Quality-of-Service Support for Mobile Users using NSIS

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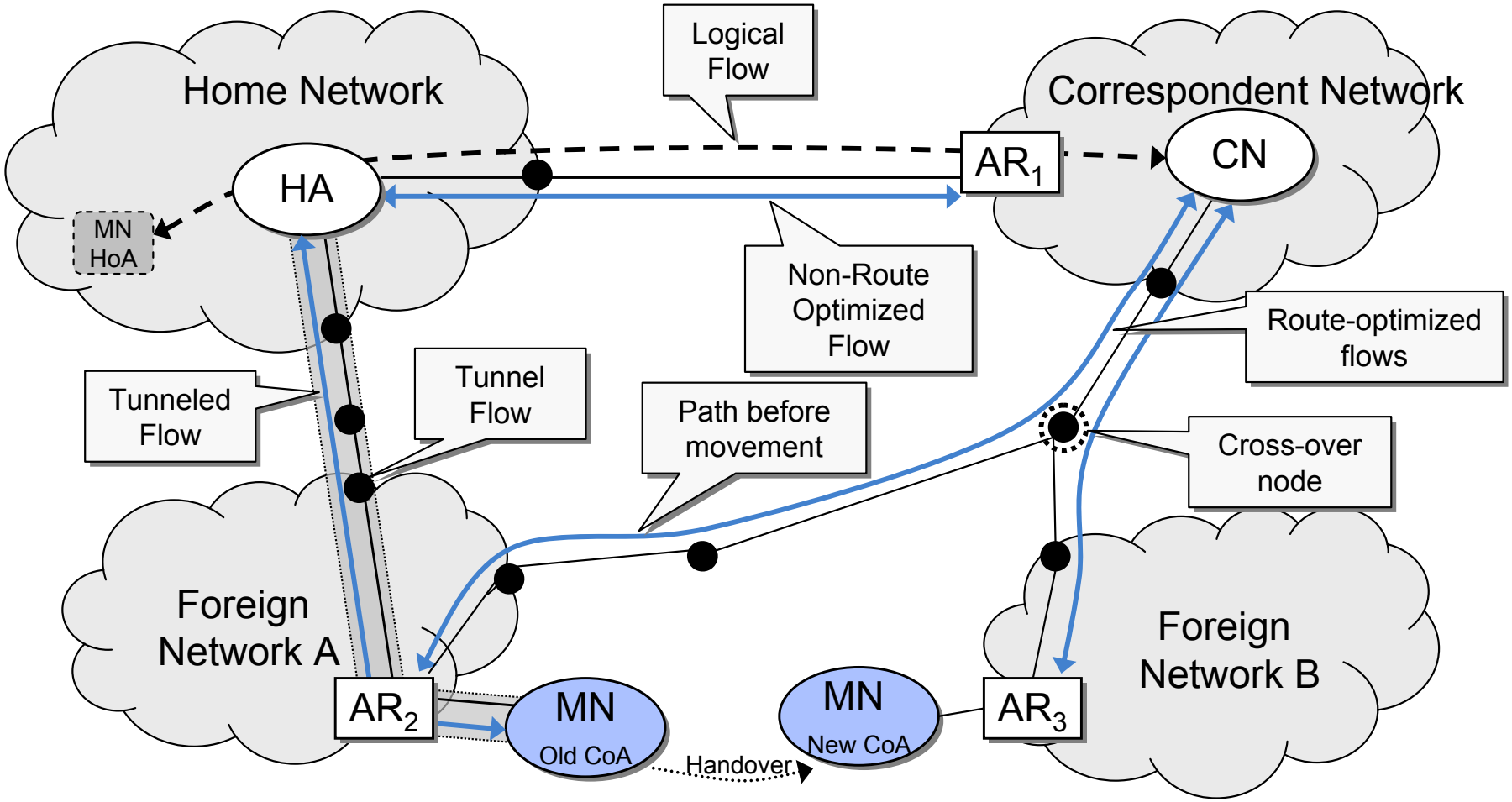
Motivation

- More and more resource demanding Internet applications and multimedia streams
  - video broadcasts, Voice-over-IP, IPTV
- Inherent need for Quality-of-Service guarantees
  - across administrative domains
  - signaling protocol needed → RSVP, NSIS
    - lacking mobility support of earlier signaling protocols like RSVP
- Increasing popularity of mobile Internet devices
  - Laptops, mobile phones (iPhone), PDAs
  - MobileIP allows for mobility in IP-based networks
    - adjusts data path transparently
- Goal: Enable Quality-of-Service in mobile environments

