ITU-T Kaleidoscope Conference
Innovations in NGN

A Study on Fast MMD Session Control Methods in 3G mobile communications

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Outline

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1. Research Background
2. MMD (MultiMedia Domain) Overview
3. Problems of MMD Session Sequence
4. Proposal of MMD Session Fast Control Methods
5. Implementation and Evaluation
6. Summary

Research Background

- NGN attracts attention for providing high advanced network services
  - Integration of fixed and mobile networks
  - Service Example: VoIP, IPTV
- IMS/MMD have been gating importance as the key technologies of NGN
  - Platform for providing multimedia services over IP network
  - IMS and MMD have almost the same architectures

Features of MMD

- Functions for providing multimedia services
  - QoS Control Function
  - Flexible Accounting according to contents
  - Easy Integration with third party services
- Communication Management
  - Session Management: SIP
    - Call Control such as calling, establishment of communication between terminals.
  - Mobility Management: Mobile IP
    - Ensure reachability of mobile terminals

These are called "Session Control" in this presentation

Simple MMD Network Architecture

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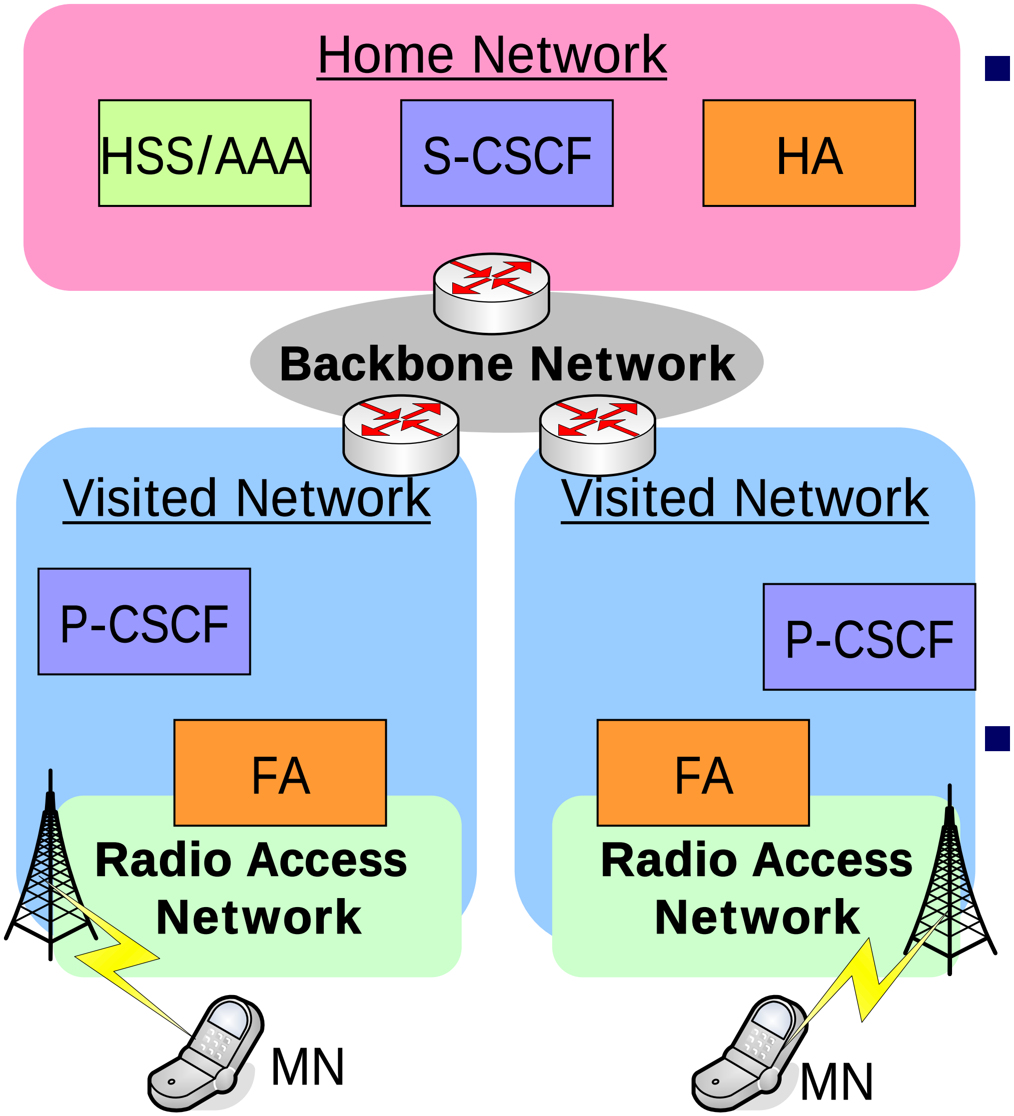

- Network Configuration
  - Home Network (HN)
    - Core Network
  - Visited Network (VN)
    - There are some VNs depending on Access media and Areas
  - There are network delays in Backbone and Radio Access Network
- Session Control Nodes
  - SIP: S(/I)-CSCF, P-CSCF
    - Distributed P-CSCF
  - Mobile IP: HA, FA
  - Authentication: HSS/AAA

