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Explicit Proactive Handoff with Motion Prediction for Mobile IP

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Outline

- Introduction
- Motivations
- System Overview
- Handoff Process
- Movement Prediction Algorithm
- Performance Evaluation
- Conclusion and Future Work

Introduction

- **Problems of Mobile IP**
  - Large network-layer handoff latency
  - Handoff disruption
  - Link-layer and network-layer handoffs are coupled
- **Mobile nodes have patterns of movement**
  - Observation from studies on real wireless networks
  - Use the patterns to predict future behavior
- **Improve handoff performance**
  - Forwarding
  - Buffering
- **Related Work**
  - Reactive handoff
  - Proactive handoff

Motivations

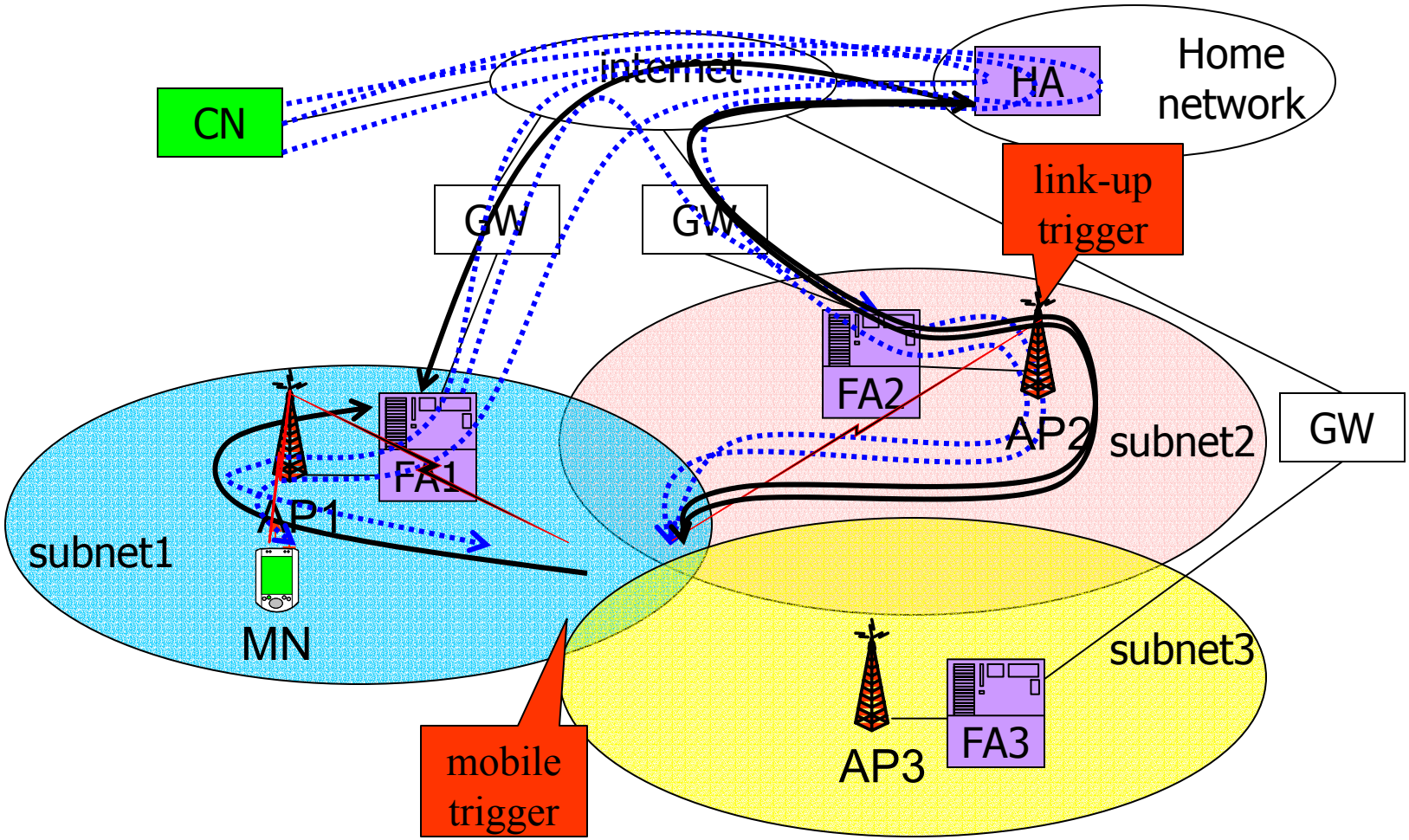
- **Improve handoff performance**
  - Prepare network-layer handoff in advance
  - Adjust individual handoff behavior dynamically to keep overhead low
  - Use patterns to predict future movements
- **Assist discovery of handoff target subnet**
  - No need to wait for beacon signals
  - For tough cases like
    - Overlapping coverage areas
    - Fluctuating wireless channel condition
- **Small modification to Mobile IP and link layer**
- **Only record and predict network-layer movement**
  - Simpler, more regular and predictable than geographic movement.
  - More applicable for subnets of different shapes and sizes.