Main Challenges

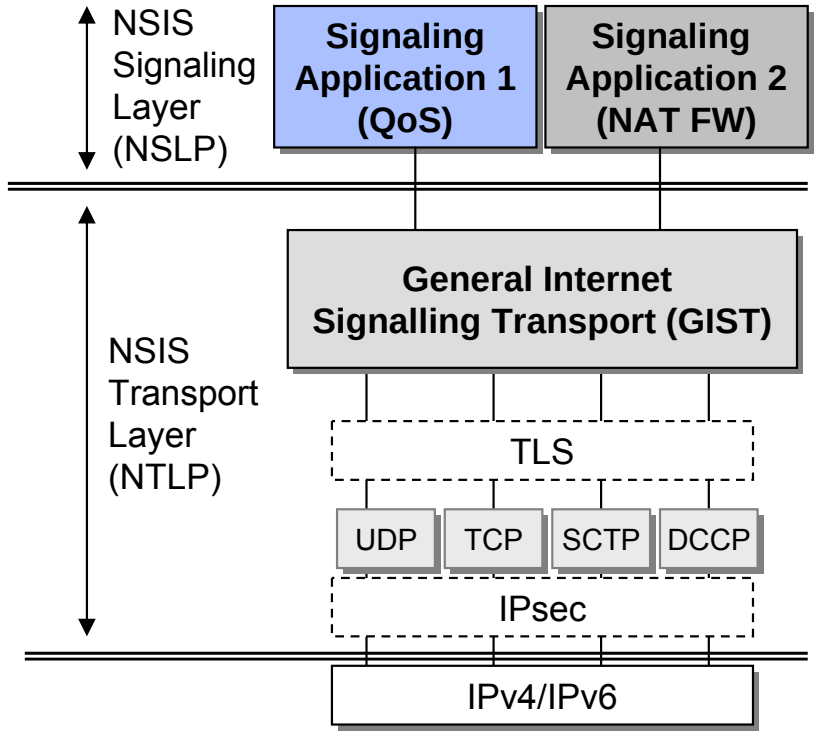
- Resource reservations need to be setup on the new path
  - as quickly as possible
  - by using same/adapted QoS parameters
  - release resource reservations on old path
- Tight interworking needed between mobility management and signaling protocol
  - QoS signaling should work seamlessly with handovers across access nodes

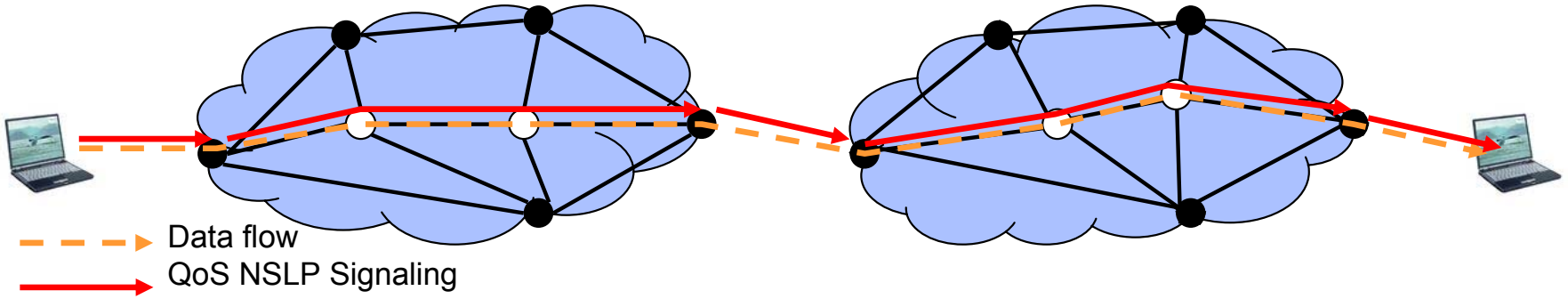
MobileIP – Overview



Next Steps in Signaling – Overview

- Two-layer approach
  - QoS NSLP
  - NTLP, i.e. GIST
    - path-coupled signaling
    - signaling node discovery
    - message transport (unreliable, reliable, secure)





