Handover simulations…

- A breif overwiev = graph marathon (=

Presented by Håvard Austad

Agenda

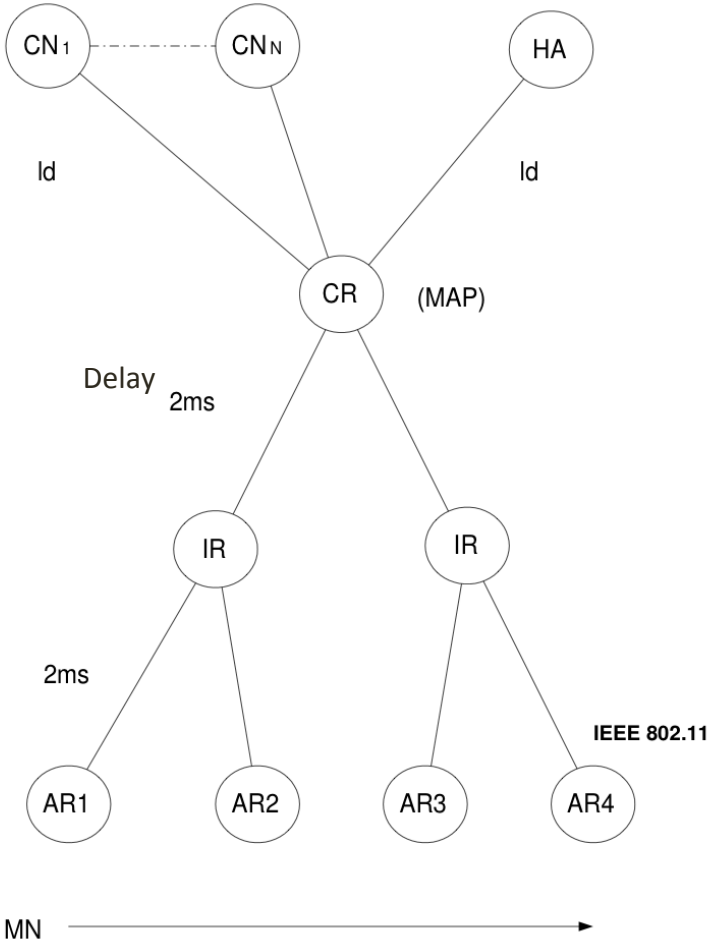
- Present three simulation and their respective results:
- Simualtion 1:
  - A Perfomance Comparison of Mobile IPv6, Hierarchical Mobile IPv6, Fast Handovers for Mobile IPv6 and their Combination
- Simulation 2:
  - Vertical Handover criteria and algorithms in IEEE 802.11 and 802.16 networks
- Simulation 3:
  - A case study: IEEE 802.21 enabled mobile terminals for optimized WLAN/3G handovers
- Results in comparison and typical numbers
- Table of summary

Simulation 1

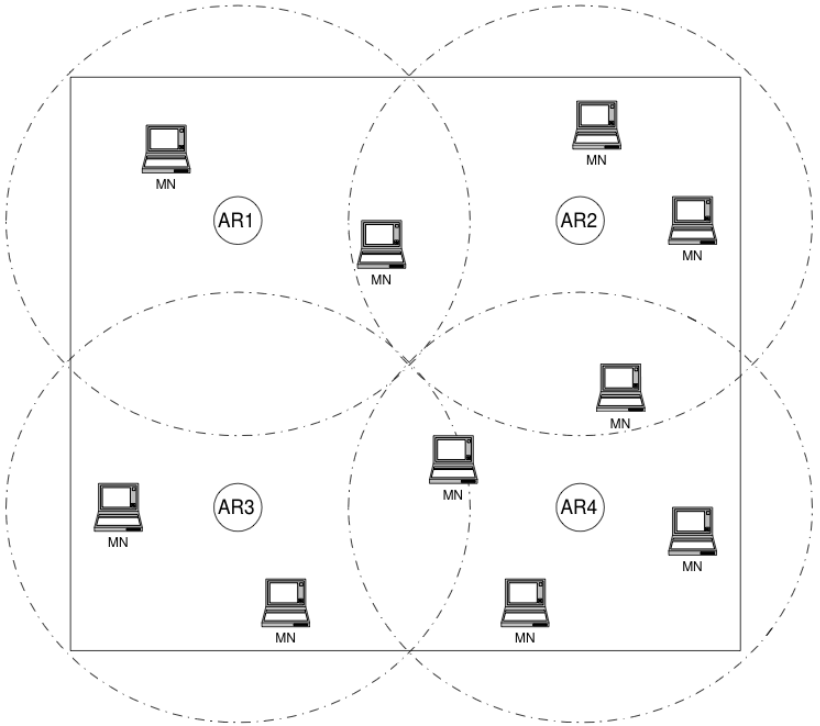
- Compares Mobile IPv6, Fast Handovers for Mobile IPv6, Hierarchical Mobile IPv6 and H+F MIPv6
- Performance metrics
  - Handoff latency
  - Packet loss
  - Bandwith per station
- Simulation length 125s with warm up for 5 sec.
- 50 stations/MN, random movment
- 2Mbps WLAN as wireless medium

