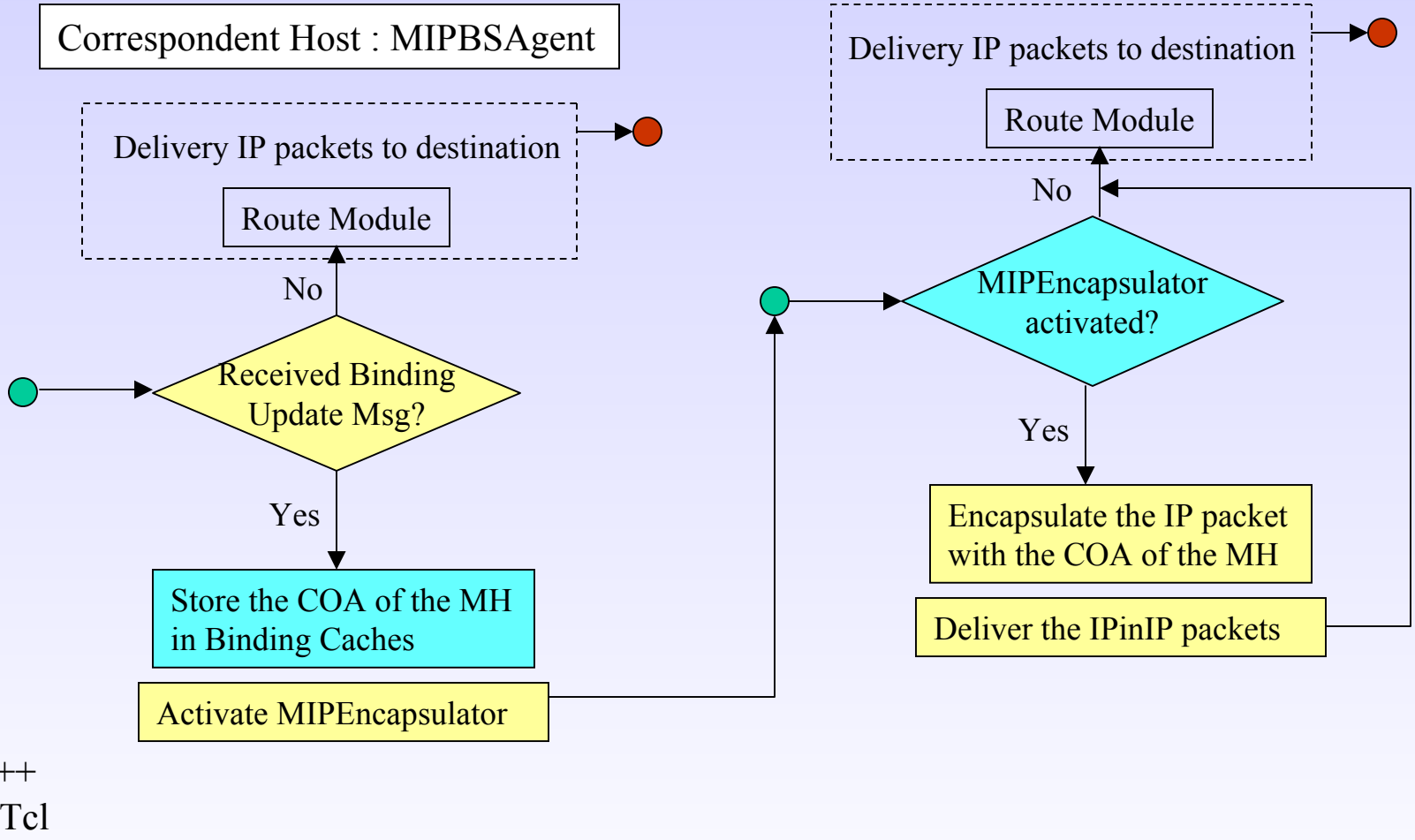


Format of Binding Update Message

C++

OTcl

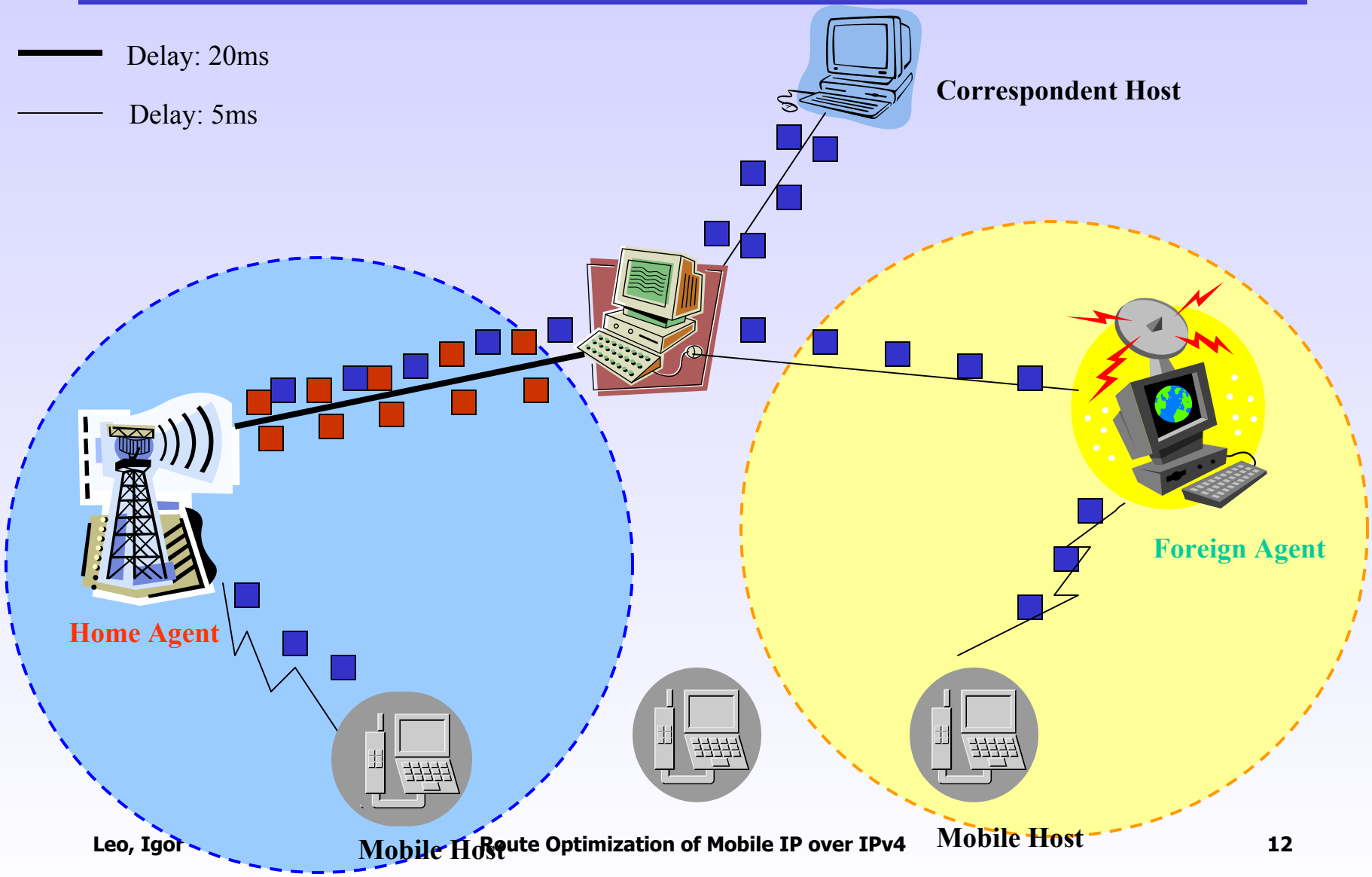
