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IPv6 Moving Network Testbed with Micro-Mobility Support

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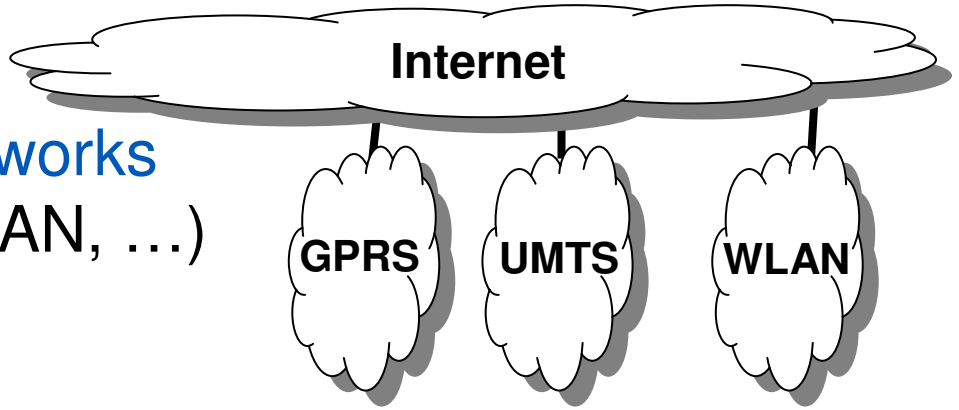
Scenario

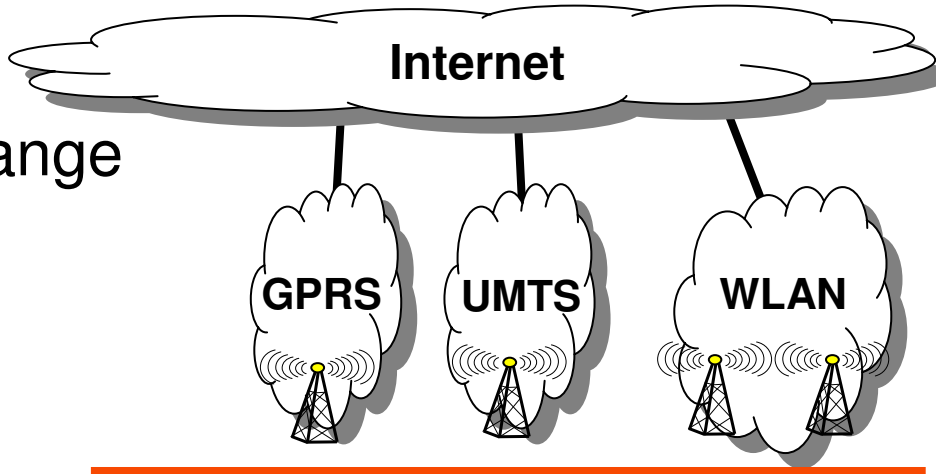


- Multitude of radio access networks available (GPRS, UMTS, WLAN, …)
- Moving vehicles with
  - many passengers
  - interconnected built-in devices
- Powerful smartphones/PDAs and laptops used outside and inside of vehicles

➢ Efficient mobility management for devices having the same mobility pattern is needed!

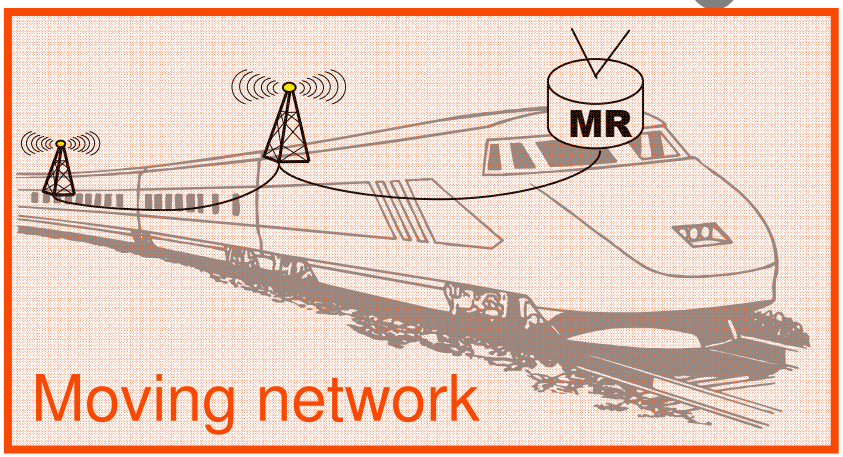
Moving networks

- network segments that can change their point of attachment to the Internet;