Simulation 1

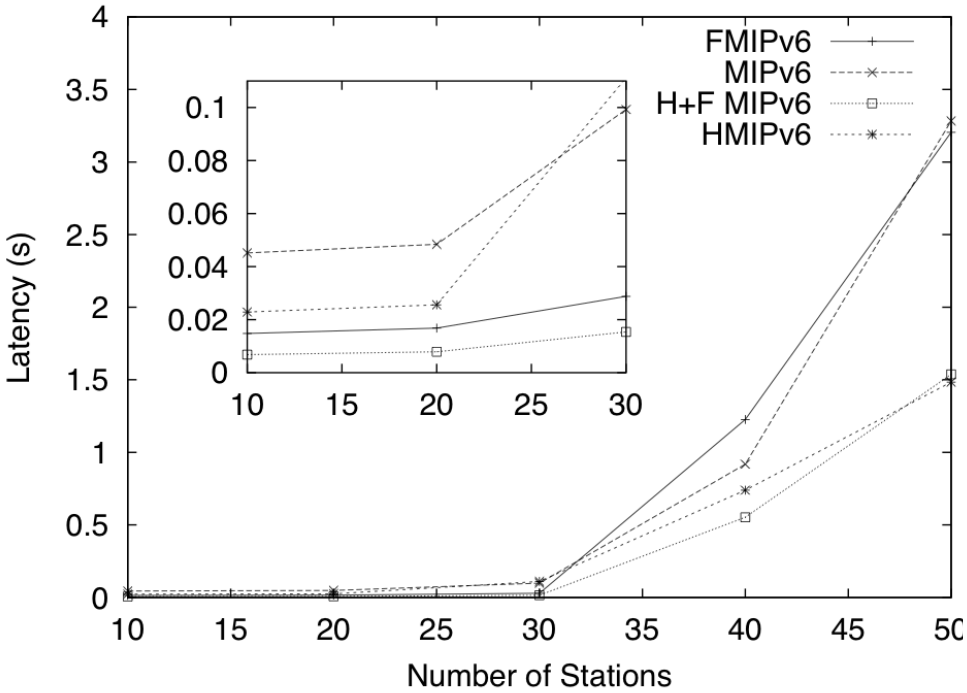
- Scenario



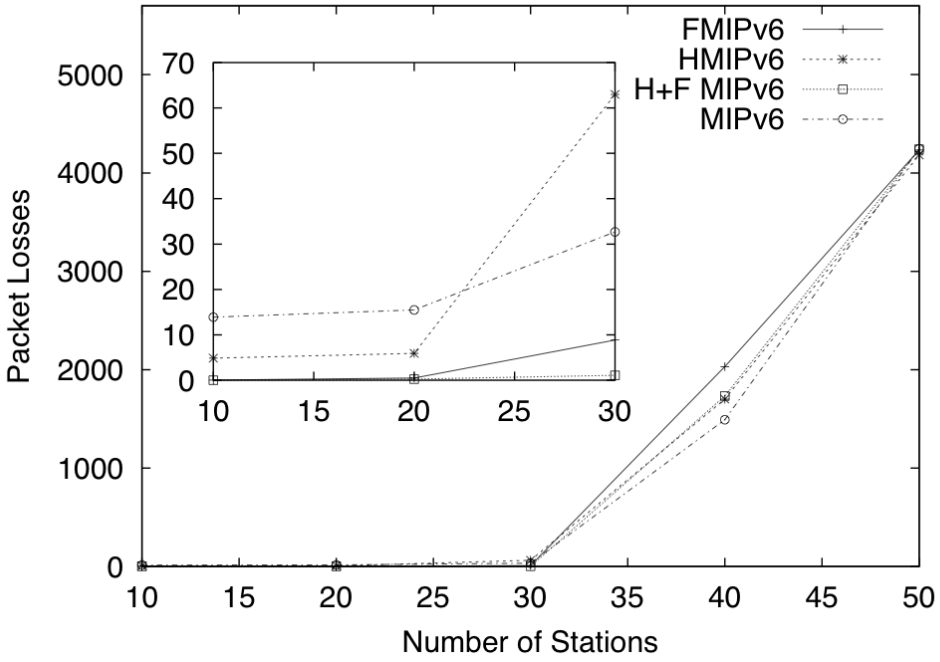
CN = Correspondent node (sender)
HA = Home agent
CR = Central Router
IR = Intermedieate Router
AR = access router
MN = mobile node
Coverage =700x700 m



Simulation 1



Handoff latency

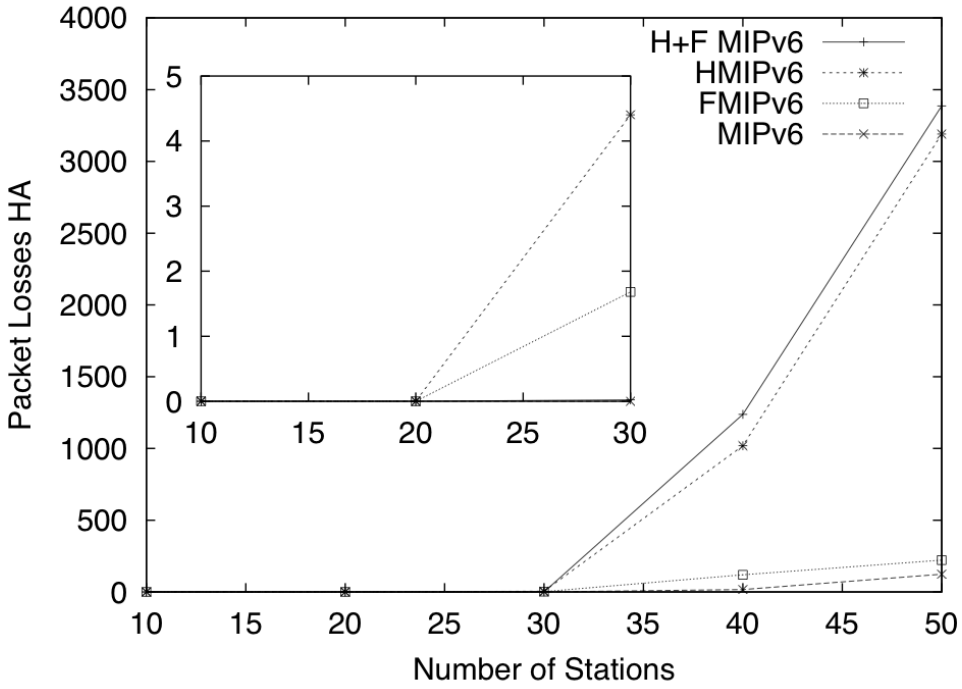


Packet loss

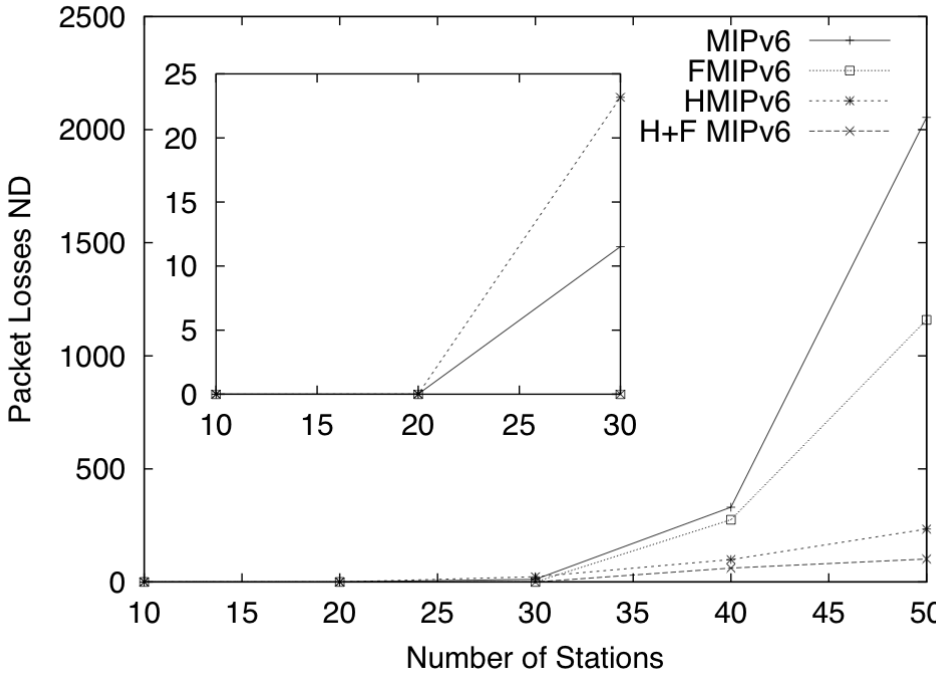
H+F MIPv6 is better up to 49/50 Nodes
Then HMIPv6 is better