Implementation – Receive Binding Update



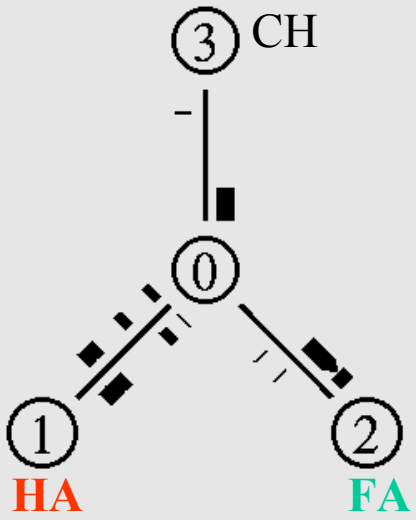
Simulation - Mobile IP w/o RO

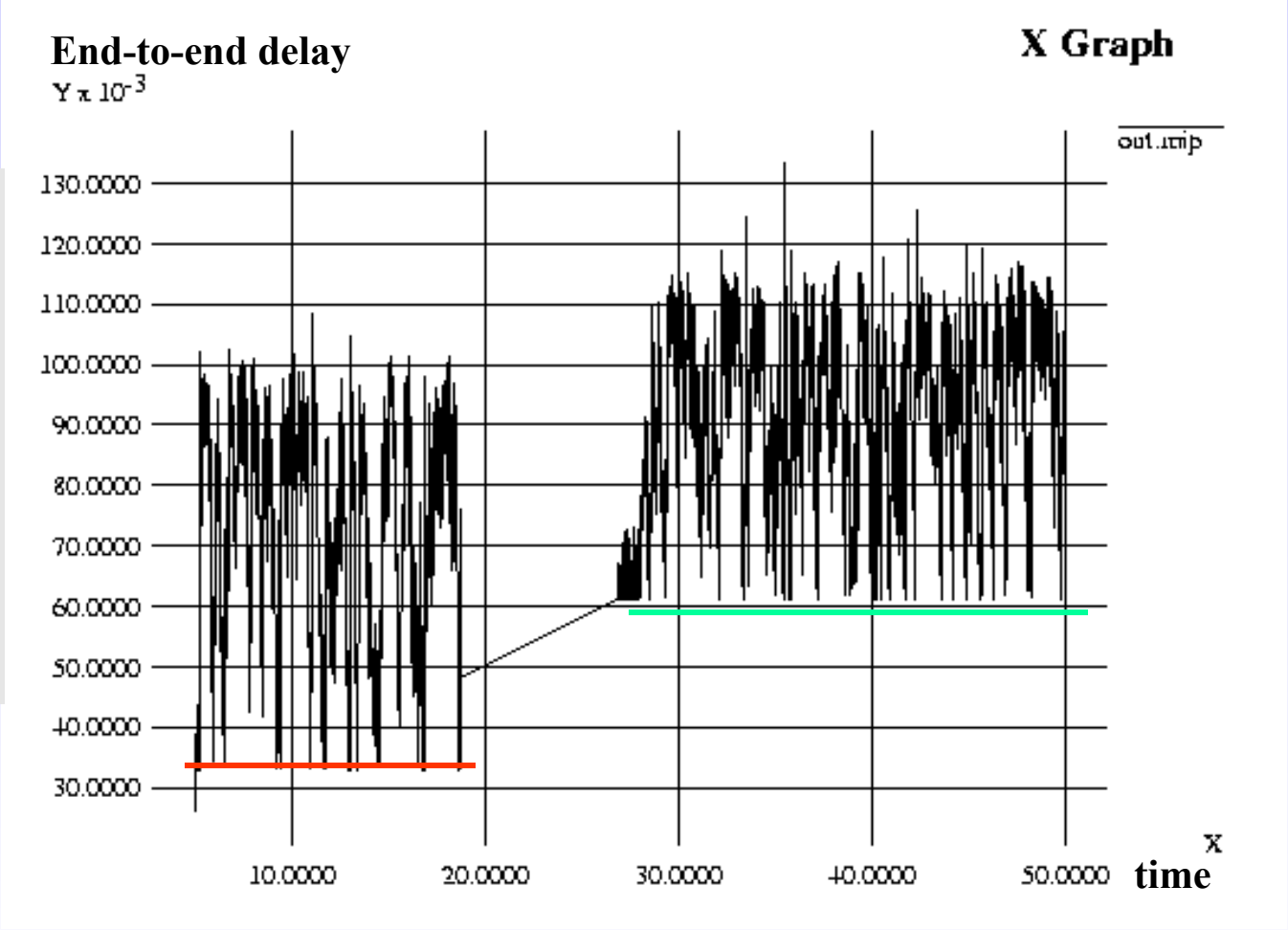
- 1 Home Agent, 1 Foreign Agent, 1 Mobile Host
- 2 wired nodes
- Wireless coverage: 50m
- Distance between HA & FA: 150m
- Traffic Type: CBR