System Overview

- **WLANs connected by wired IP backbone**
  - MIPv4 for mobility management
  - Link-layer mechanism for link-layer handoff
  - Proposed scheme to reduce handoff latency and packet loss
- **New capability and messages required**
  - L2 trigger: mobile trigger and link-up trigger
  - Beacon signals: also containing subnet ID and FA IP address
  - New messages: forwarding request and stop forwarding
- **Movement history recording**
  - By the MN, at the MN
  - FIFO movement history cache
  - Pattern database

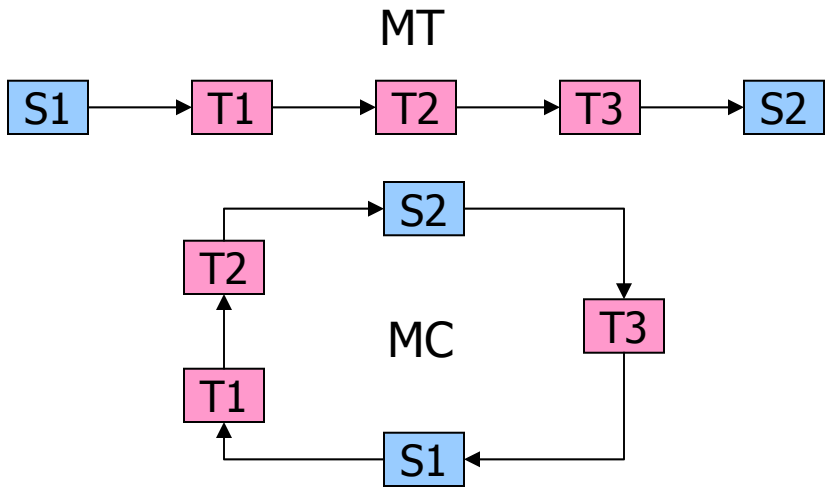
Movement history cache entry		
Time Stamp	Subnet ID	FA IP Address