Mobile Router (MR)

- special gateway to the Internet;
- handles mobility of the network;

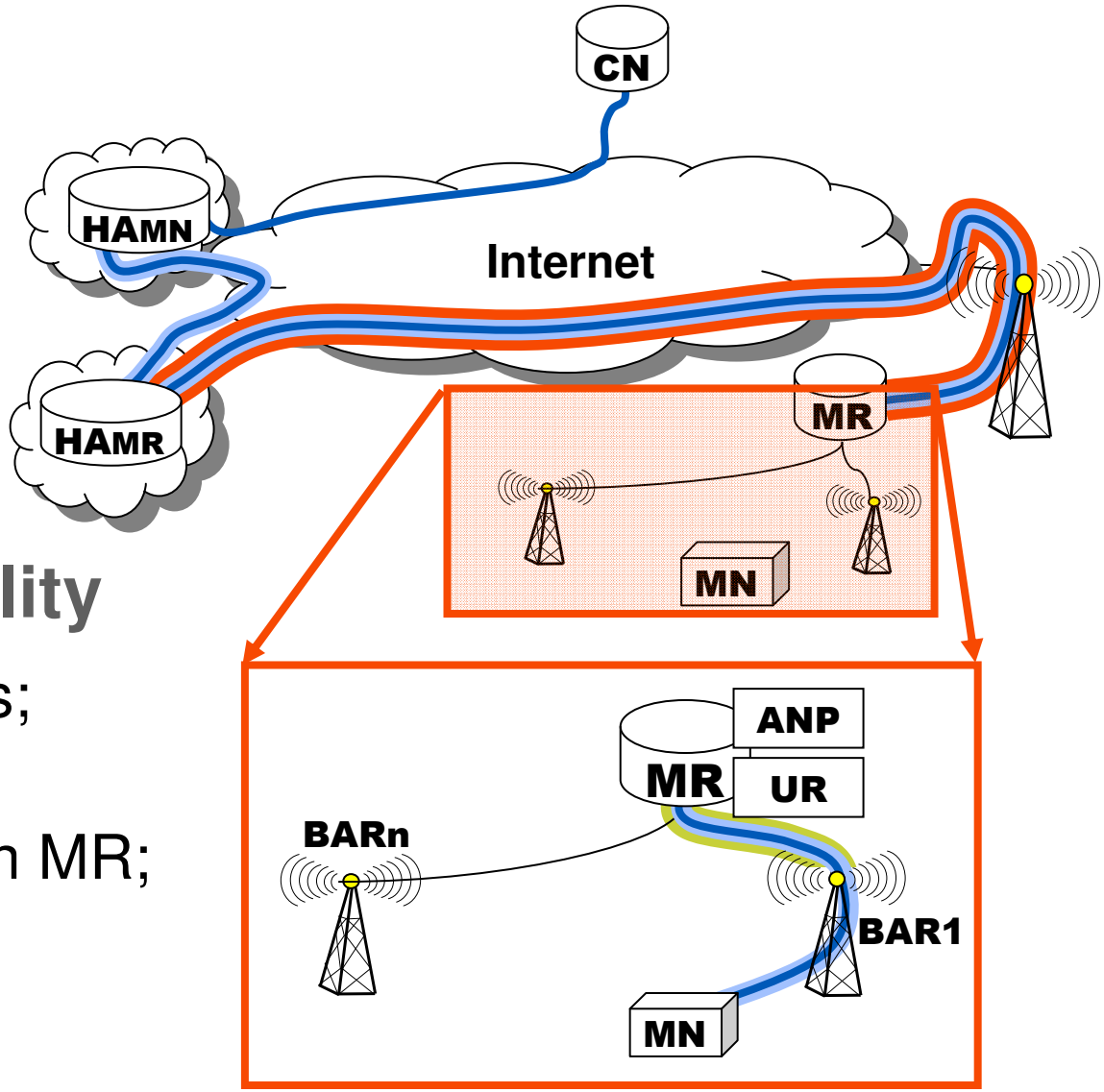


Problem

- movement of the network:
  - mobility management has to support transparency, roaming and multi-access;
- movement of the users inside (large vehicles);

MR-HA tunneling

- IETF NEMO proposal;
- bi-directional tunnel; between MR and its HA;