Simulation - Mobile IP w/o RO



Simulation Result (Mobile IP w/o RO)





Simulation Result Analysis (MIP w/o RO)

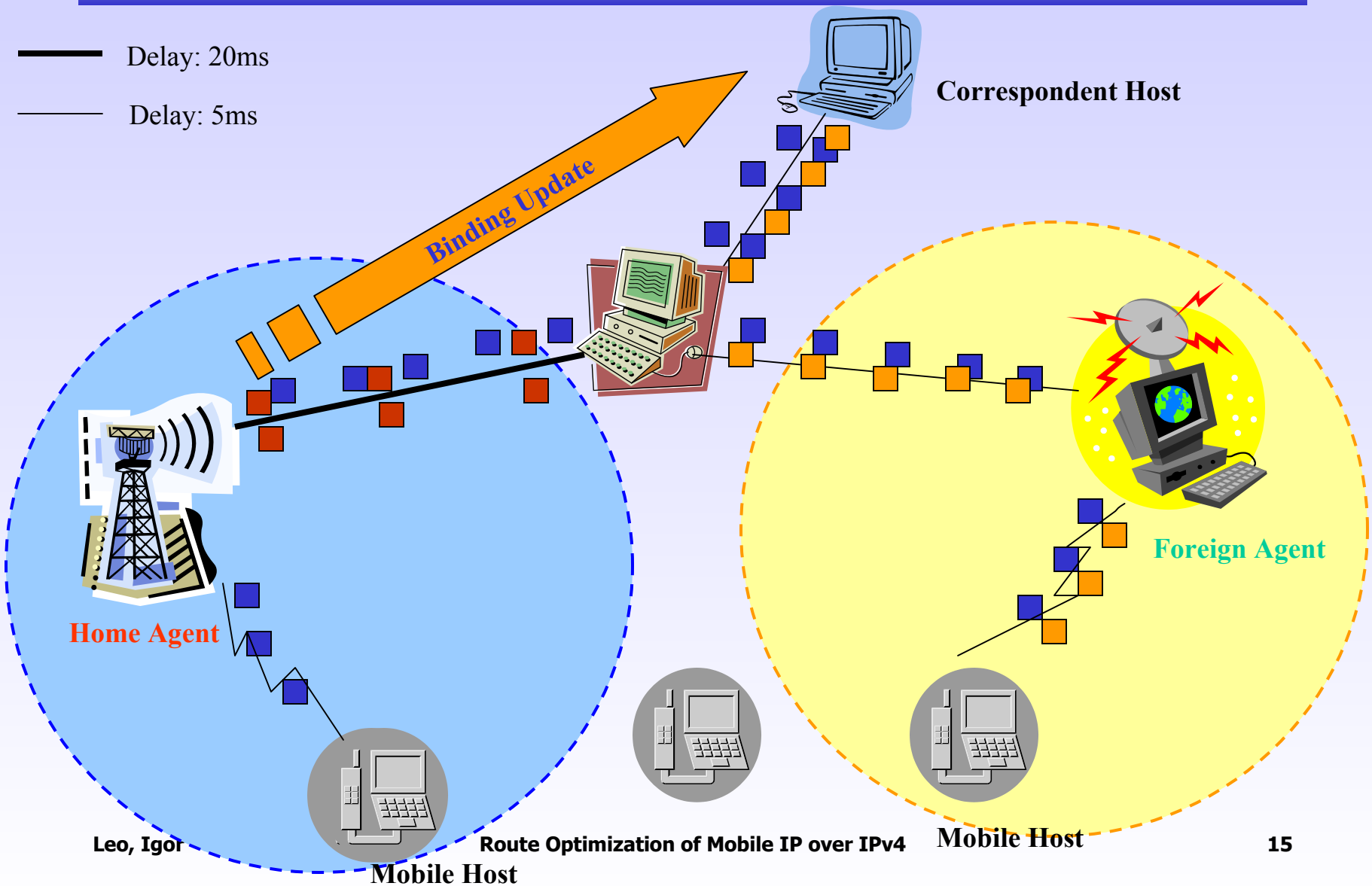
- When MH is within HA domain:
  Minimum delay from CH to MH is
  around 33ms = 20 + 5 + 8* ms