Handoff Process



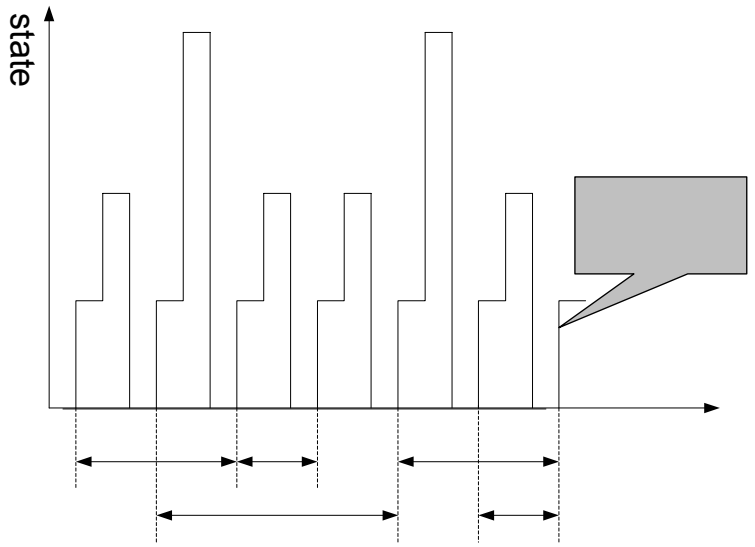
Movement Prediction Algorithm

- **Traditional mobility models not applicable**
  - Aggregate, not individual behavior
  - Models geographic movement
- **Improved Liu's motion prediction algorithm**
  - Correlate current movement with past movement
  - States
    - Stationary S
    - Transitional T
  - Movement track
  - Movement circle



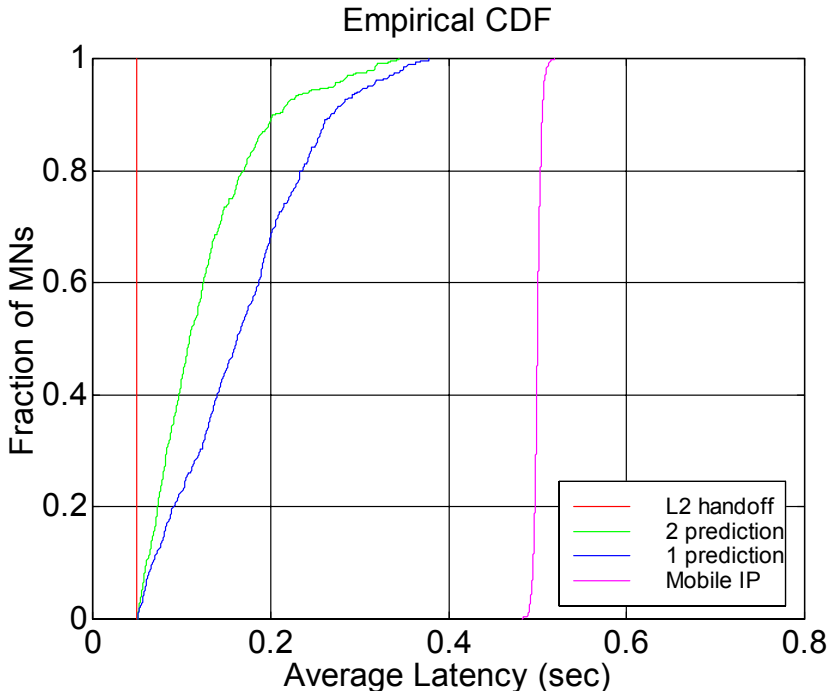
Movement Prediction Algorithm (cont'd)

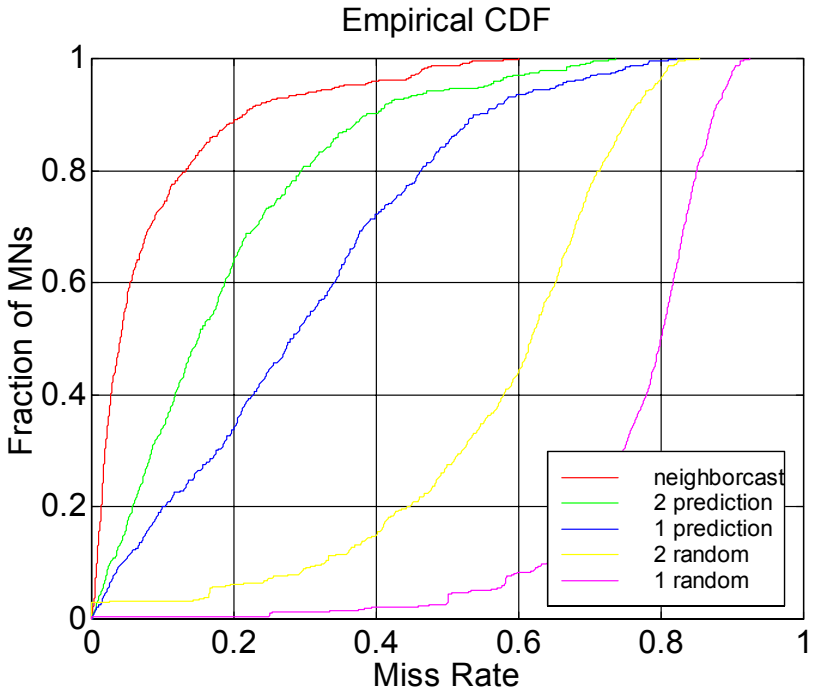
- **Sequence matching techniques**
  - State matching
  - Velocity matching
  - Occurrence matching
- **Algorithm work flow**
  - Enter a new state
  - Record movement in cache
  - State becomes stationary
  - Pattern discovery
  - Mobile trigger fires
  - Correlate sequence in cache with patterns in database
    - State matching
    - Velocity matching if multiple state match
    - Occurrence matching if multiple velocity match