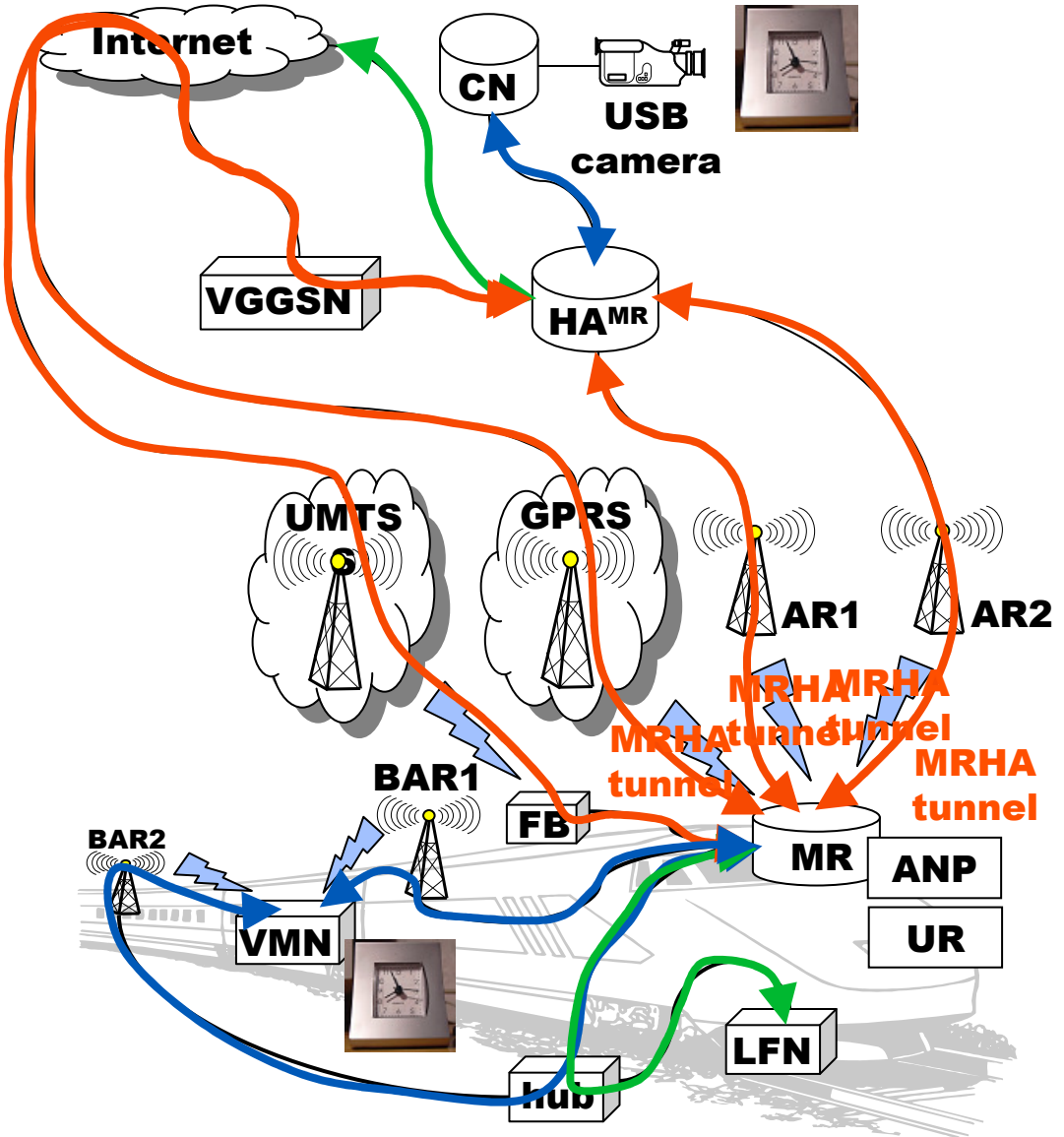


BCMP for local mobility

- seamless IP handovers;
- anchor point and user registry co-located with MR;
- based on tunneling;

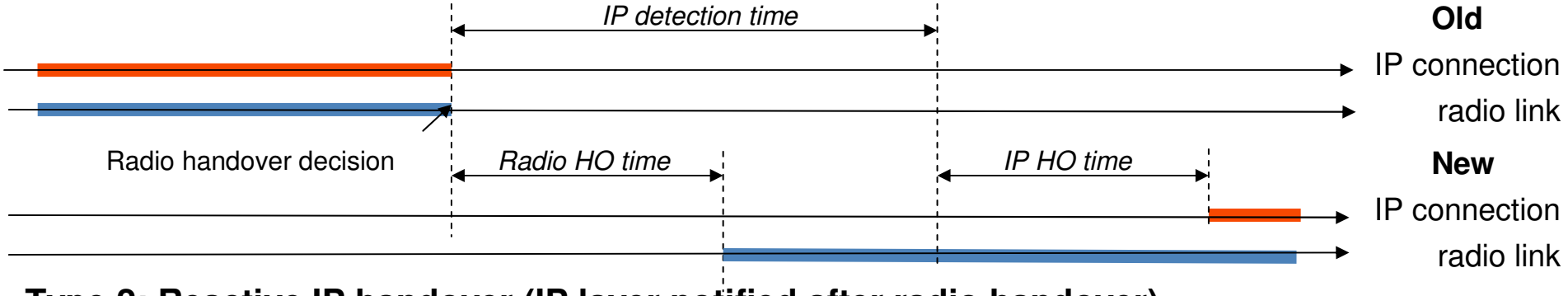
Ericsson's testbed

- Based on MIPL stack;