- When MH is within FA domain:
  Minimum delay from CH to MH is
  more than 60ms = 5 + 20 + 20 + 5 + 10* ms

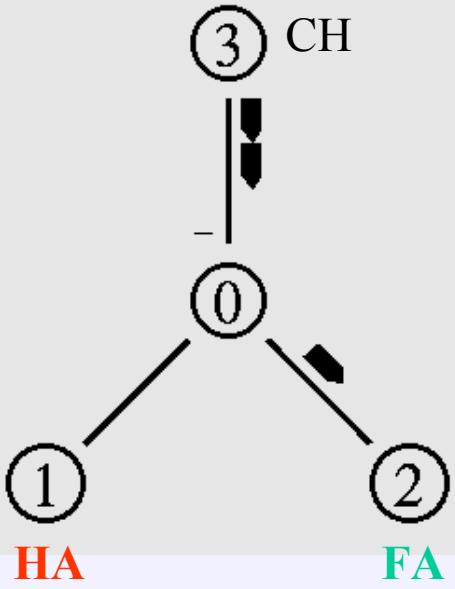
- Triangle Routing drastically increases the end-to-end packet delay, especially when MH is far from HA

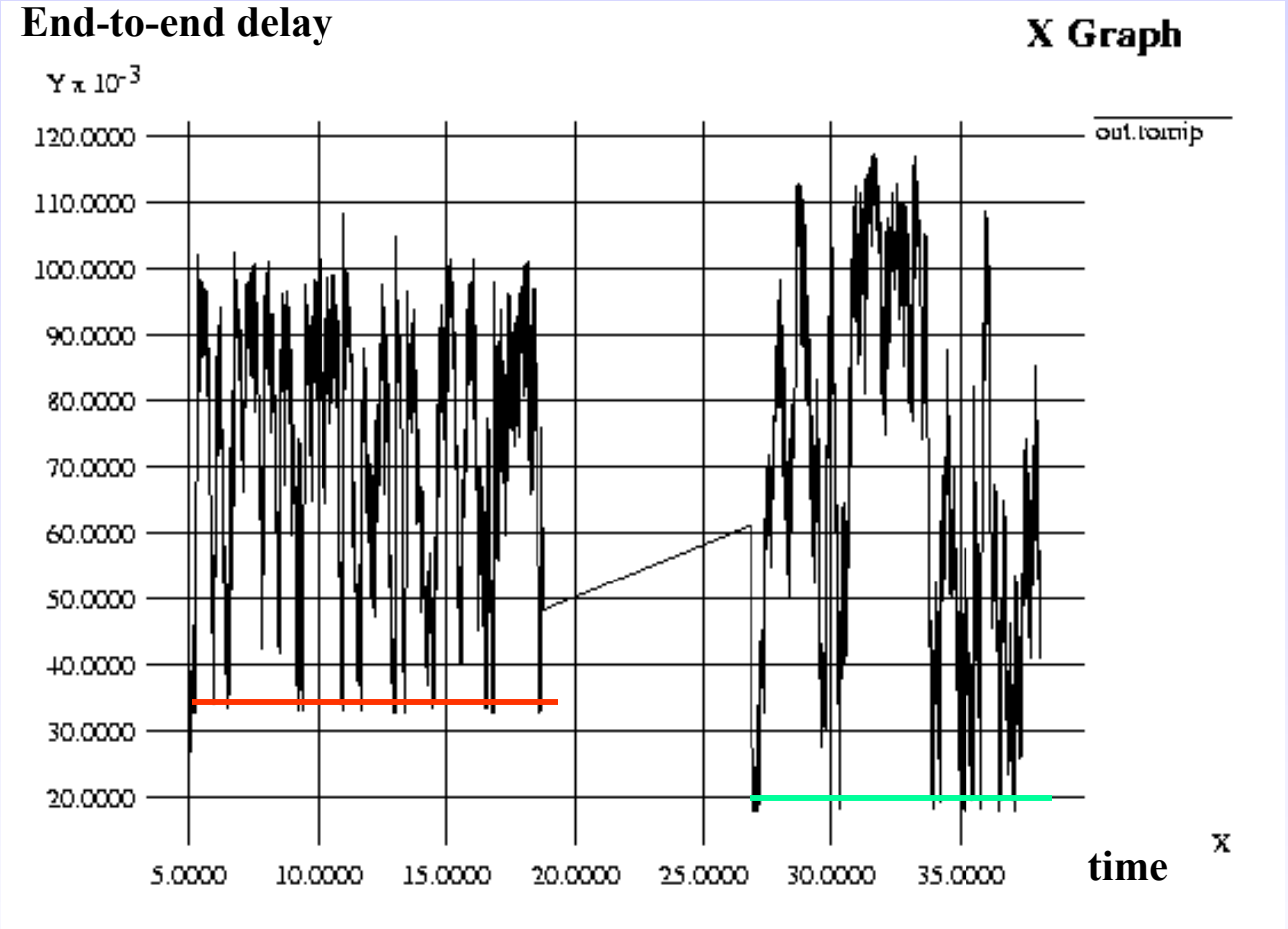
* : wireless transmission delay

Simulation (Mobile IP with RO)



Simulation Result (Mobile IP with RO)





Simulation Result Analysis (MIP with RO)

- When MH is within HA domain:
  Minimum delay from CH to MH is
  still around 33ms = 20 + 5 + 8* ms

- When MH is within FA domain:
  Minimum delay from CH to MH is
  less than 20ms = 5 + 5 + 10* ms

- Triangle Routing is eliminated; end-to-end delay decreases drastically

* : wireless transmission delay

Simulation Result Comparison

Scenario	Minimum End-to-End Delay	
	MH in HA	MH in FA
MIP w/o RO	33 ms	60 ms
MIP with RO	33 ms	20 ms

Conclusions

- Route Optimization is efficient in Mobile IP to eliminate Triangle Routing, and decrease the minimum end-to-end delay

  !! 20ms << 60ms !!

- Successfully implement the Binding Update message and Correspondent Host of ROMIP in *ns-2*
- The ROMIP can be contributed to *ns-2* as an extension of the current MIP
- Phase 2: Smooth Handoff
