FHTW
Rechenzentrum

Roaming Real-Time Applications

Mobility Services in IPv6 Networks

Thomas C. Schmidt, Matthias Wählisch,

{schmidt, mw}@fhtw-berlin.de
FH für Technik und Wirtschaft Berlin


PHILIPS


Köpenick

Agenda

FHTW
Rechenzentrum

- VCoIP & Real-Time Communication
- Internet Mobility
- Local MIPv6 Handover
- Improving the General Handover
- Mobile Multicasting
- Conclusions & Outlook

VCoIP
Real-Time Requirements

FHTW
Rechenzentrum

! Latency $\approx<$ 100 ms

! Jitter $\approx<$ 50 ms

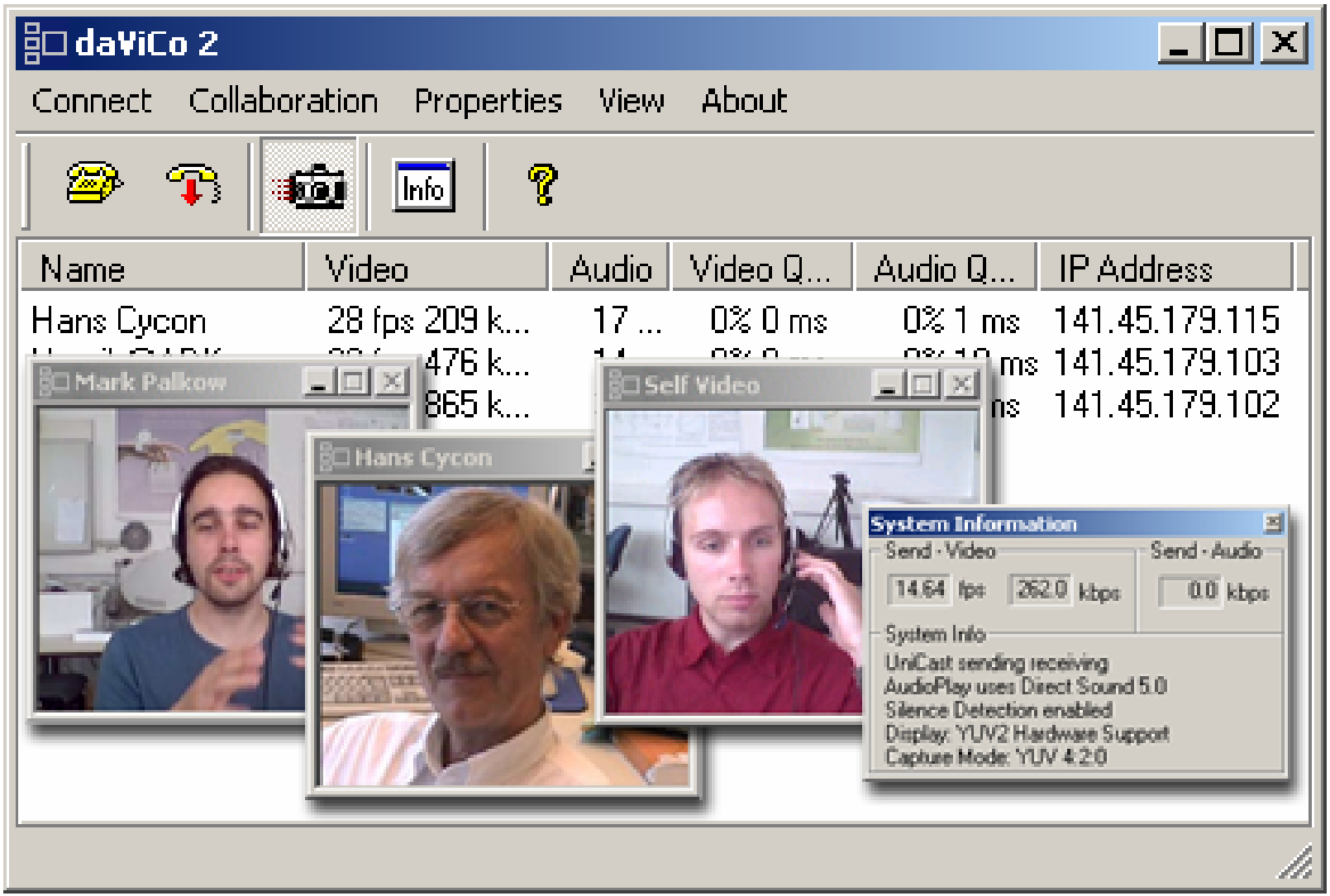
! Packet loss $\approx<$ 1 %

! Interruption: 100 ms $\approx$ 1 spoken syllable

! Typically: Multicast Listener & Sender

The daViCo Videoconferencing System

FHTW