MIPv6 is the better

Simulation 1

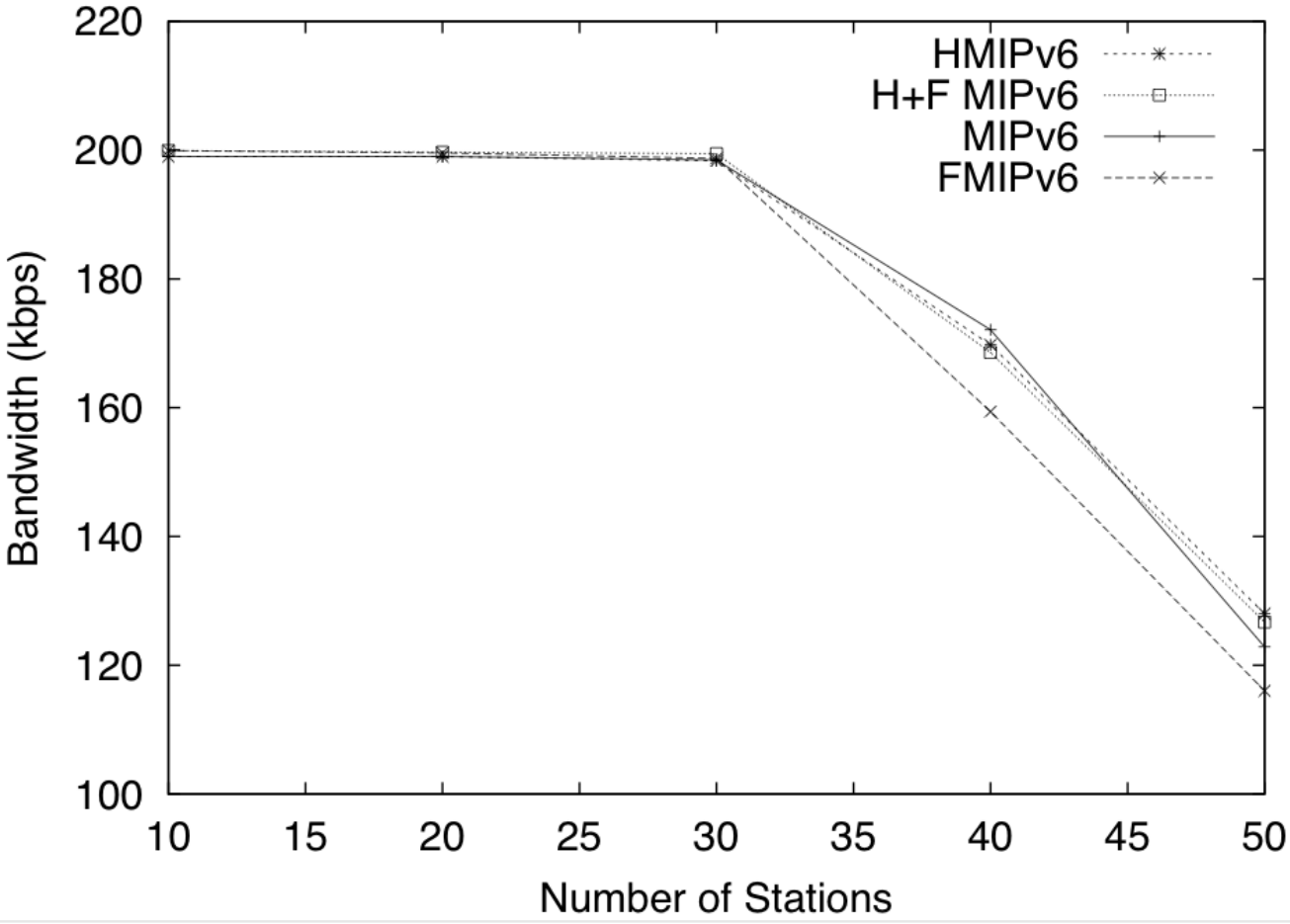


Impact of number of stations on packet Loss at the HA



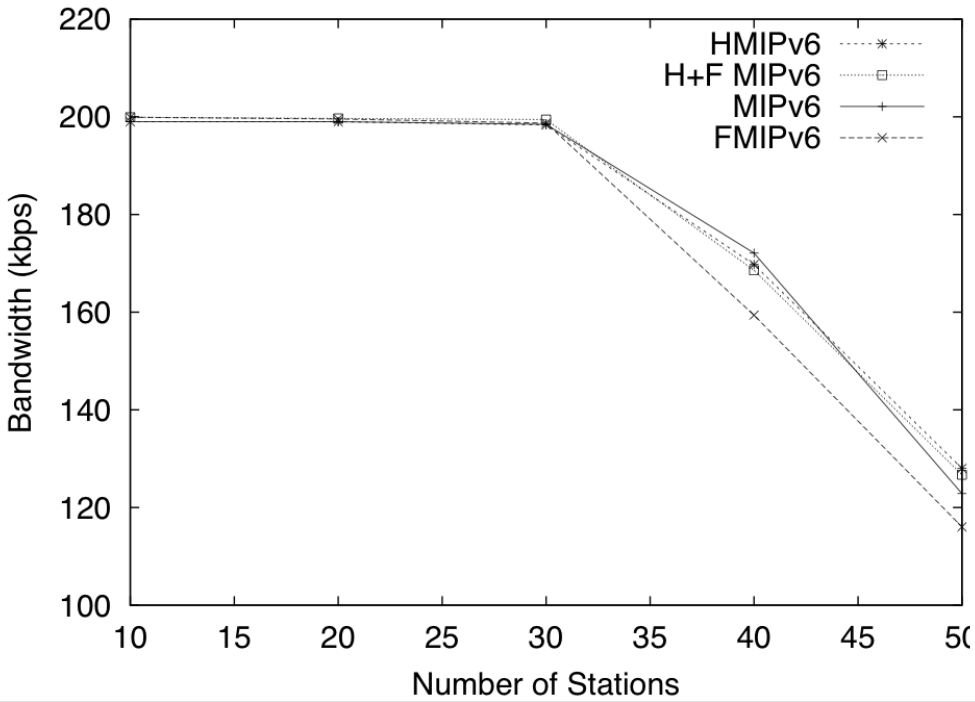
Impact of number of stations on packet Loss in the Neighbor Discovery resolution Queue,