- 2 types of HOs between ARs of the access system (radio unaware, radio aware);
- Vertical HO to GPRS;
- Vertical HO to UMTS;
- MRHA-BCMP interworking;
- Local BCMP handoffs inside the IVAN;
- Support for mobility unaware nodes (LFN) inside the IVAN;

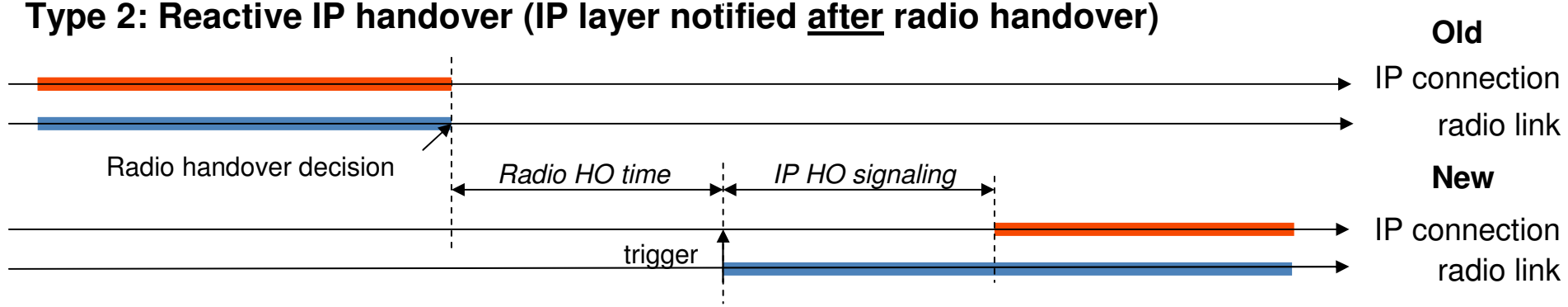


IP Handover types 1.