Rechenzentrum



daViCo
Videoconferencing Software

FHTW
Rechenzentrum

Pure Software solution including

- multicast/multipoint video communication
- highly efficient wavelet video codec
- buffer latencies about 100 ms
- application sharing
- implements peer-to-peer model
- implements IPv6 and user location
- designed for best effort transport & effortless use

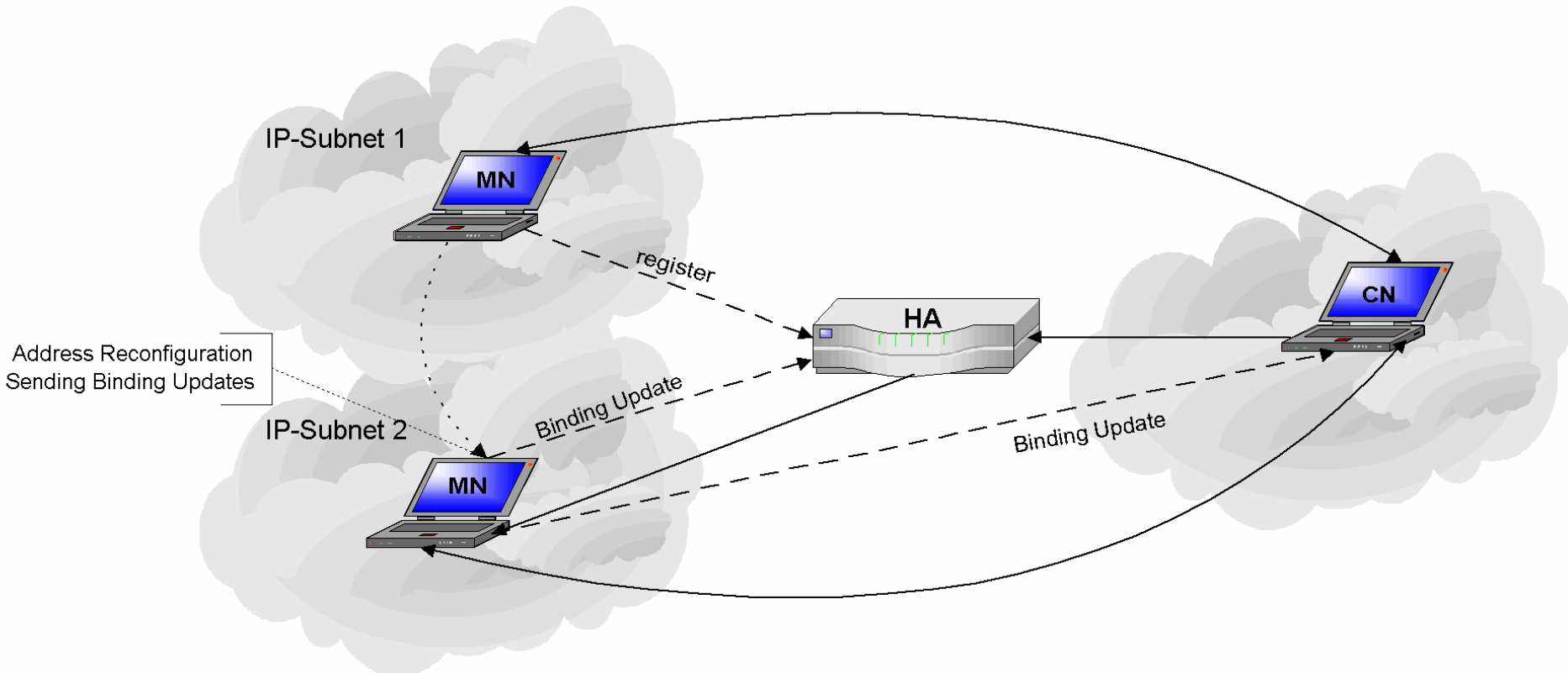
IP Mobility Approaches

FHTW
Rechenzentrum

- Mobile IPv6
  - Stateless, transport transparent handover
- Multicast-based IP Mobility Support
  - Mobile with personal multicast address
- Mobile SCTP
  - Stateful transport handover (doubly bound)
- SIP Handover
  - SIP-server as application specific home agent