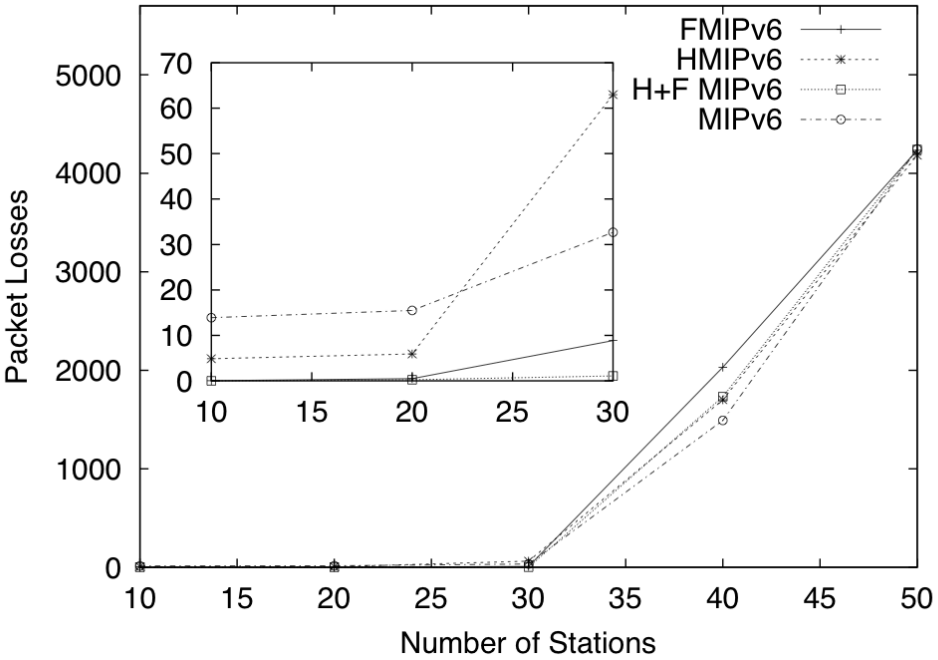
Simulation 1



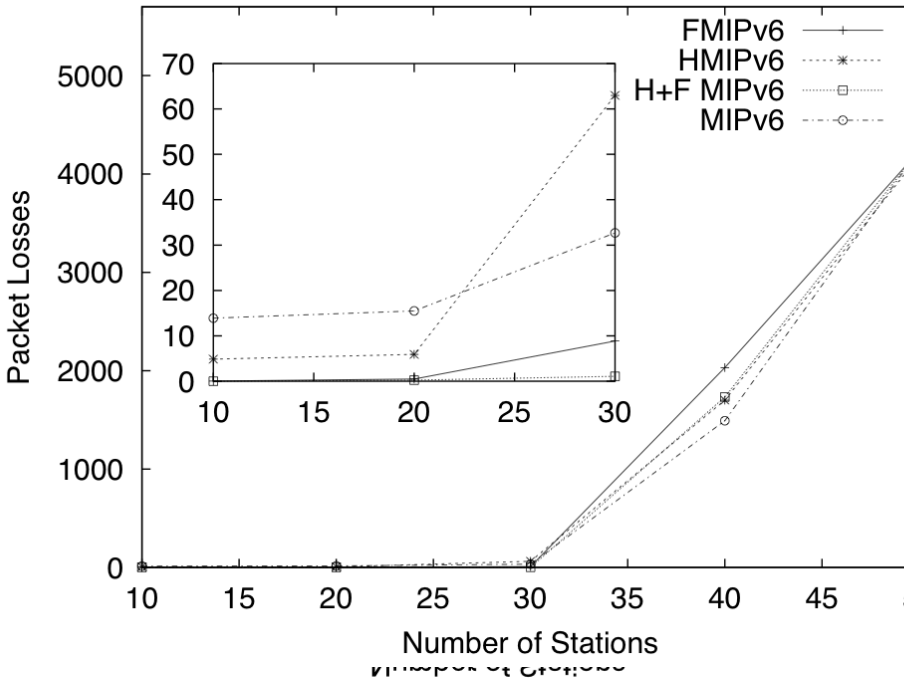
BW obtained by the different nodes

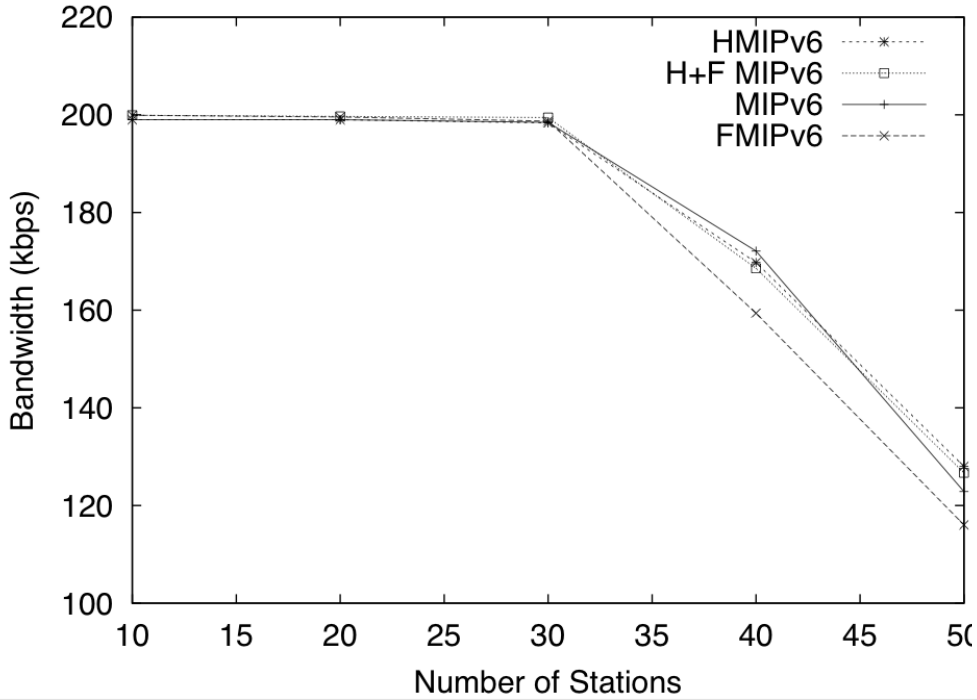
Simulation 1





Simulation 1





Conclusion simulation 1

- Touching the highlights:
- HMIPv6 has the lowest latency
- Mobile IPv6 has the least packet loss
- Fast Mobile IPv6 obtained more bandwith

