Comparison of Route Optimization and Reverse Routing for Mobile IP Over IPv4

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Roadmap

- Introduction
- Mobile IP Overview
- Implementation
- Results & Analysis
- Conclusion
- References
Introduction: Motivation

- Popularity of wireless communications and portable devices
- The Internet Engineering Task Force (IETF) introduced Mobile IP (MIP) to support mobile IP addresses
- Route Optimization in Mobile IP (ROMIP) - address efficiency
- Reverse Routing (RRMIP) - message simplification
Introduction: Project Objective

- Complete Route Optimization in NS-2 started by Leo Chen in Spring 2002
- Provide a quantitative efficiency evaluation between MIP and ROMIP
- Implement an alternate route optimization – Reverse Routing
- Compare performance between the two protocols
Mobile IP Overview

What is Mobile IP?

- Provides continuous Internet connectivity to the mobile user

- Terminologies:
  - *Home Agent (HA) / Foreign Agent (FA)*
  - *Mobile Host (MH)*
  - *Corresponding Host (CH)*
  - *Care-Of-Address (COA)*
Mobile IP Overview
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Mobile IP Overview

Problem: Triangle Routing

- MIP allows transparent inter-operation between MH and CH
- Indirect routing – non-efficient use of routing packets
MIP Overview: Route Optimization

- Binding Cache
  - Allow packets to be sent directly to the MH, bypassing the HA
  - Use 4 messages:
    - Binding Update (BU)
    - Binding Acknowledge (BA)
    - Binding Warning (BW)
    - Binding Request (BR)
MIP Overview: Route Optimization
MIP Overview: Route Optimization
MIP Overview: Route Optimization
Route Optimization: Smooth handoff

- Datagrams in flight to the MH are lost during a transition period between different FA’s
- MH informs the previous FA of the new MH address
- Creates a temporary binding cache to address in-flight packets
- MH needs to retransmit BU messages to the previous FA until a BA is received
MIP Overview: Smooth Handoff

[Diagram showing a network setup with notes and connections labeled as Internet, FA, and CH.]
MIP Overview: Smooth Handoff
MIP Overview: Smooth Handoff

binding update from HA
MIP Overview: Smooth Handoff
MIP Overview: Reverse Routing

Why Reverse Routing?
- ROMIP – complex protocol and inconsistent cache mobility binding
- Offers simplicity of MIP and direct routing of ROMIP

Overview
- MH sends new COA directly to the CH via a registration message
- CH router updates its routing table so that packets for MH are routed directly to the new COA
MIP Overview: Reverse Routing

Internet

CH

FA

HA
MIP Overview: Reverse Routing
MIP Overview: Reverse Routing
MIP Overview: Reverse Routing
MIP Overview: Reverse Routing
Implementation

- Installed NS 2.1b8 on Linux
- Got Leo’s implementation working
- Completed the Route Optimization protocol
  - Added Binding Request Handling
  - Added Binding Acknowledge Handling
  - Added smooth handoff
- Added Reverse Routing
- Upgraded to NS 2.26
Implementation

C++

Agent
- MIPBSAgent
- MIPMHAgent

Classifier
- MIPEncapsulator
- MIPDecapsulator

OTCL

Node
- MobileNode
- MIPBS
- MIPMH

Colors:
- Orange: Route Optimization
- Yellow: Reverse Routing
- Green: Both
Results & Analysis

Protocol performance of ROMIP vs. MIP

Average Delay (s)

Time (s)
Results & Analysis

Smooth handoff performance (compared to Leo’s)

Average Delay (s)

Time (s)
Results & Analysis

Reverse Routing performance graph

Average Delay (s)

Time (s)
Future Work

- Comparison of ROMIP/RRMI P with other approaches [7]
- Comparison of mobility support between IPv4 and IPv6
Conclusion

- ROMIP does offer better performance than MIP
- Smooth handoff offers smaller packet lost during ‘transition’ periods
- Reverse Routing does eliminate inefficiency of MIP and complexity of ROMIP
References