Sequence Overview of Basic Mobile IP/SIP

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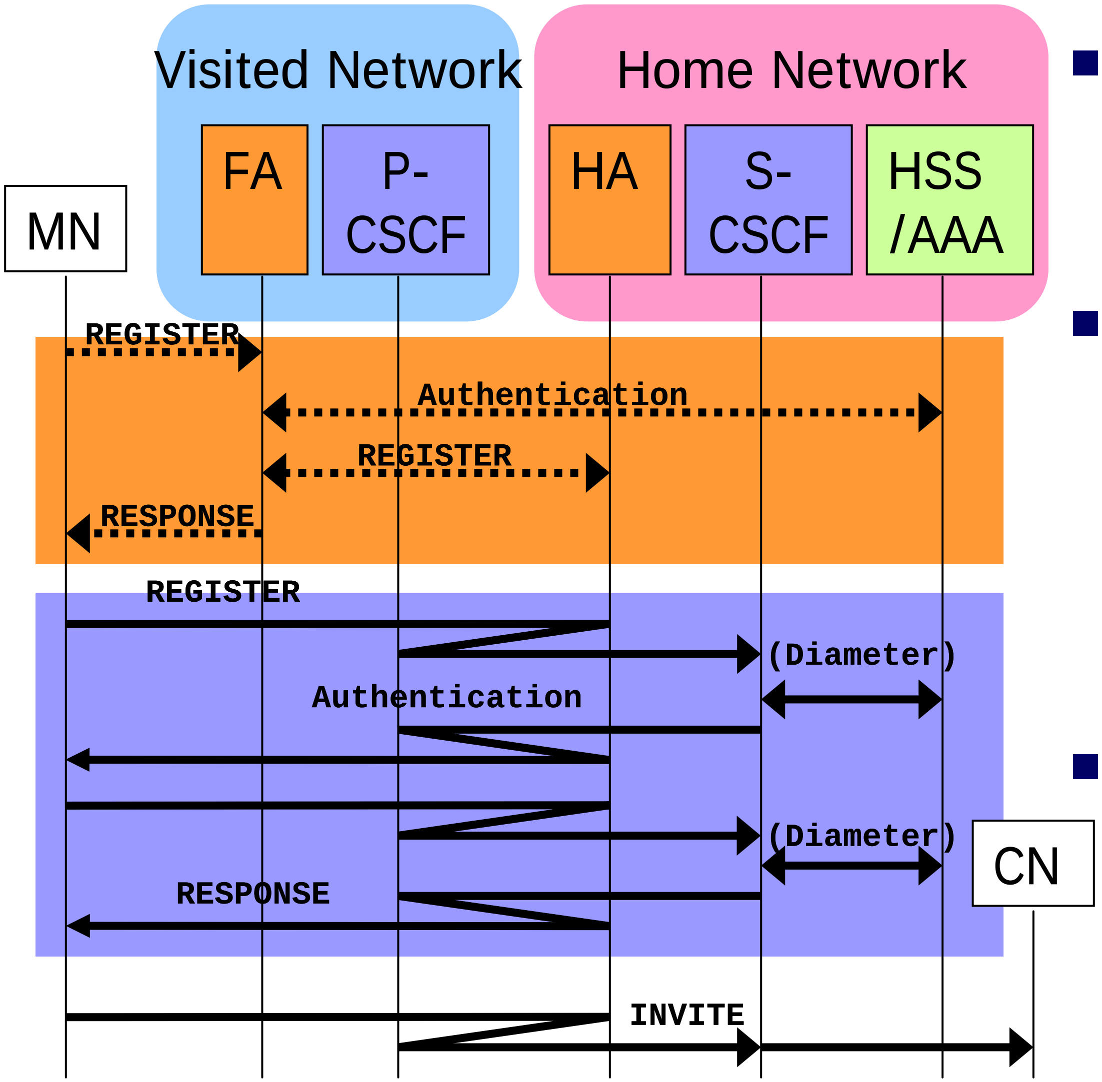

- Reachability of Mobile host is ensured after Mobile IP registration
- Call Control becomes available after SIP Registration
  - Establishment of IPSec Connection and Gate Open
- Both Registrations are needed for being provided with MMD Service

Problems of MMD Session Control

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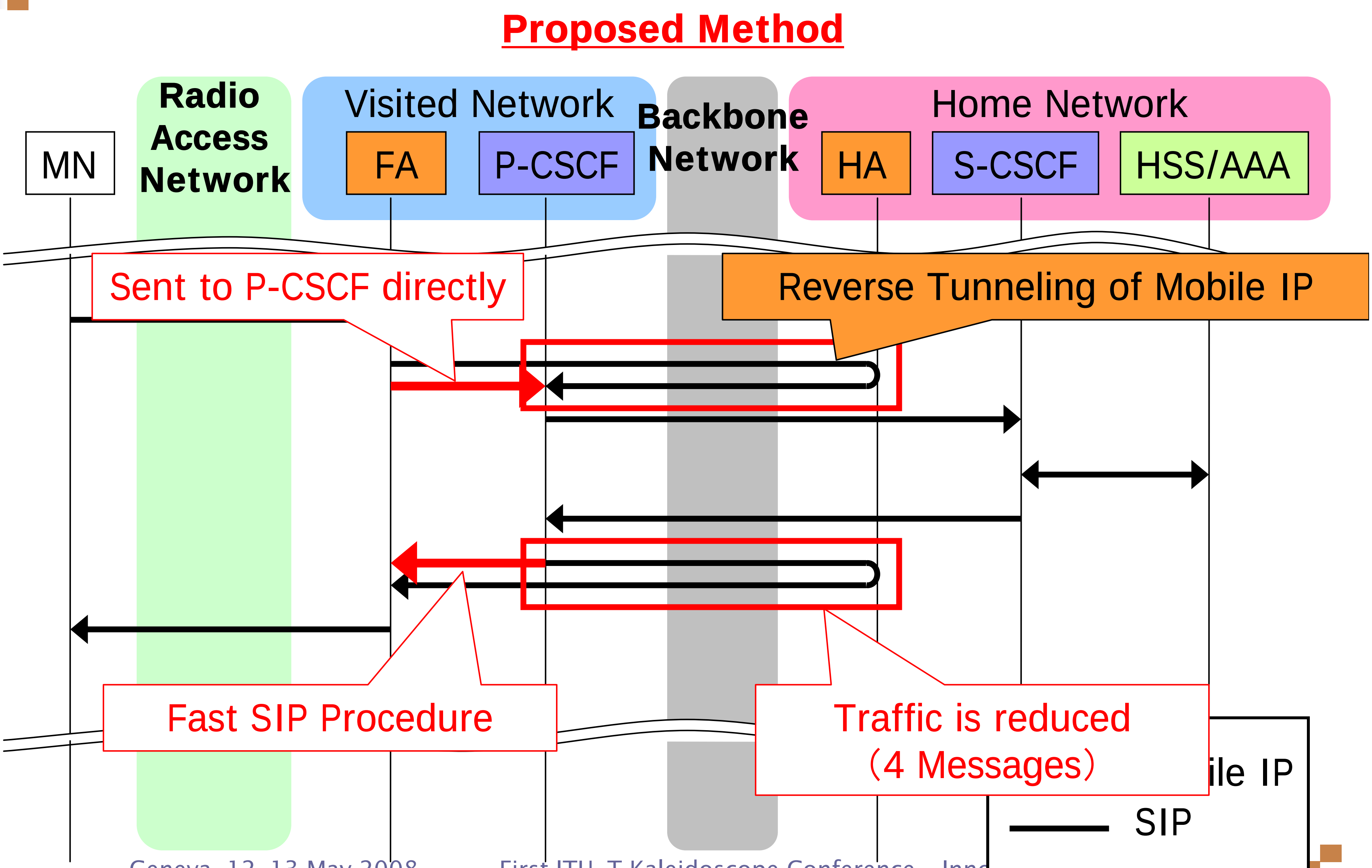
- Fast Session Control is needed
  - Voice Data is blocked until session control is finished when handover occurs
  - Mobile IP and SIP are effective, respectively
- Redundancy caused by Independent Procedures of Mobile IP and SIP
  - Redundant Route
    - SIP messages within a VN are routed through a HA
  - Similar Procedure
    - Sequential Registration of Mobile IP and SIP
    - Individual authentication of Mobile IP and SIP