Simulation 2

- Scenario: WLAN -> WiMax
- Long lived FTP-stream
- WLAN->WiMax->WLAN->WiMax
- 2m/s -> WiMAX

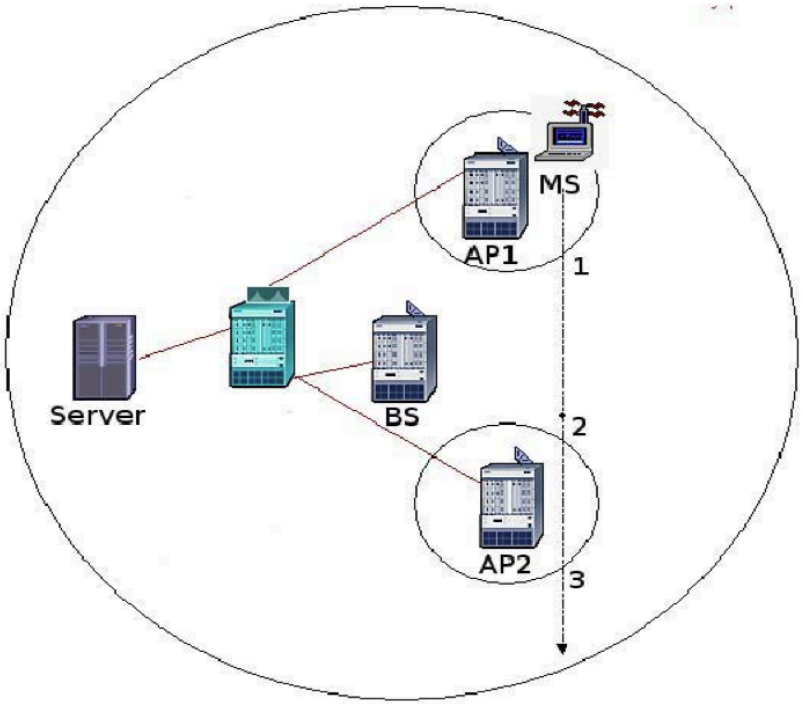


Fig. 2. Handover validation scenario

Simulation 2

- Two triggers
  - Wireless connectivity trigger (Signal to interference plus noise) = SINR
  - Performance trigger
    - Data rate and network load