Problems

- NSIS protocol suite provides
  - Basic mobility support: Session-ID remains constant even if a flow's addresses change
  - Re-establishment of a reservation along a new path
- Main problems to solve
  - get triggers from mobility events
  - get the current addressing information
  - provide internal interfaces required to provide the necessary information
- Solution focuses on MobileIPv6 as mobility management solution

Mobility Scenarios

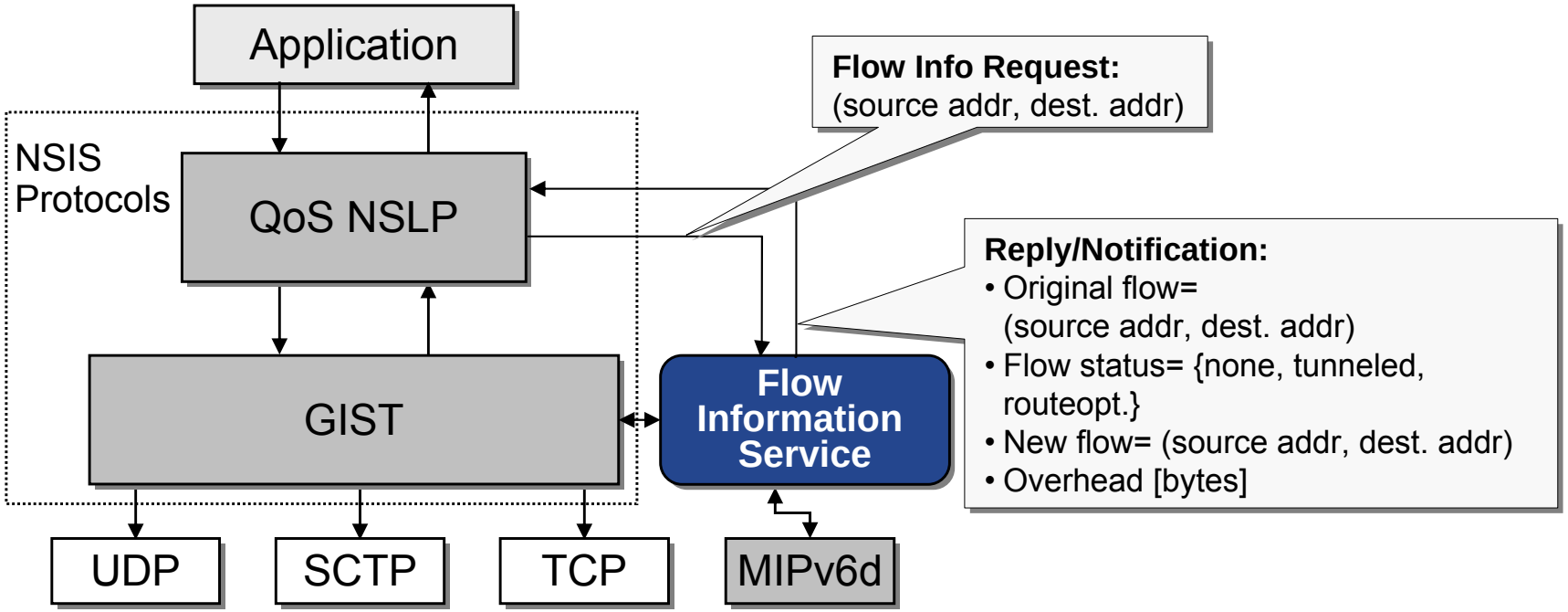
- Mobile node is sender and initiator/responder
  - mobility events may trigger QoS NSLP actions
    - emit new RESERVE or QUERY message
    - QSPEC may be adapted, constant Session ID
- Mobile node is receiver and initiator/responder
  - difficult to notify sender (CN), i.e. to signal in upstream direction
    - path not known in advance
    - difficult to determine cross-over node
  - flow address may change
    - profile in first-hop router must be updated at sender side
  - available QoS at new Access Router may differ
    - re-negotiation along whole path required