We propose Collaborative Methods between Mobile IP and SIP

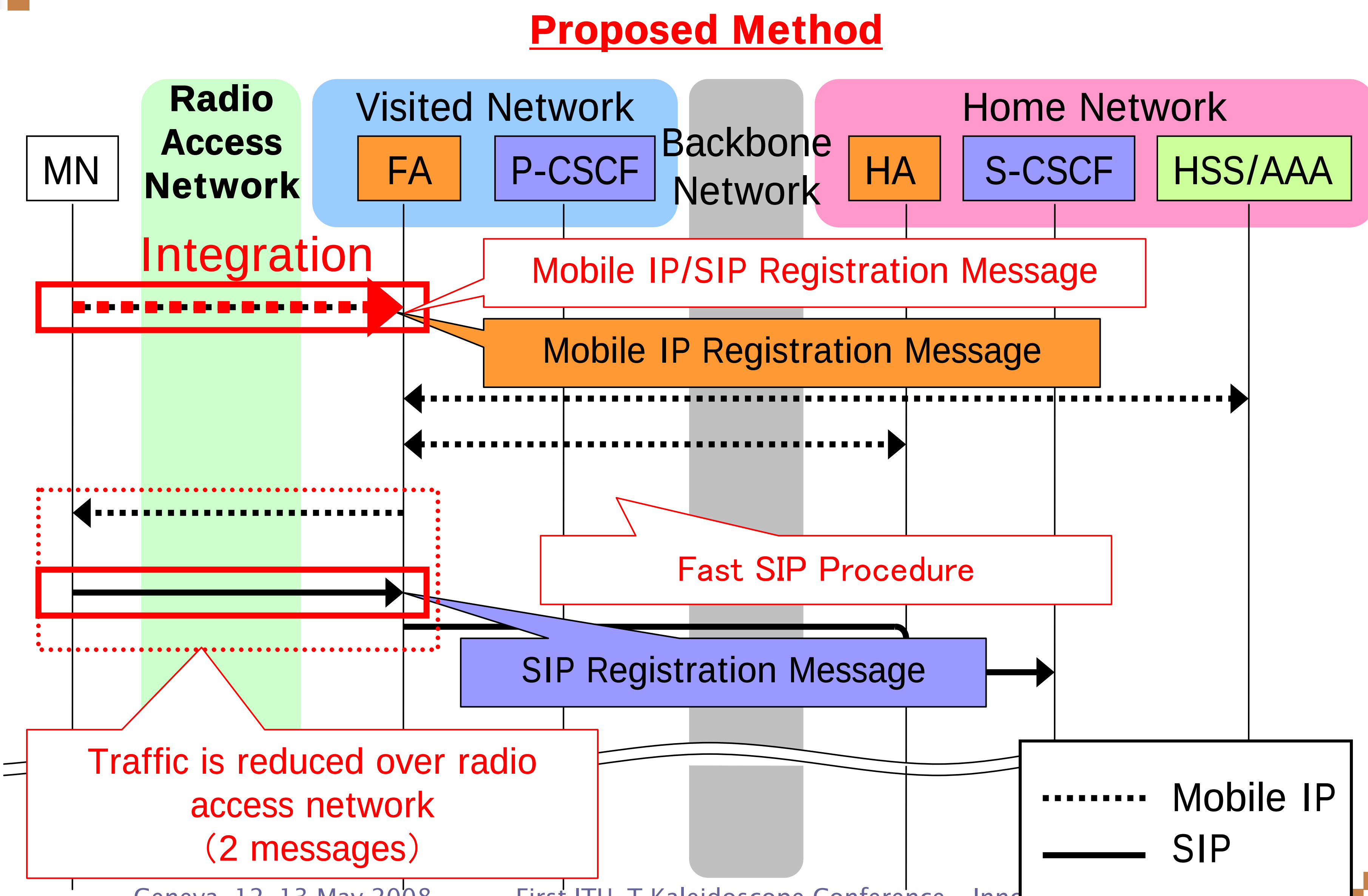
Proposed Methods

- Method1: Selective Reverse Tunneling
  - Optimization of route of SIP Message
- Method2 : PiggyBacking
  - Optimization of a number of Control Messages
- Method3: Collaborative Authentication
  - Optimization of Authentication Procedure without reducing the level of security
- Method4: Integrated Method
  - Integration of the above three methods