Simulation 2

1 and 2:
- Throughput trigger

3 wireless con. trigger

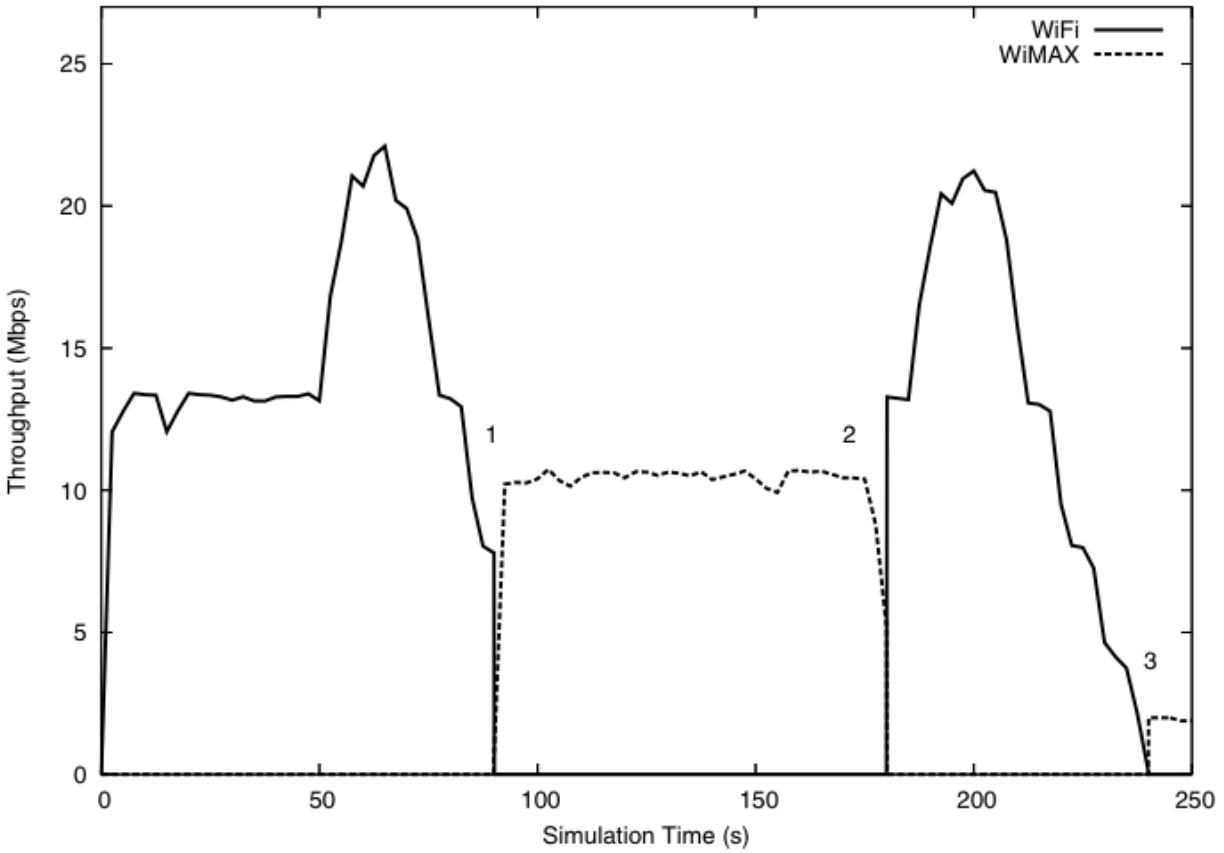


Fig. 3. Handover validation simulation results

Simlation 2

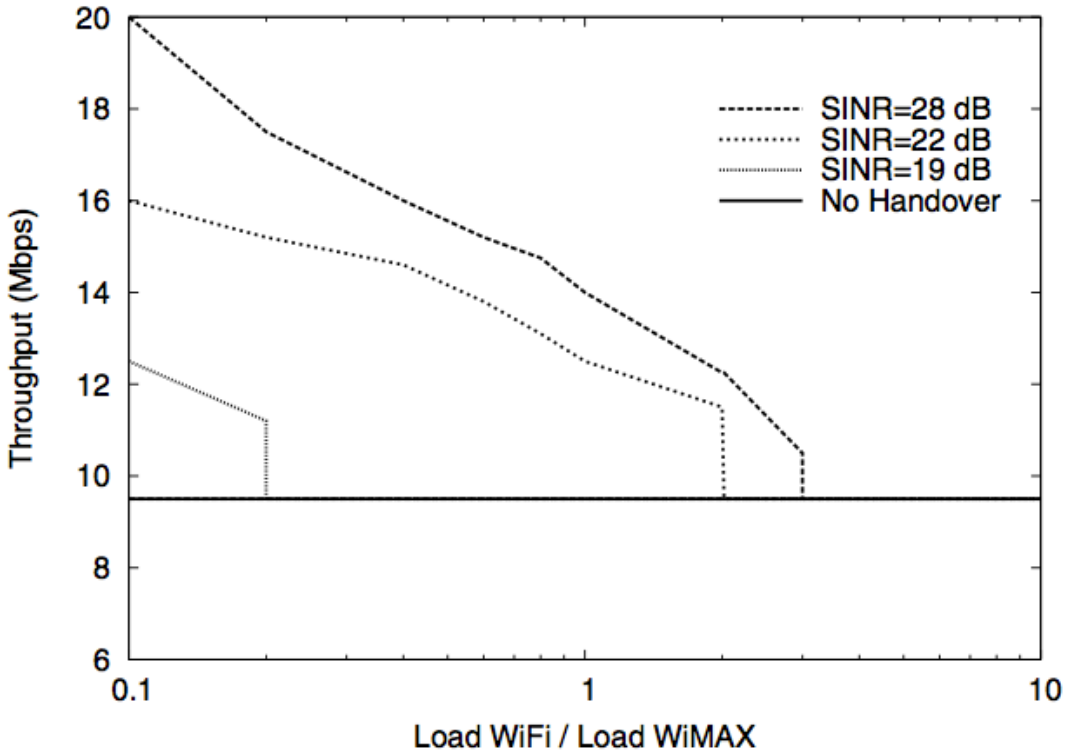


Fig. 4. Average throughput of the MS as a function of the ratio between WiFi and WiMAX load for different WiFi SINR

Higher SINR = more load on WLAN

-video conference (640kbps)

- Every 10s = new user
- Covered by WiMax and WiFi
- Start at WLAN, free to choose

- No handover = pure wimax
- Data rate= choose interface by

Estimated higher datarate

- Load = choose interface by lowest load
- Throughout = chooses interface

By best hroughout combining load and Datarate

Max wlan 8Mbps

Max WiMax 4Mbps

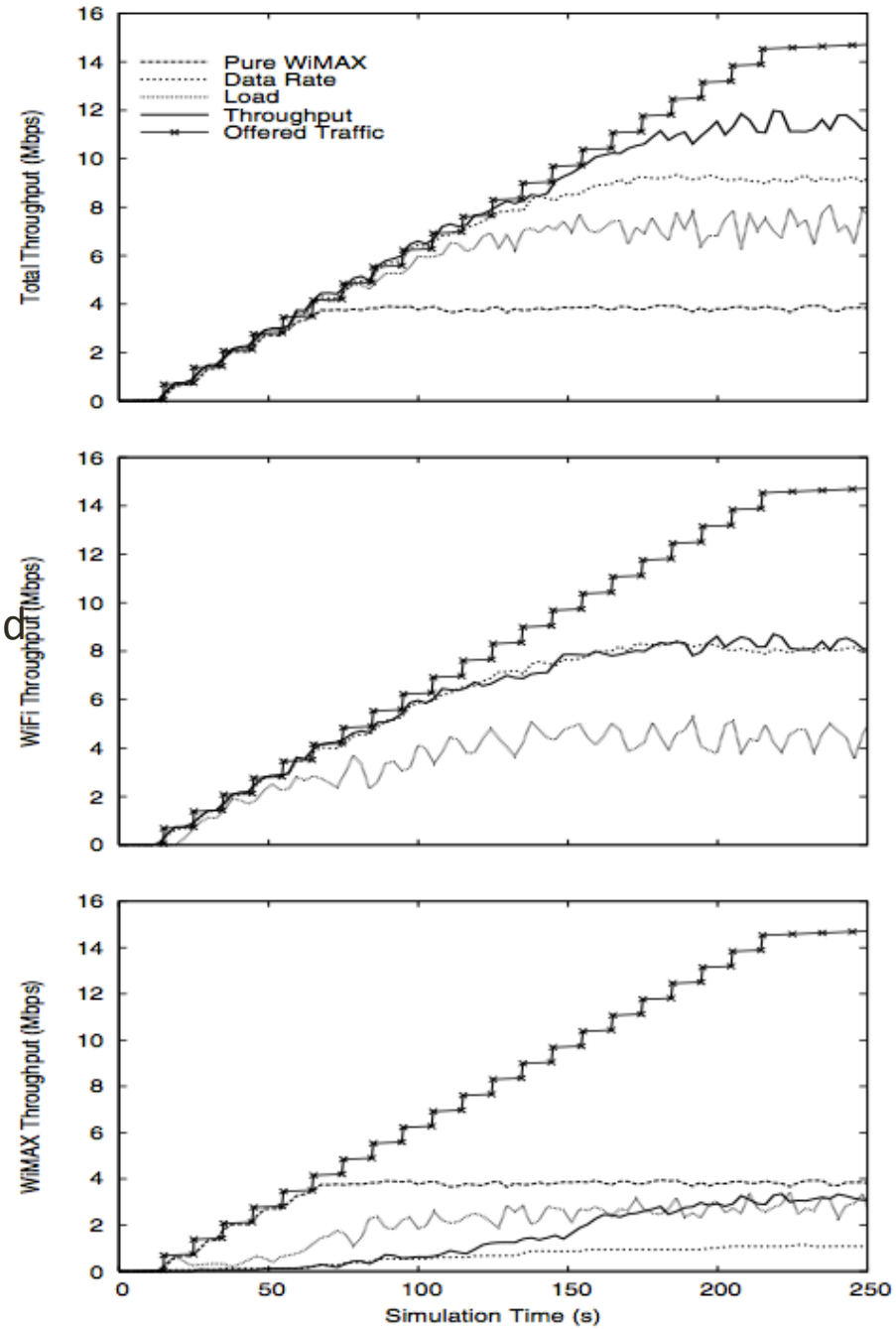


Fig. 5. Handover criterion influence on the achieved throughput

Simulation 2

- Touching the highlights
- Data rate as trigger = more WiMax users (higher freq)
- Load as trigger = more WLAN users
- All combined gives the most balanced user distribution= more total throughput

TABLE II

AVERAGE USER THROUGHPUT (KBPS)

	Pure WiMAX	Data Rate	Load	Throughput
WiFi	0	440	640	568
WiMAX	190	640	195	502

Simulation 3(G <-WLAN..)