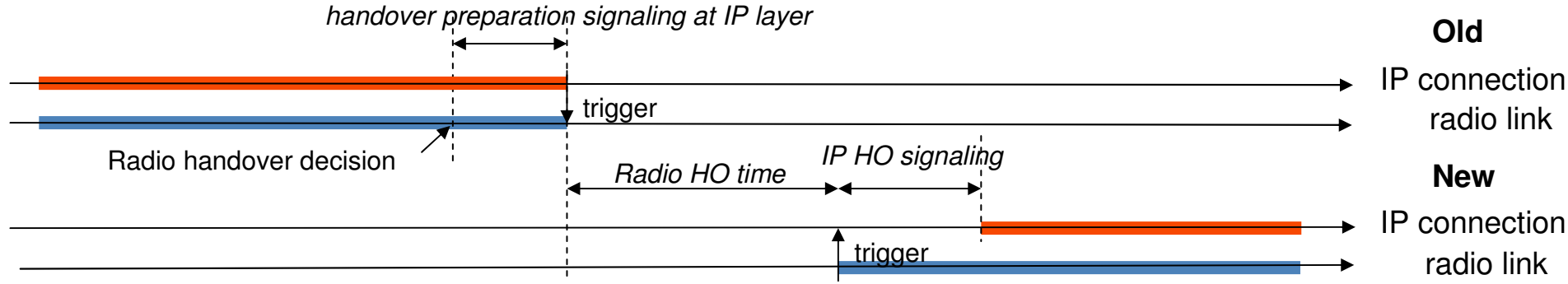
Type 1: Radio unaware IP handover (no interaction between IP layer and radio)



Type 2: Reactive IP handover (IP layer notified after radio handover)

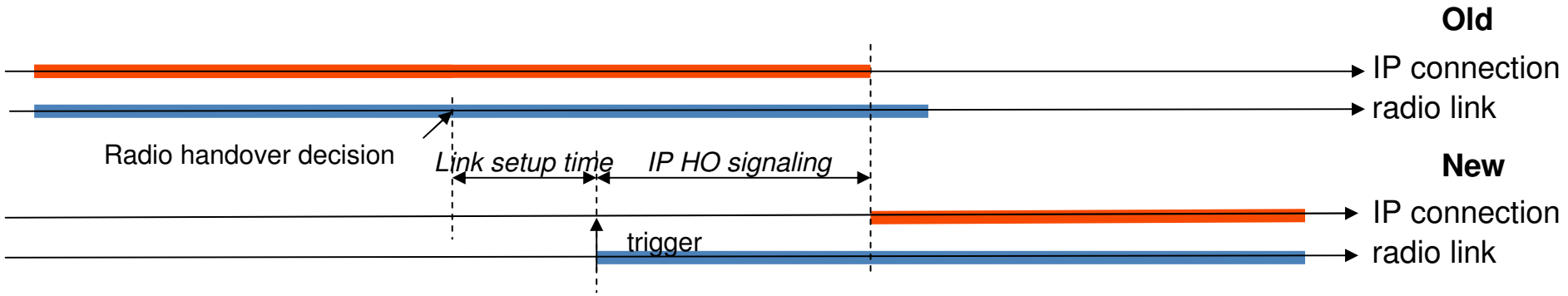


Type 3: Proactive IP handover (IP layer notified before radio handover)



IP Handover types 2.