- Future Work
  - Complete the Route Optimization of MIP
  - Comparison of ROMIP in IPv4 between IPv6 [3]
  - Comparison of ROMIP with other approaches [6,7]

References

- [1] RFC3220: "IP Mobility Support for IPv4", C. Perkins, January 2002
- [2] Internet Draft: "Route Optimization in Mobile IP", C. Perkins, D. Johnson, 09/06/2001. (work in progress)
- [3] Internet Draft: "Mobility Support in IPv6", C. Perkins, D. Johnson, 11/21/2001. (work in progress)
- [4] The ns Manual, Edited by Kevin Fall & Kannan Varadhan.
- [5] S. Cheshire and M. Baker, "Internet Mobility 4x4", ACM SIGCOMM Computer Communication Review, Conference proceedings on Applications, technologies, architectures, and protocols for computer communications. Volume 26 Issue 4, August 1996, pp. 318 - 329.
- [6] P. Zhou and O. Yang, "Reverse Routing: An Alternative to MIP and ROMIP Protocols", Proceedings of 1999 IEEE Canadian Conference on Electrical and Computer Engineering, Volume 1, pp. 150 - 155.
- [7] R. Jain, T. Raleigh, et al. "Enhancing Survivability of Mobile Internet Access Using Mobile IP with Location Registers", INFOCOM '99. Proceedings of Eighteenth Annual Joint Conference of the IEEE Computer and Communications Societies. Volume: 1 pp. 3 - 11.

Thanks !