Method1 : Selective Reverse Tunneling



Method2 : PiggyBacking



Method3 : Collaborative Authentication

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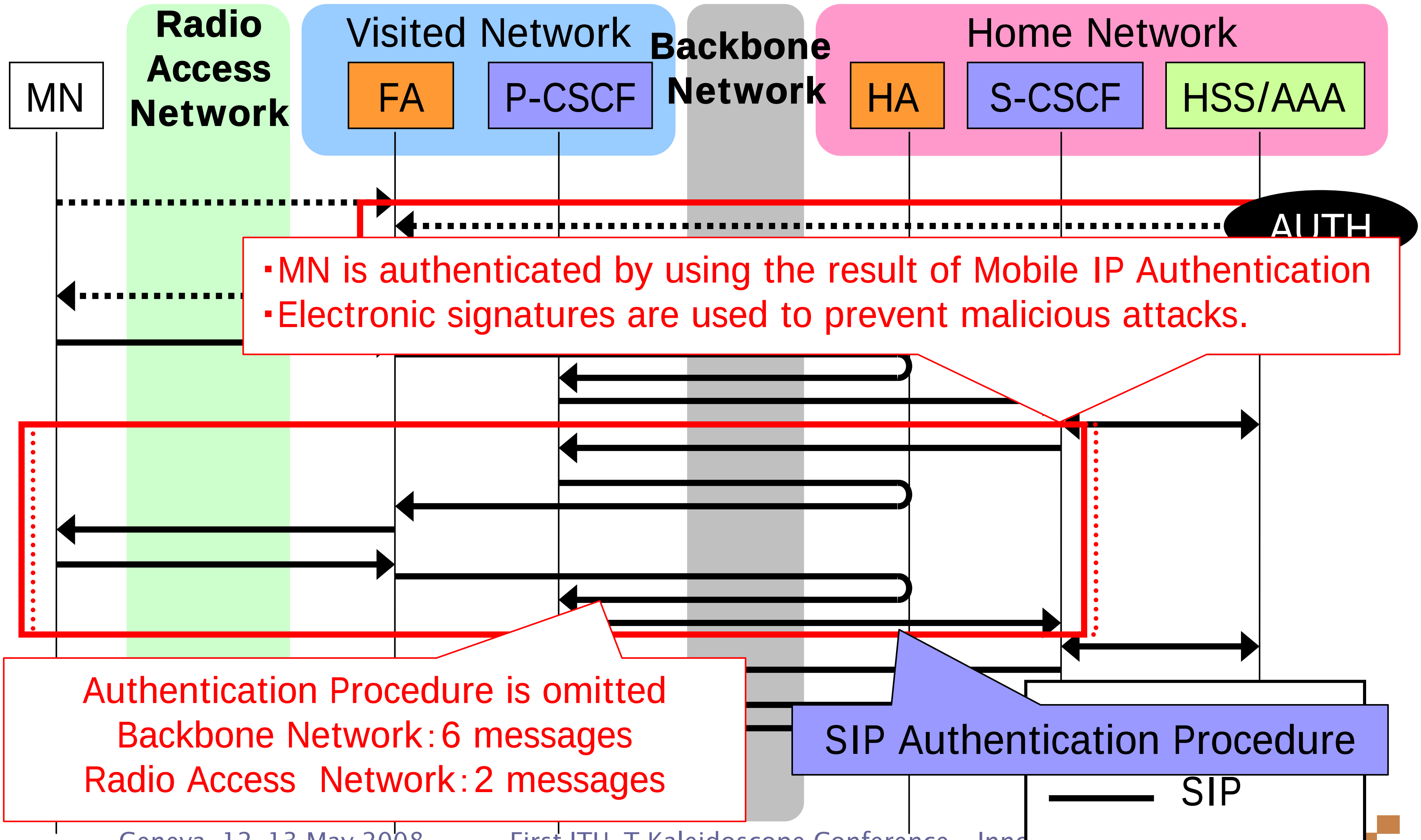
Proposed Method



Method4 : Integrated Method

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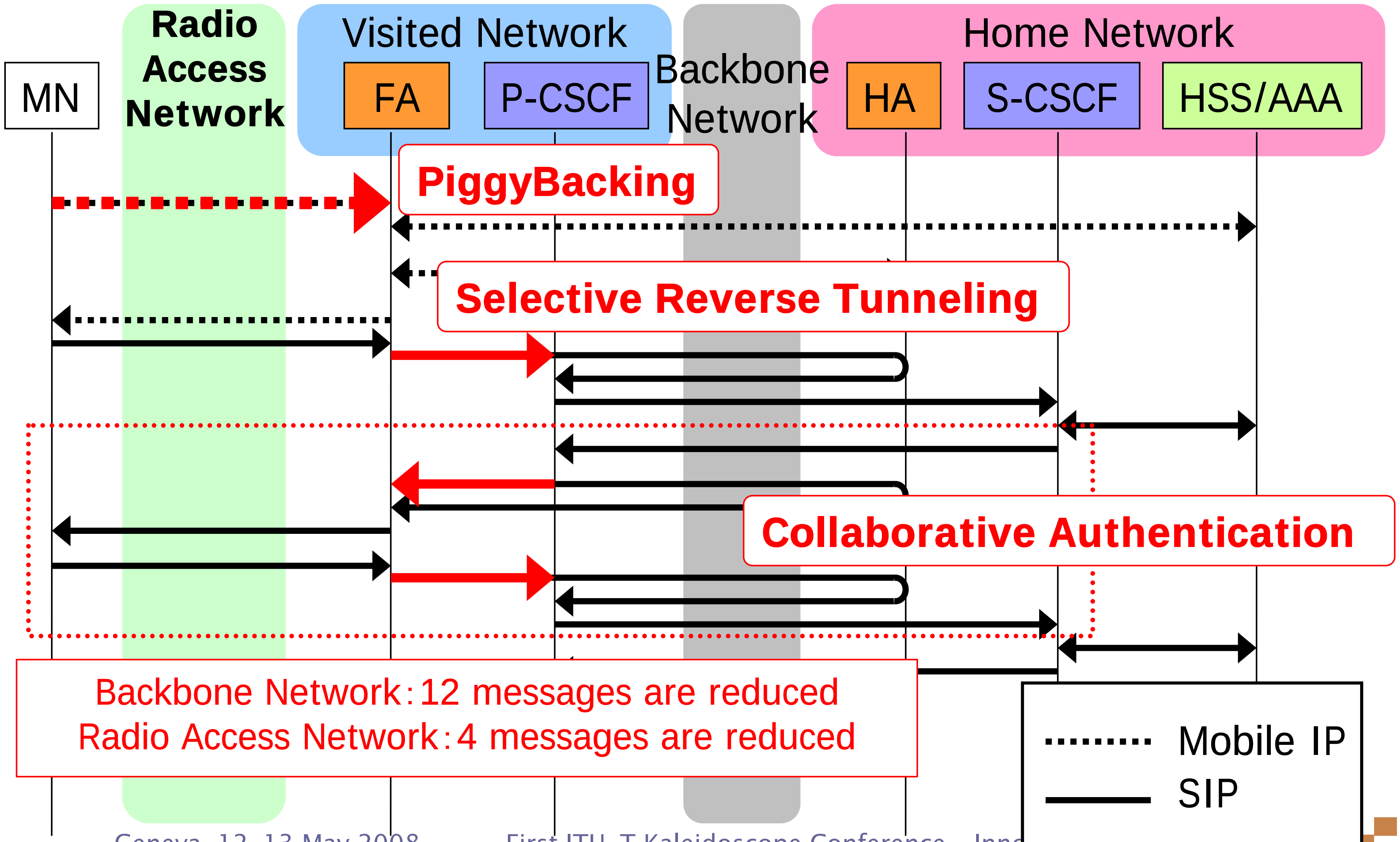
Proposed Method



Implementation

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- Experimental MMD Network Configuration
  - 1 HN and 3 VNs
    - VNs: 2 radio access networks, 1 fixed network
    - RAN Emulators and delay generators
  - Mobile IP and SIP Constituent Nodes