Type 4: Make-before-break handover (new radio link is up before old link goes down)



IP Handover Types – Summary

Type 1: Radio unaware IP handover (no interaction between IP layer and radio)

The original Mobile IP model. It is usable mainly for portability

Type 2: Reactive IP handover (IP layer notified after radio handover)

Typical assumption for basic IP mobility protocols (BCMP unplanned HO)

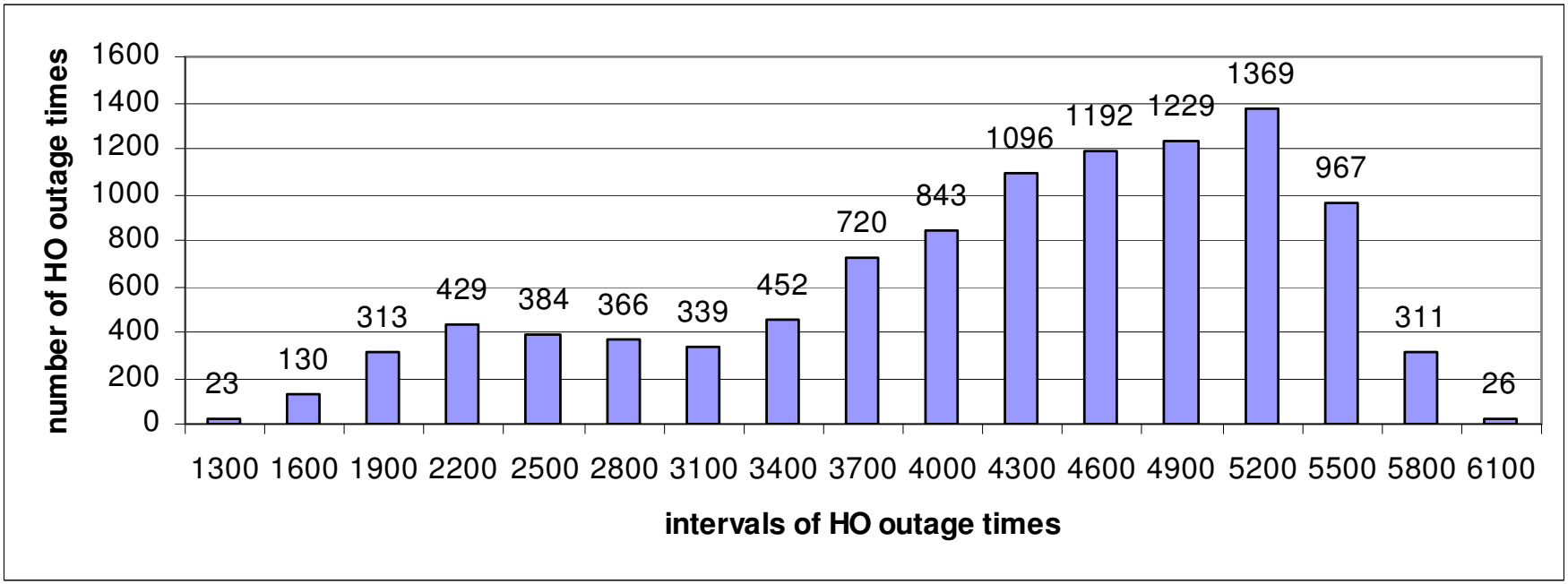
Type 3: Proactive IP handover (IP layer notified before radio handover)

Typical assumption today for "fast handover protocols" (BCMP planned HO)

Type 4: Make-before-break handover (new radio link is up before old link goes down)