Solutions to Mobility Problems

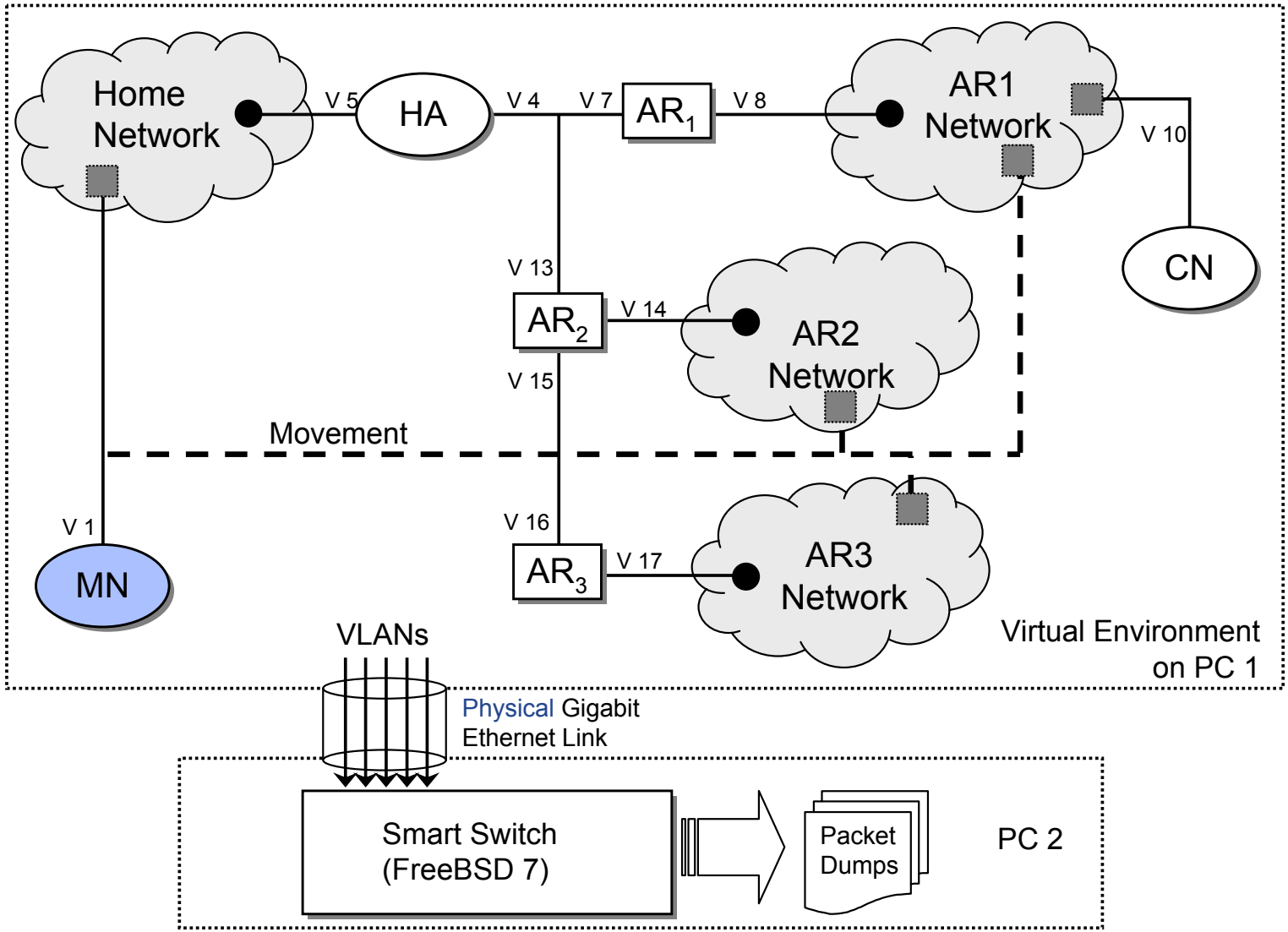
- Mobility-aware applications (e.g., SIP) could provide the necessary triggers
- Assumption: MobileIPv6 as mobility management protocol
  - Provides transparent support for transport protocols/applications
- Flow descriptor in QoS NSLP requires knowledge of current Care-of Address
  - contradicts use of Mobile IP that hides mobility
- Mobility is not transparent to QoS NSLP, e.g., must also consider
  - overhead added by MobileIP for QoS reservations (additional headers)
  - source address selection
- Main problem: notification of mobility events to QoS NSLP