- Scenario
- Inndoor with several overlapping
- WLAN cells, full 3G coverage
- Speed 10m/s generated random
- Downstream audio 83 kbps
- Mobile IPv6

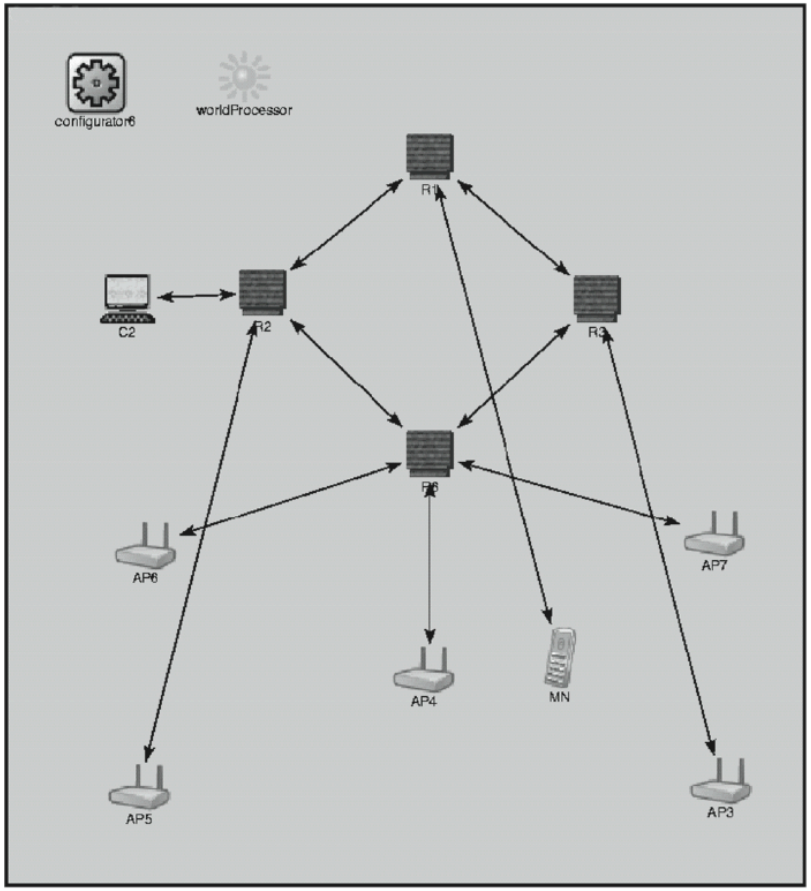


Figure 4: Simulated Scenario

Simultaion 3

- Time WLAN is used per HO
- 3G->WLAN inc, HO decreases
- High enough threshould skips usesless HO
- Only HO that allow MN to stay longer i WLAN performs HO
- Better WLAN user-experience

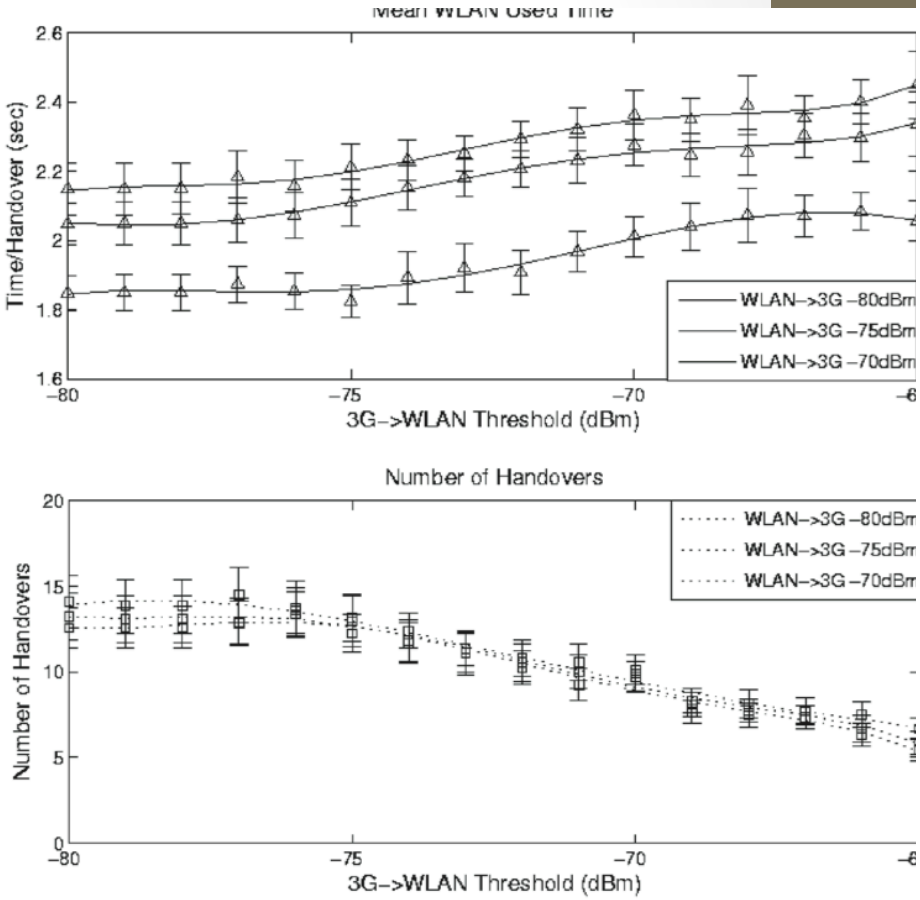
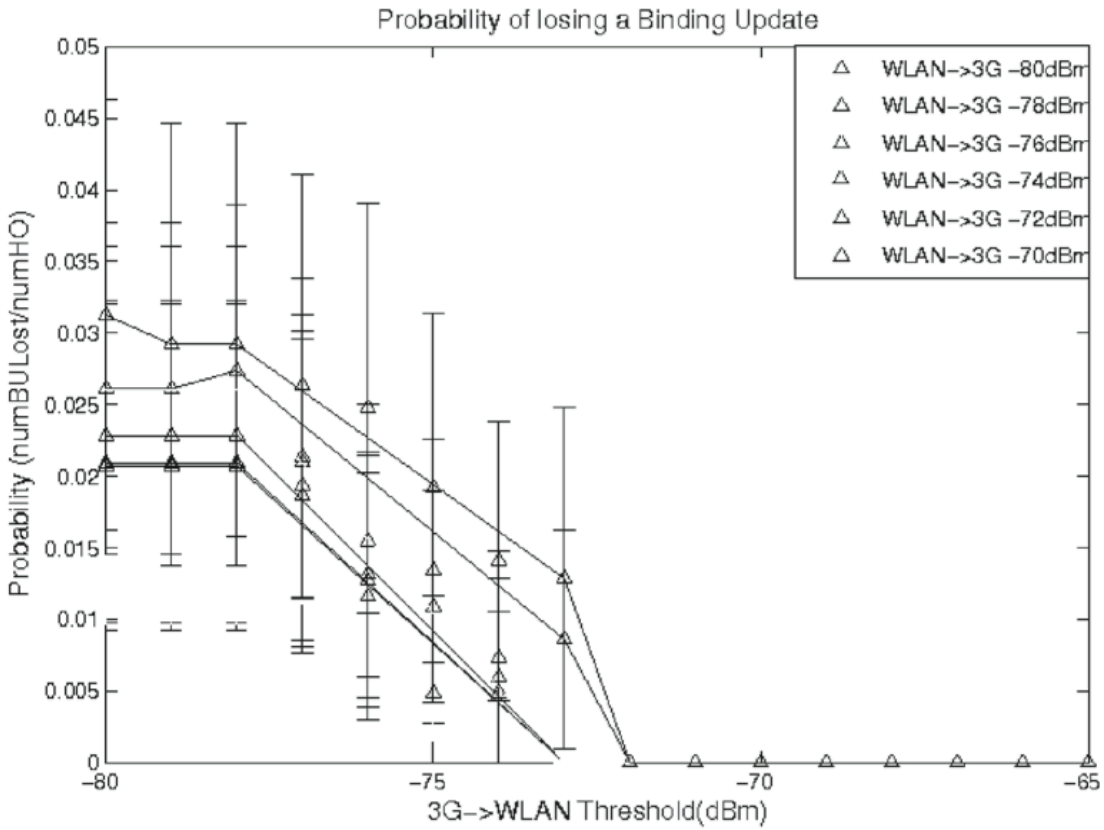