Performance Evaluation

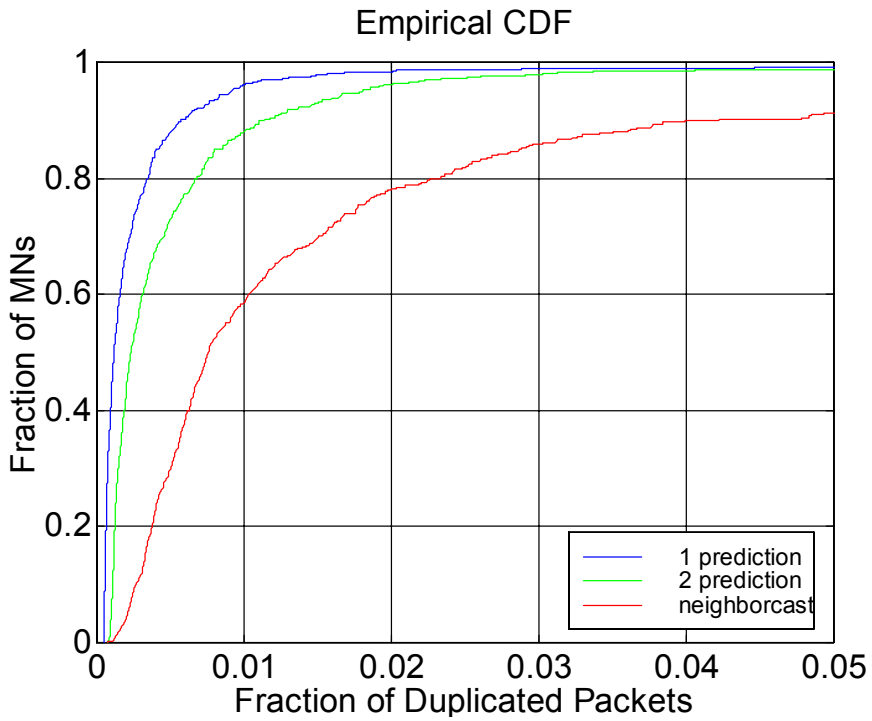
- **Scenario**
  - Real movement trace from Dartmouth College
  - Synthetic CBR traffic
- **Effectiveness**
  - Handoff latency
  - Prediction miss rate





Performance Evaluation (cont'd)

- **Efficiency**
  - # of duplicated packets



Conclusion and Future Work

- **Explicit proactive handoff**
  - Anticipate handoff by L2 trigger, prepare handoff in advance
  - Capture past movement patterns
  - Predict future movements
  - Handoff latency and packet loss reduced
  - Less overhead than other proactive schemes
  - Fully distributed, small modification to current infrastructure
- **Future work**
  - Use other traces
  - Application in multi-tier wireless networks
  - Enforce QoS in handoffs
  - Adaptation in MIPv6

Thank you.

For more information

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