- Specifications of Nodes
  - Hardware: General PCs
    - Pentium4: 2.8GHz, Memory: 2GB, OS: Fedora Core 3
      - Partly, FreeBSD 5.5-RELEASE
  - Software: Free Programs and Our original Programs
    - SIP Client: Sip Communicator
    - DB: MySQL
    - Mobile IP: dynamics

Experimental MMD Network Configuration

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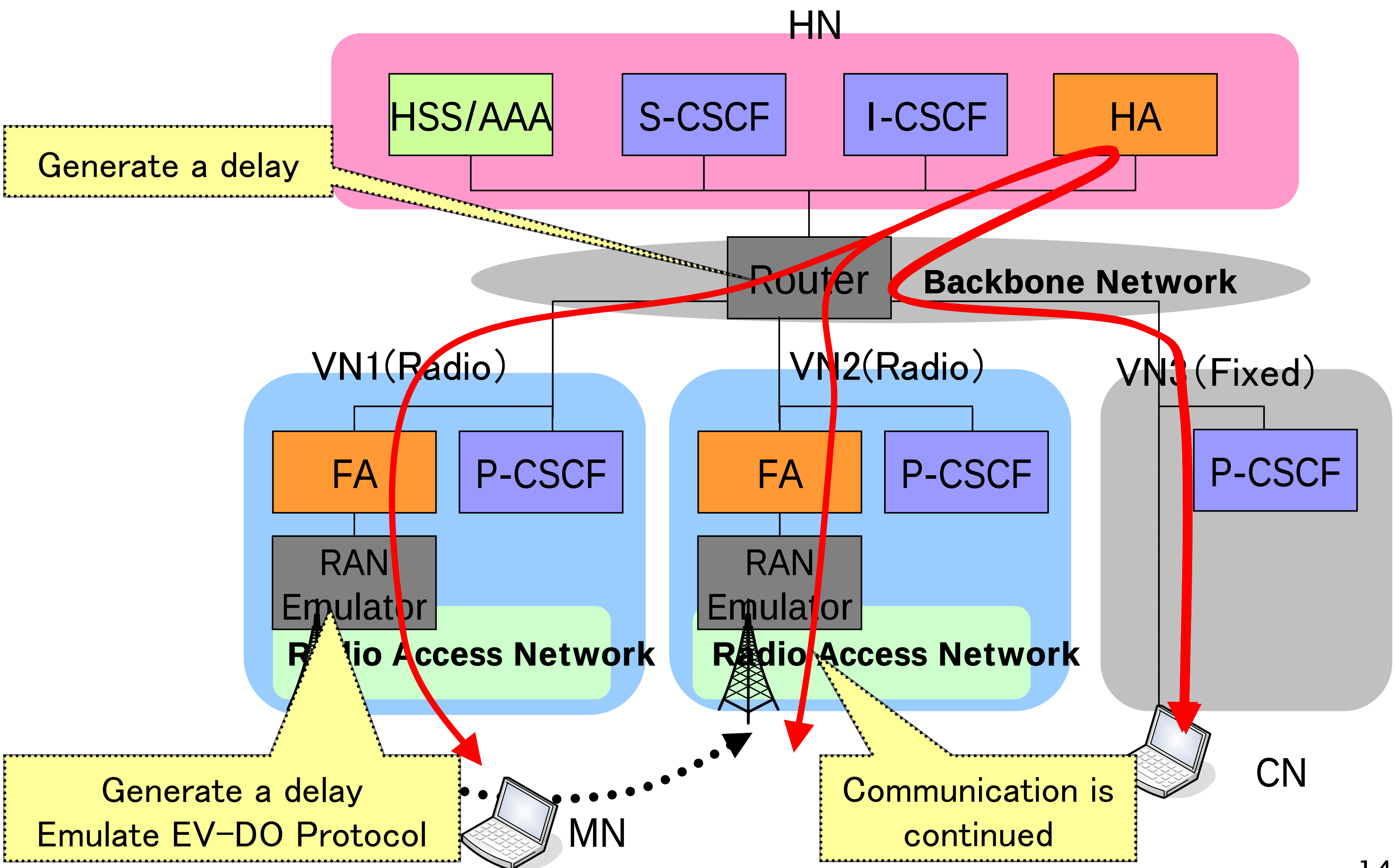

Evaluation

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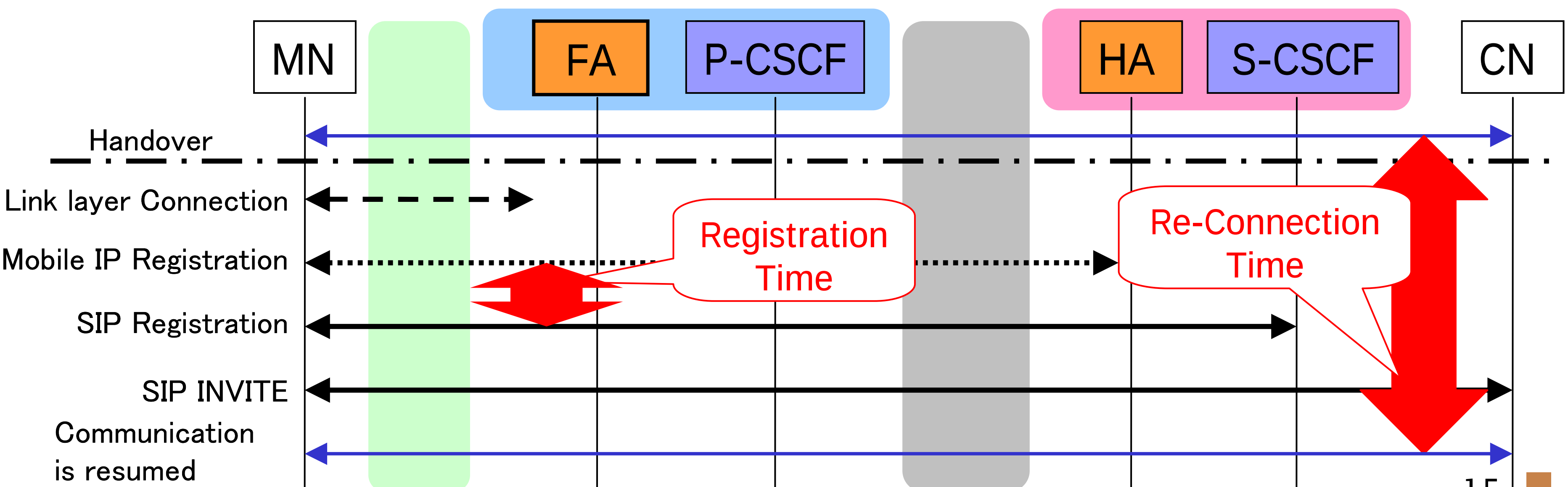
- Evaluation Methods
  - Mode1: Baseline Sequence
  - Mode2: Collaborative Authentication
  - Mode3: Integrated Method
- Evaluation Index
  - Registration Time: Time required for Mobile IP and SIP registration
  - Re-Connection Time: Interrupting time while handover