FlowInfoService Module

- New approach: add FlowInfoService module
  - allows to request information about flows, e.g., current care-of-addresses, sizes of additional headers
- must get updates if addresses change



Evaluation – Setup



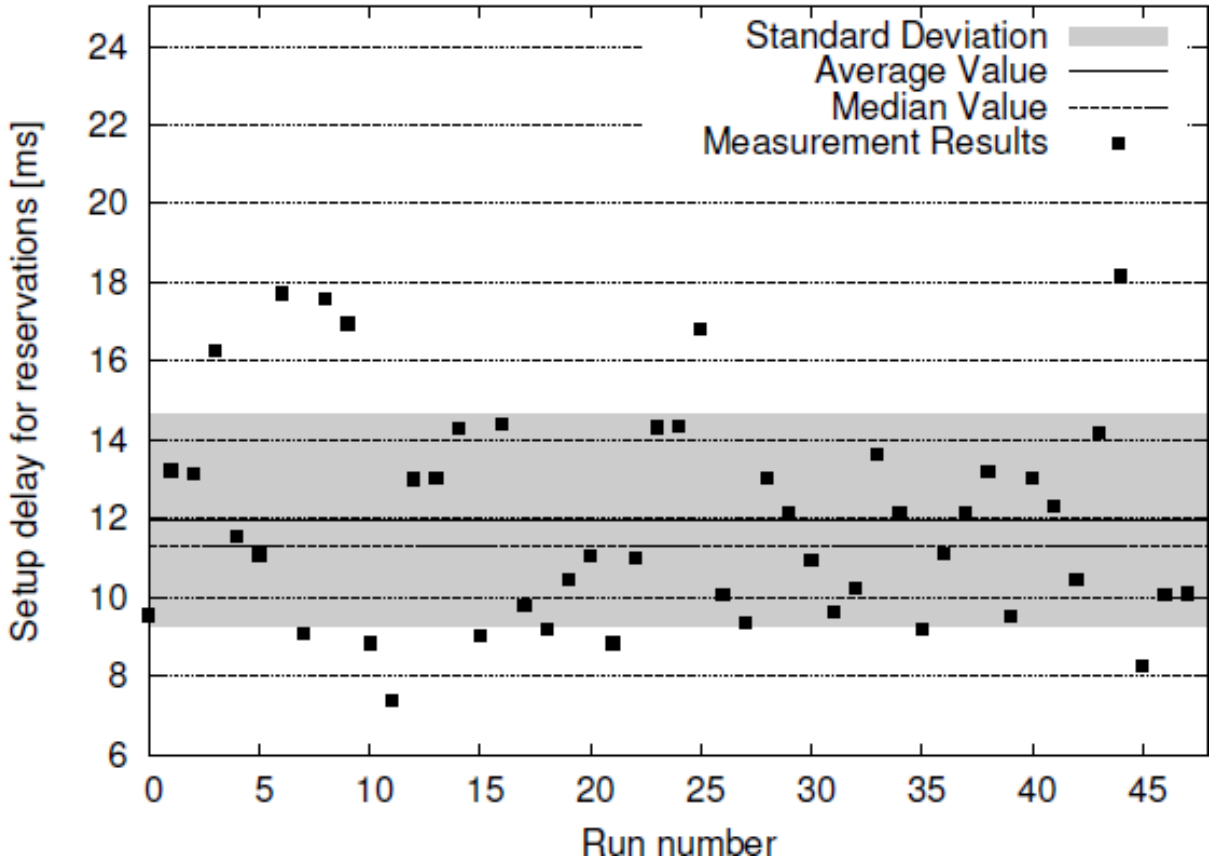
Evaluation – Performance Benchmarks I

- 50 consecutive movements of the MN between AR3 to AR2 to AR1 and back
- Reservation setup and tear down of old path

Testcase	AR1 Setup	AR2 Setup	AR3 Setup	Tear down
MN sender, sender-initiated	11.8 ms	26.9 ms	37.5 ms	20600 ms
CN sender, sender-initiated	13.3 ms	27.4 ms	40.3 ms	26.8 ms
MN sender, receiver-initiated	11.3 ms	29.0 ms	43.1 ms	28.0 ms
CN sender, receiver-initiated	12.5 ms	33.4 ms	42.2 ms	31.9 ms