Mobile IPv6

FHTW
Rechenzentrum



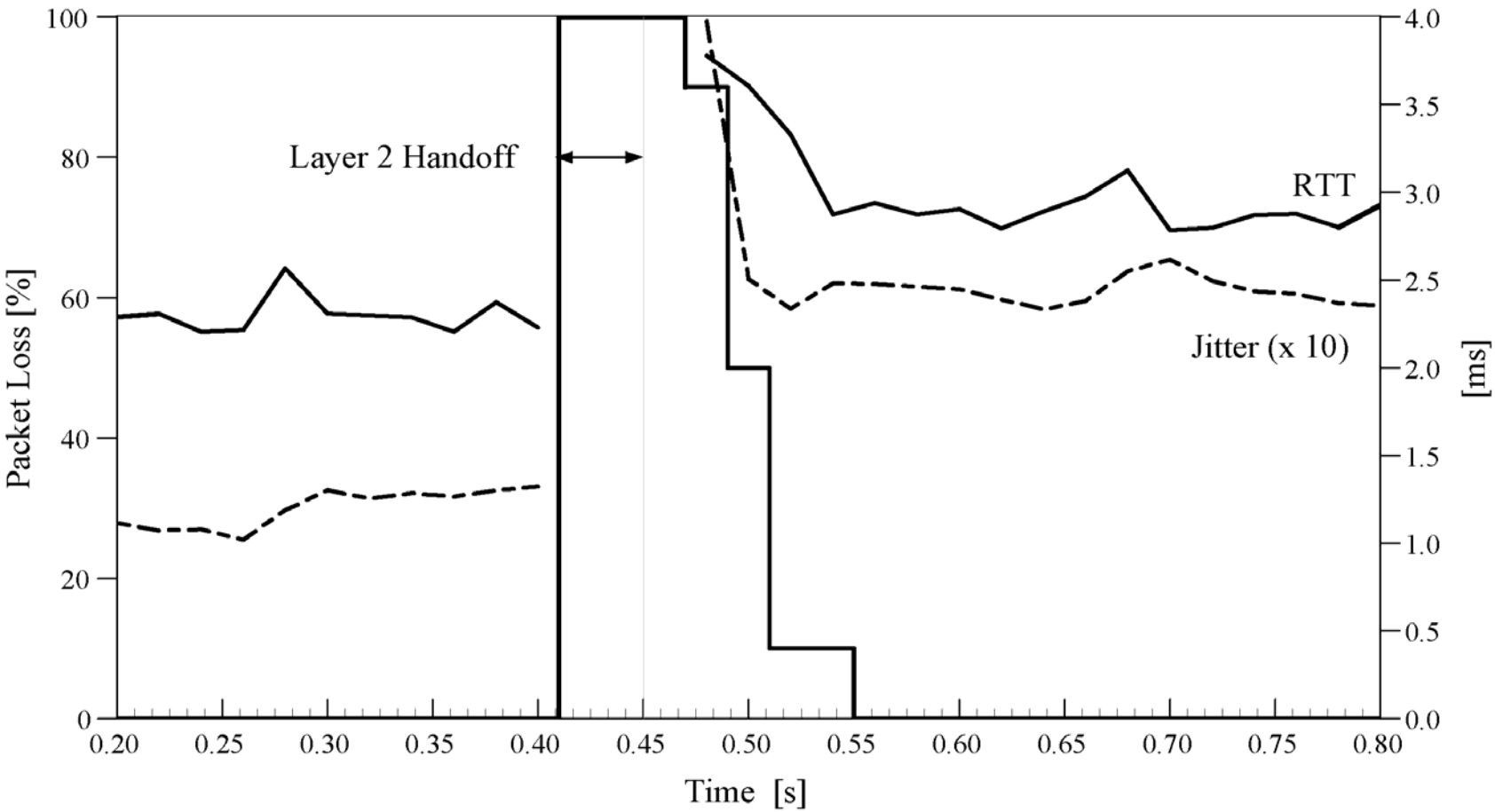
Local Handover Performance Experimental Scenario