Figure 5: Wireless LAN Time usage and number handovers

Simulation 3

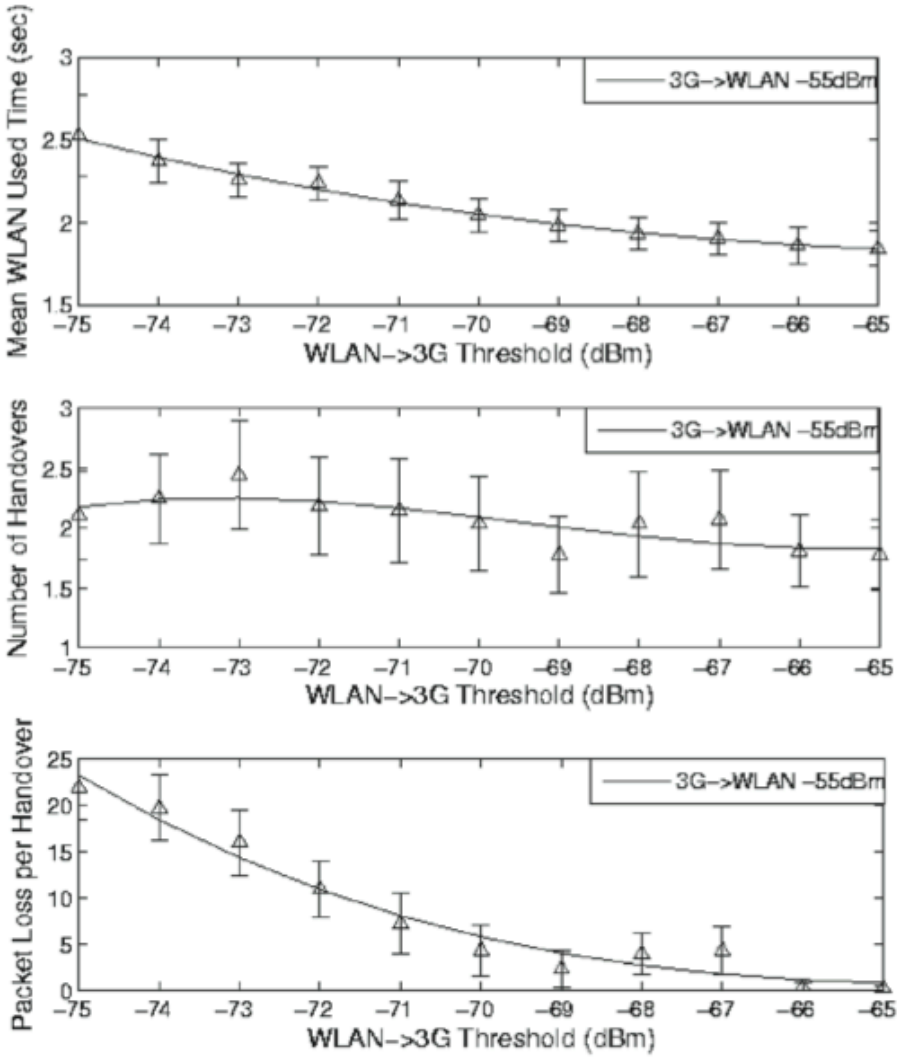
- Binding updates are dropped when the Mobile Node tries to perform a handover when the signal is not good enough
- HA cant send data
- -74dBm



Simulation 3

- Zero packet loss performance
- 3G-> WLAN -55dBm to
  - make sure the BU is rescived

High threshold = fewer HO



Simulation3

- Summary
- Ping-pong effekt
  - 3G->WLAN >= WLAN->3G
- WLAN -> 3G -66dBm for seamless handovers
- 3G -> WLAN -55dBm

Super Summary

- Simulation 1
  - HMIPv6 has the lowest latency (good for VoIP)
  - Mobile IPv6 has the least packet loss
  - Fast Mobile IPv6 obtained more bandwith
- Simulation 2
  - Combination of signal, estimated load and estimated data rate gives highest throughput
- Simulation 3
  - 3G->WLAN >= WLAN->3G
  - WLAN -> 3G > -66dBm for seamless handovers
  - 3G -> WLAN -55dBm

The End…