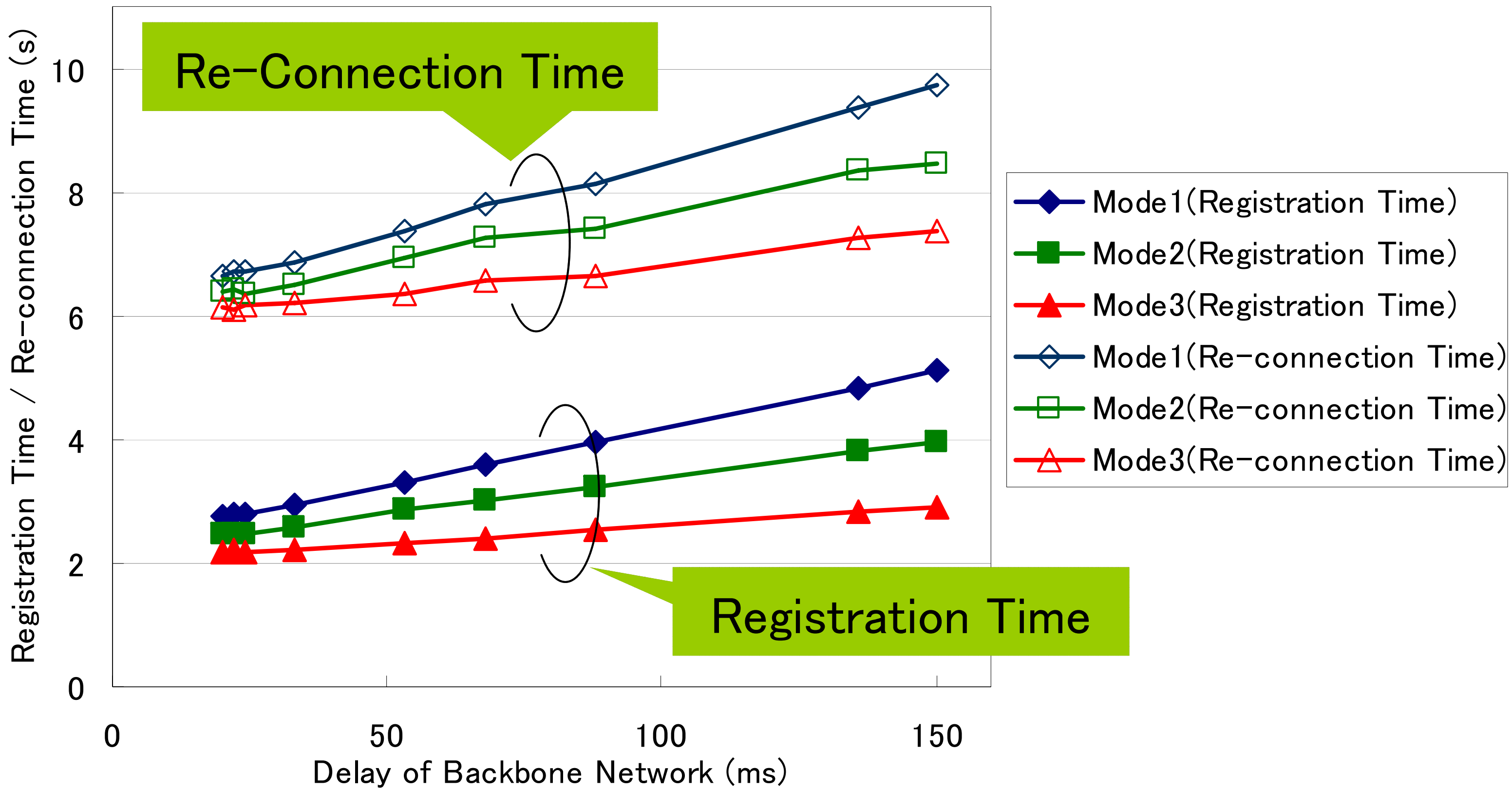
Measurement Methods

- Measurement Procedure
  - MN communicates with CN using VoIP, then move to other VN, and resumes the communication
  - Calculates Registration Time and Re-Connection Time based on times of captured packets
- Change of delay
  - The delay of the backbone network is calculated on the basis of ITU-T Y.1541
  - The delay of the radio access network comes from ITU-T G.114

	Delay of Backbone Network	Delay of Radio Access Network
Delay Pattern1	20,22,24,33,53,68, 88,136,150ms	80ms fixed
Delay Pattern2	24ms fixed	40,80,110,220ms