Very good performance, but puts special requirements on radio

Measurements – Radio unaware IP Handover



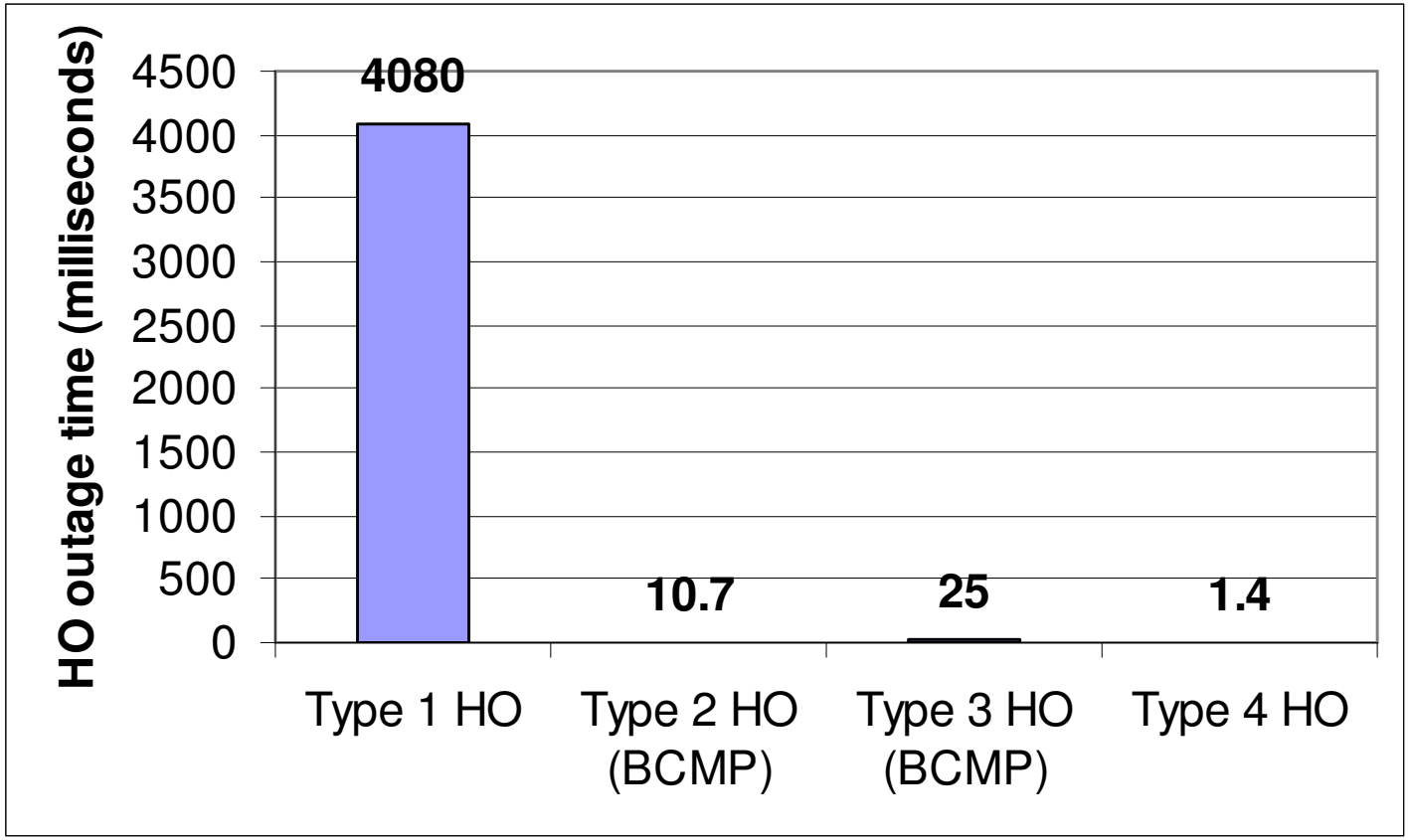
Histogram of handover outage time when ARs disappear periodically

Average outage time: 4080 ms

Measurements – Make-before-break IP handover

- Radio interfaces of both access routers turned on;
- MR and access routers on the same radio channel;
- UDP packets sent in every 2 milliseconds;
- Handover in every 2 seconds;
- 0.7 % of packet loss in average → outage time: 1.4 ms;

Measurements – Comparison



Measurements – UMTS Network

- Ping packets from home agent to local fixed node inside the moving network;
- Downloading file from the Internet to the local fixed node;
- Video streaming from correspondent node to the local fixed node;
- Average delay: 220 ms
- Average bandwidth: 310.31 kbit/s

Conclusion

- We built a moving network testbed supporting horizontal and vertical handovers;
- We combined macro-mobility (MIPv6) protocol with micro-mobility protocol (BCMP);
- Radio unaware IP handover performs very poor;
- Make-before-break IP handovers are desired, but needs special radio;
- It is crucial to take some information from the radio (e.g.,triggers) into account to improve handovers (reactive, proactive IP handovers);
- 3G provides enough bandwidth for real time video;

Thank you for your attention!

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