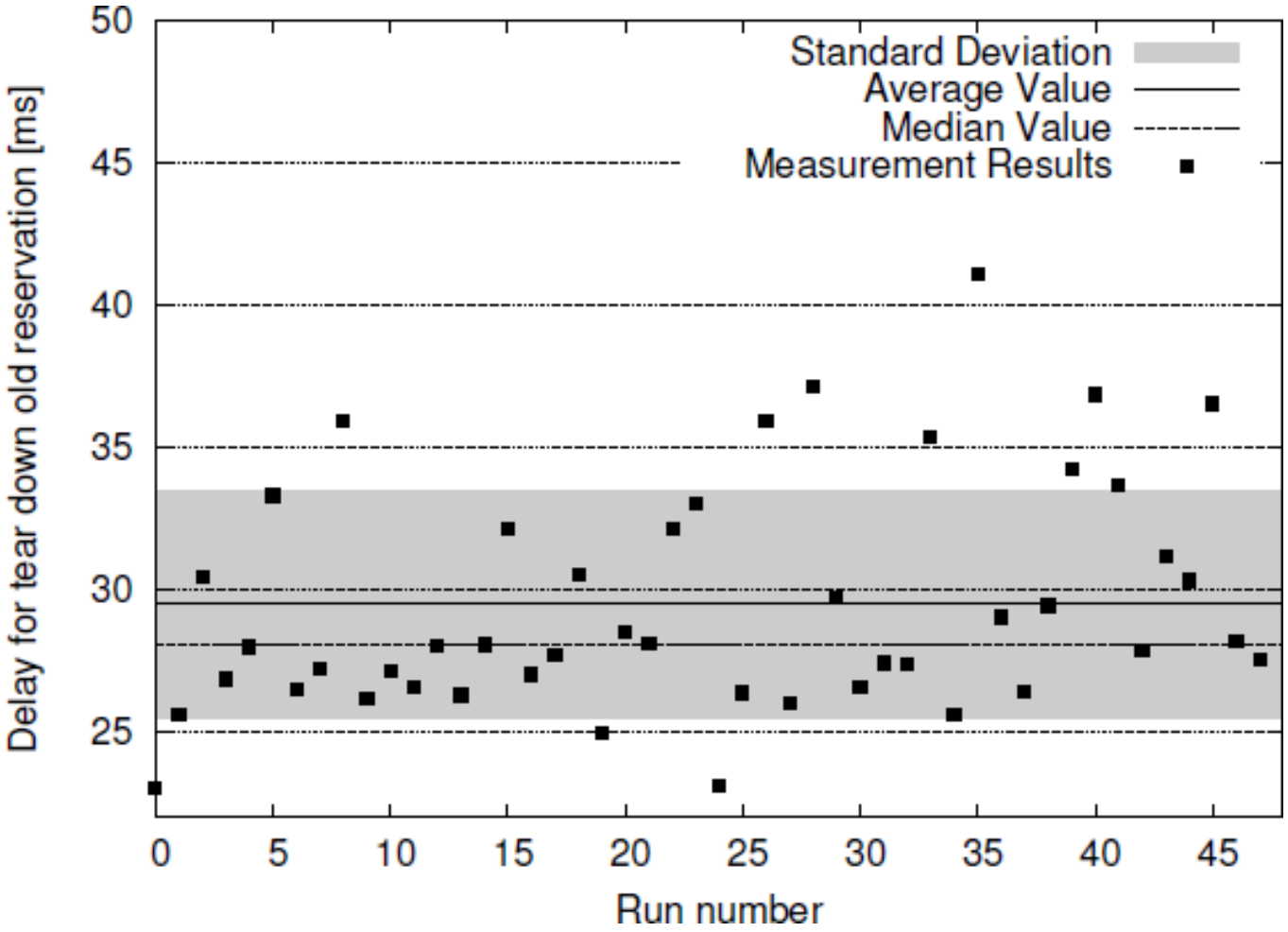
Evaluation – Performance Benchmarks II

- Receiver-initiated Reservation
  - setup delay for reservation from Access Router 1