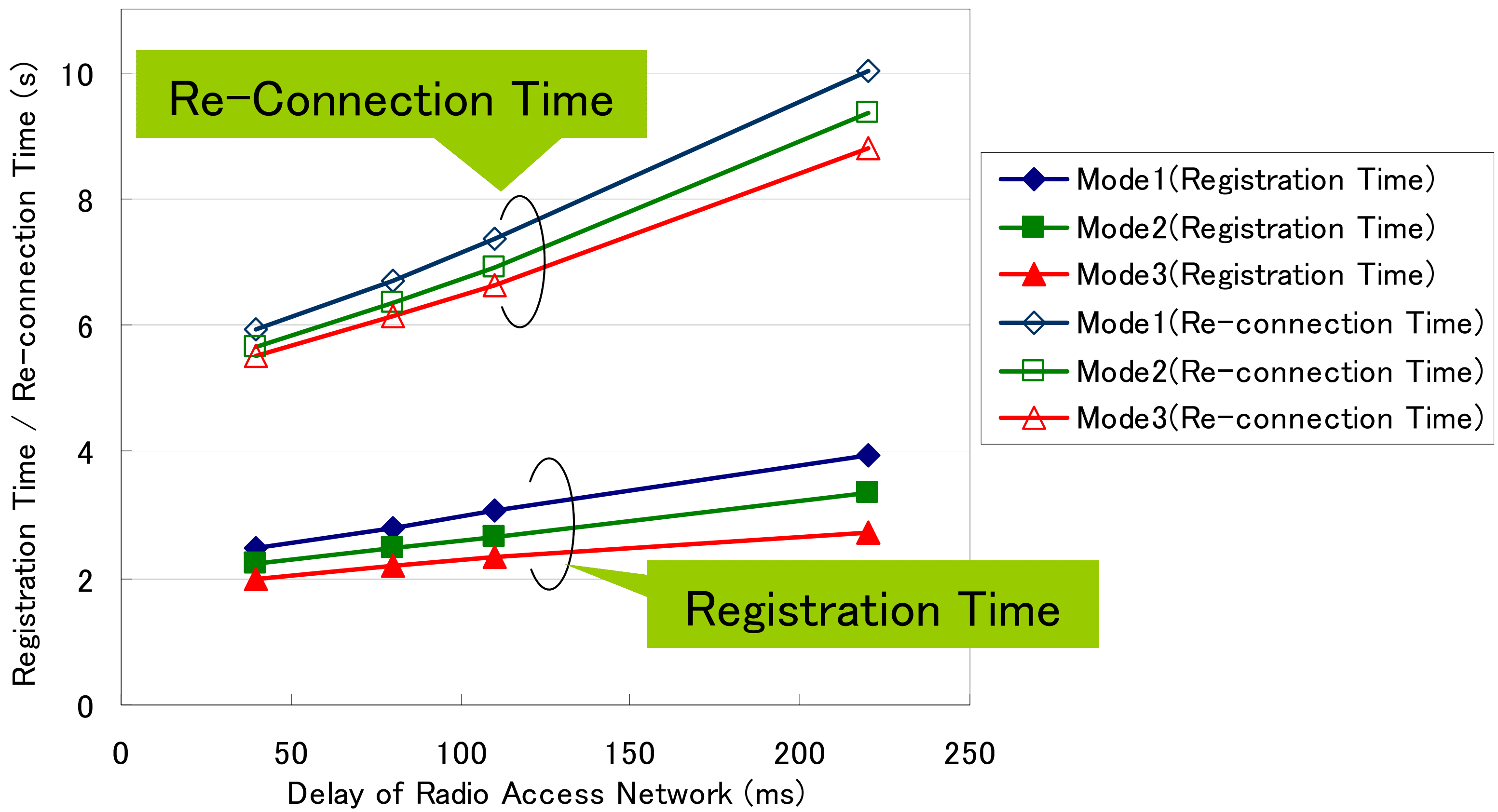
Result(1/2)

- Registration Time and Re-Connection Time for Delay Pattern 1



Result(2/2)

- Registration Time and Re-Connection Time for Delay Pattern 2
  - The result follows a similar pattern to the result of Delay Pattern 1



Estimated and Observed Values(1/2)

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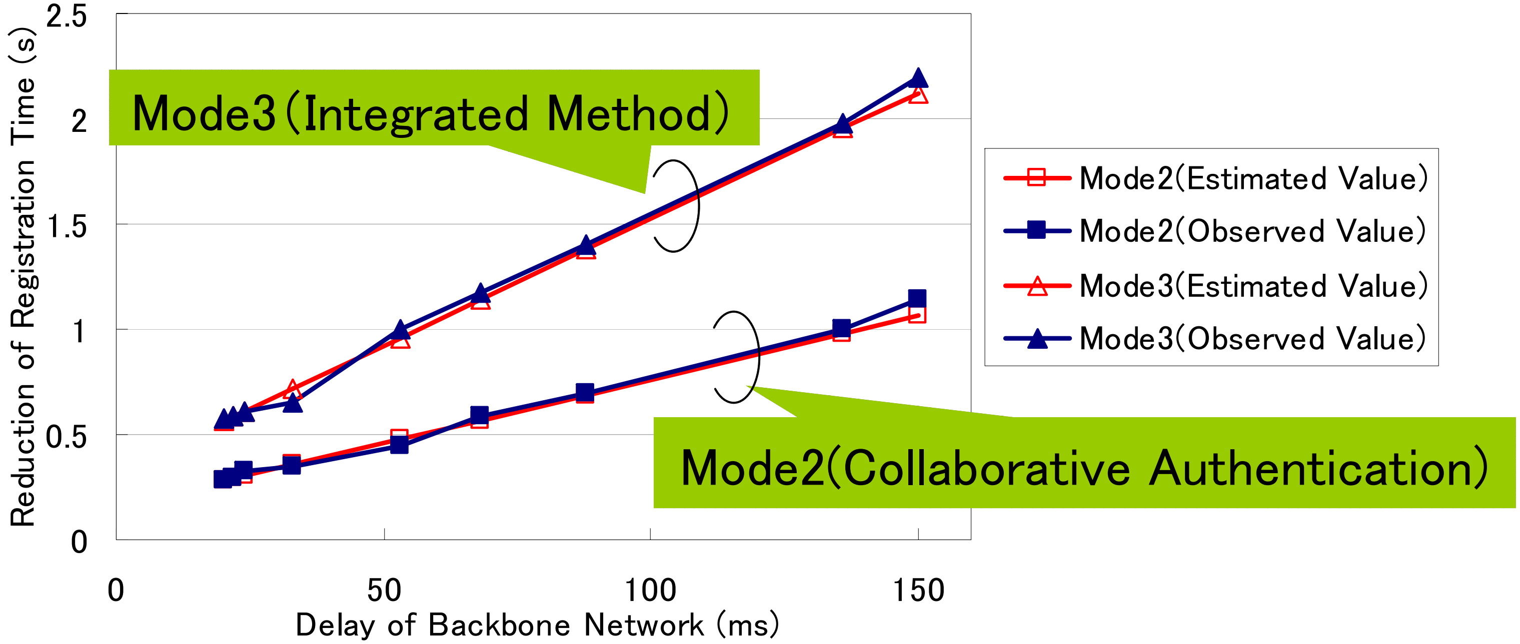
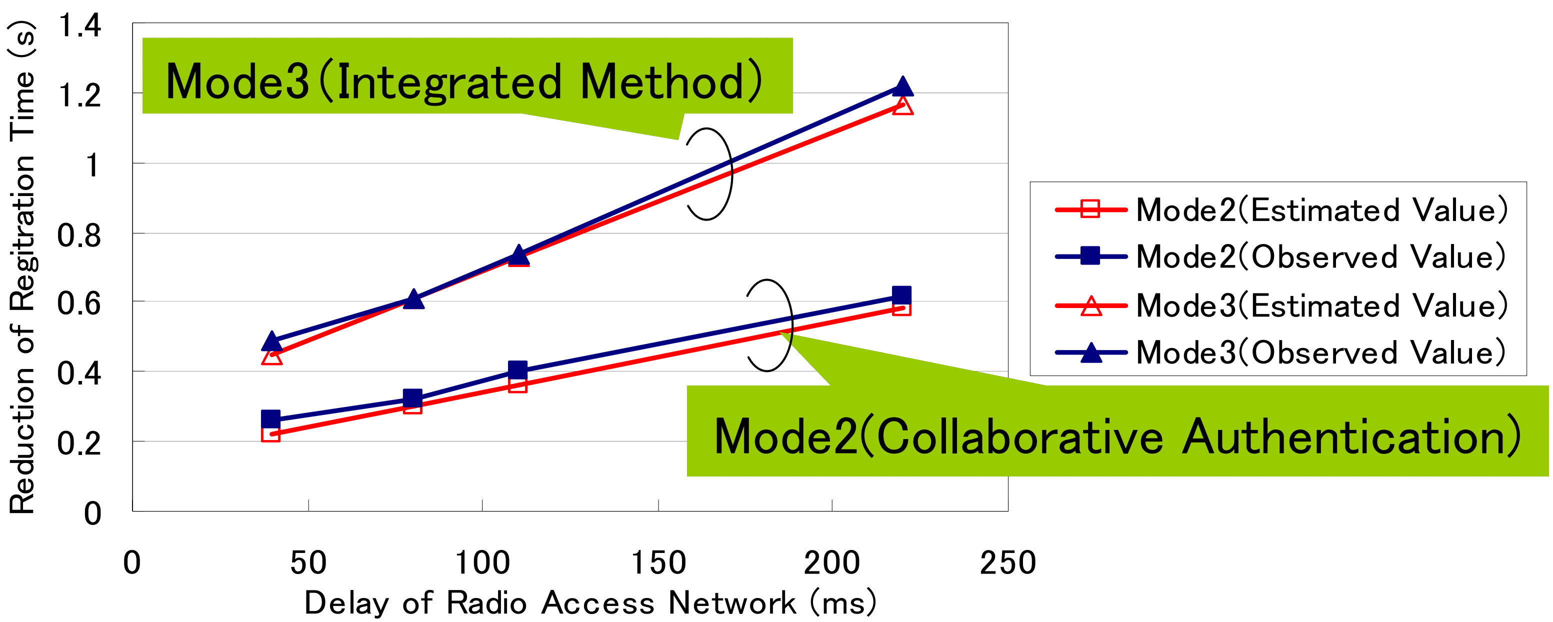
- Estimated Value of Reduction of Registration Time for Delay Pattern1