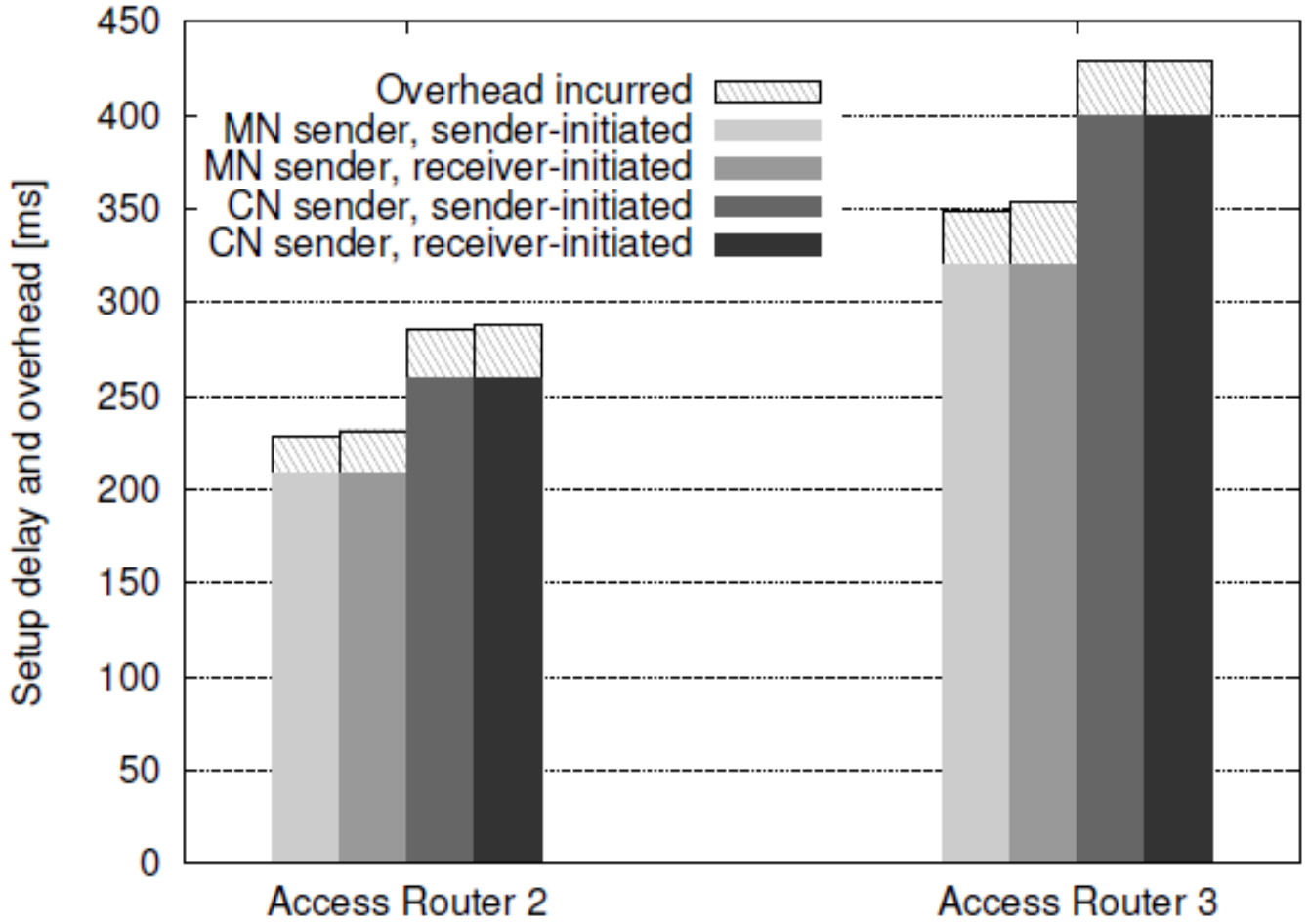
Evaluation – Performance Benchmarks III

- Delay for tear down of old reservation



Evaluation – Performance Benchmarks IV

- Added additional delay between AR1/AR2 (50ms) and AR2/AR3 (25ms)
- Setup Delay Overhead ≤ 10%



Conclusion & Outlook

- QoS support for mobile users viable
- NSIS QoS NSLP is prepared for mobility
- Mobility triggers required
- Flow Information Service
- Low additional overhead
- Code freely available: http://nsis-ka.org

Outlook

- Repeating measurements in real testbed
- Seamless QoS support: Anticipated Handover
- Requires protocol extensions
- Ongoing implementation effort

Thanks! Questions?

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