- Observed values are about 50 ms smaller than estimated values
  - The amount of process at each node is reduced by reduction of messages

Estimated and Observed Values(2 / 2)

- Estimated Value of Reduction of Registration Time for Delay Pattern2
  - The result follows a similar pattern to the result of Delay Pattern 1



Improvement of Re-Connection Time

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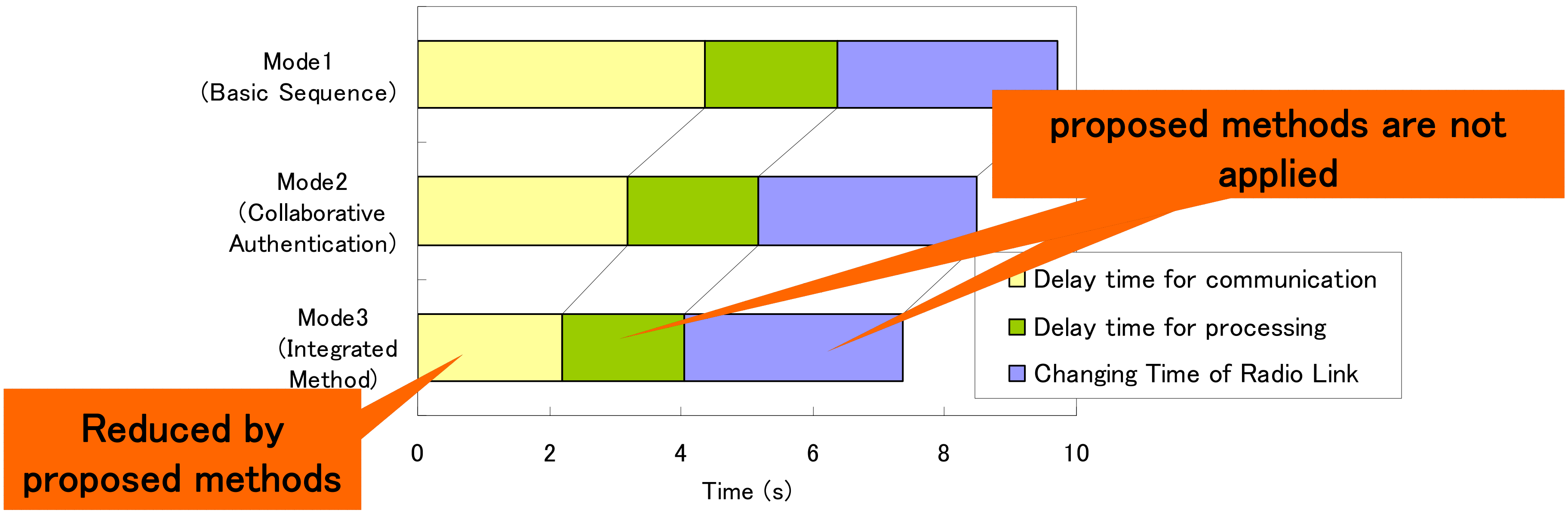
- The result of Experiment is not enough
  - 7 sec is still taken for re-connection in Mode 3
    - Delay of Backbone network: 150ms
    - Delay of Radio Access Network: 80ms



- Time is taken for processes to which proposed methods are not applied

Summary

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- IMS/MMD are the key technologies of NGN
  - There is redundancy caused by individual procedures of Mobile IP and SIP
- Fast Session Control Methods are proposed based on collaboration between Mobile IP and SIP
  - Selective Reverse Tunneling, PiggyBacking, Collaborative Authentication, Integrated Method
- Effectiveness of proposed methods are verified by measurement and evaluation using real machines
  - The fast methods for other processes are needed

Thank you for your attention

Estimated Value of Time Reduction

$$D_{back} \times N_{back} + D_{access} \times N_{access}$$

- D_{back} : Delay of Backbone Network
- N_{back} : A number of messages reduced over Backbone network
- D_{access} : Delay of Radio Access Network
- N_{access} : A number of messages reduced over Radio Access Network