FHTW Rechenzentrum

- Focus on local handoff over 802.11b
- MN: Linux MIPL 0.9.4 (DAD removed)
- Rtr: FreeBSD 4.6 + rtadvd,
  MinDelayBetweenRAs = 50 ms
- UDP-Probe: Triggered (10 – 20 ms) reflection of numbered and time stamped packets
- Sniffer event recording (etherreal)

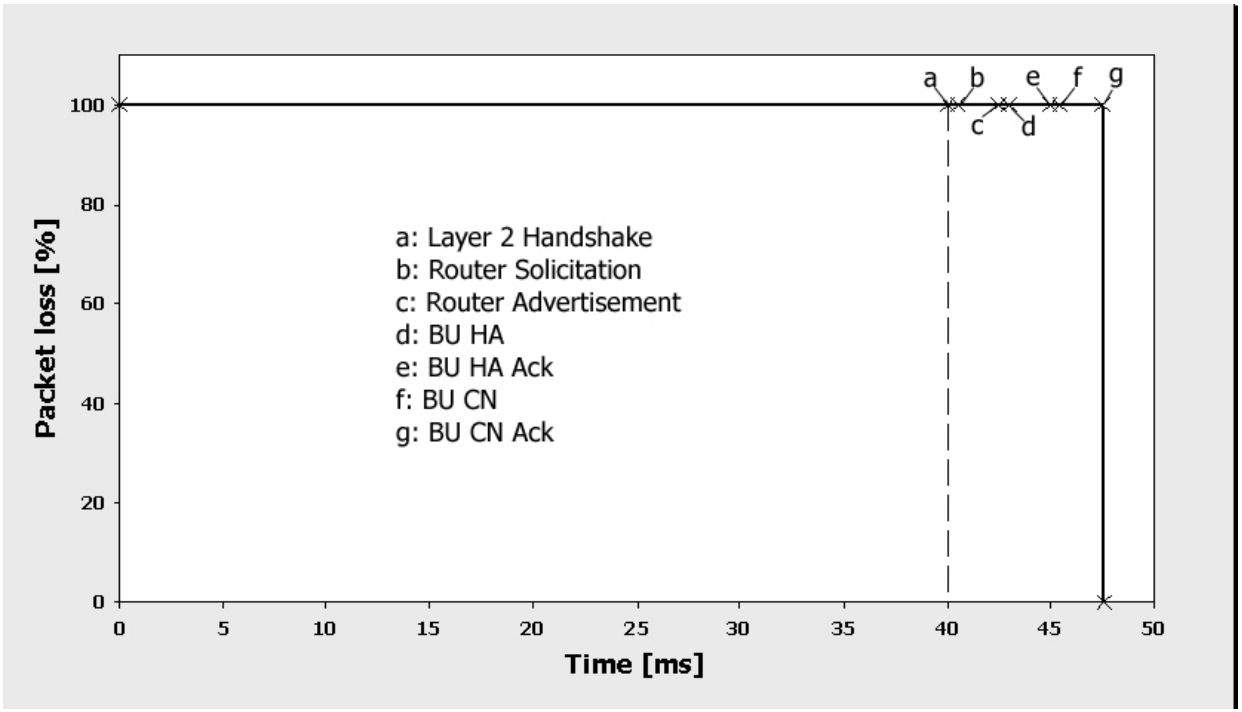
Empirical Results

FHTW
Rechenzentrum



Improvement: L2-Trigger

FHTW Rechenzentrum

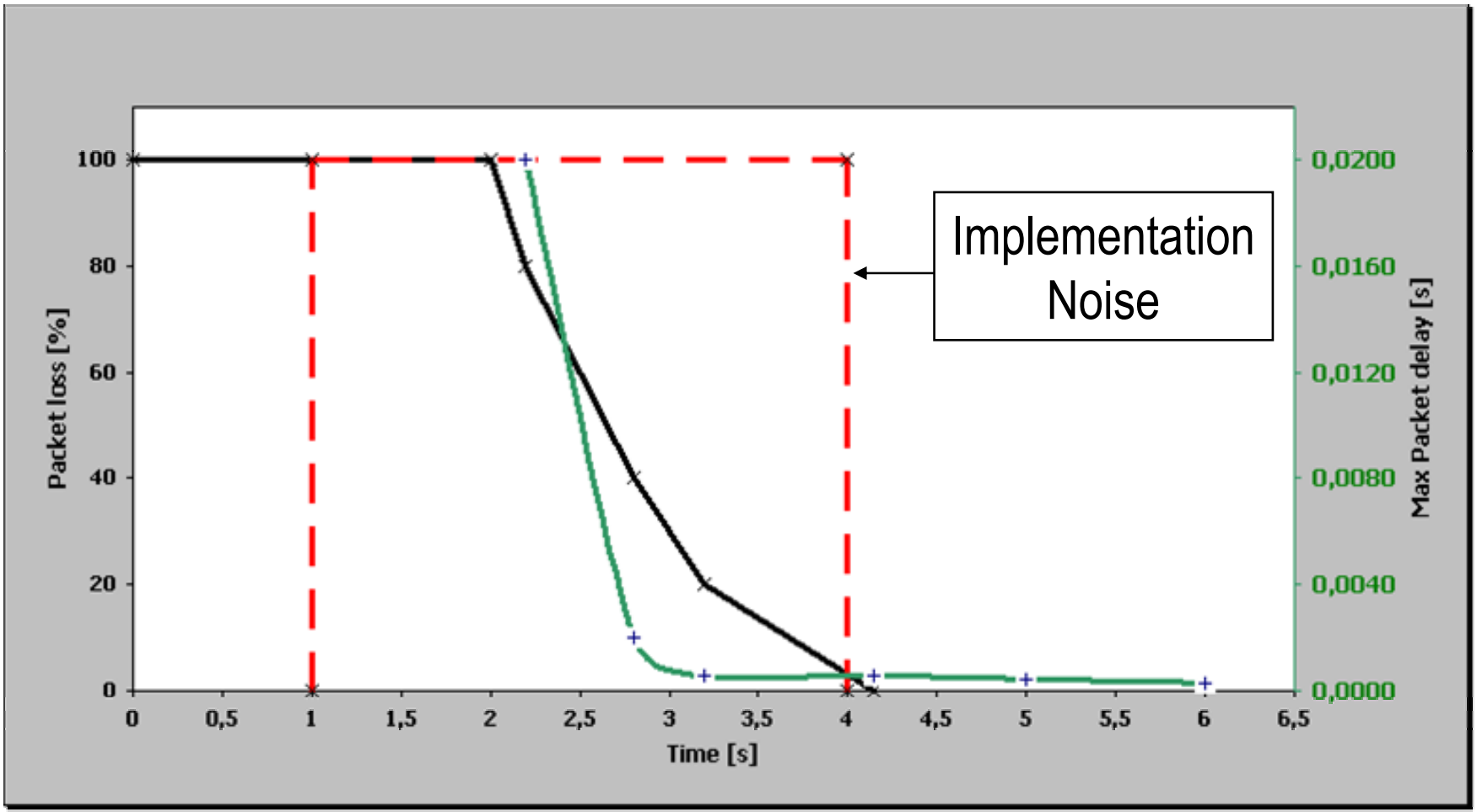


Reduce

- MAX_RA_DELAY_TIME ≈ 1 – 3 ms
- MAX_RTR_SOLICITATION_DELAY ≈ 1 – 3 ms

Empirical Results

FHTW
Rechenzentrum



HA: Linux Debian 2.4.19; MIPL Mobile IPv6 0.9.4
CN,MN: Windows 2000, SP2; MSR (1.4) TCP-IPv6 driver, 5.0.21955.1620
Router: FreeBSD 4.6-STABLE: rtadvd

Accelerating MIPv6 in a General Topology

FHTW Rechenzentrum

Generally HA and CN are at Significant Distance

o Handover Time:

$$t_{handoff} = t_{local} + t_{BU-of-HA} + t_{BU-of-CN}$$

$$\approx t_{local} + \frac{3}{2}\left\{t_{CN} + t_{HA}\right\}$$

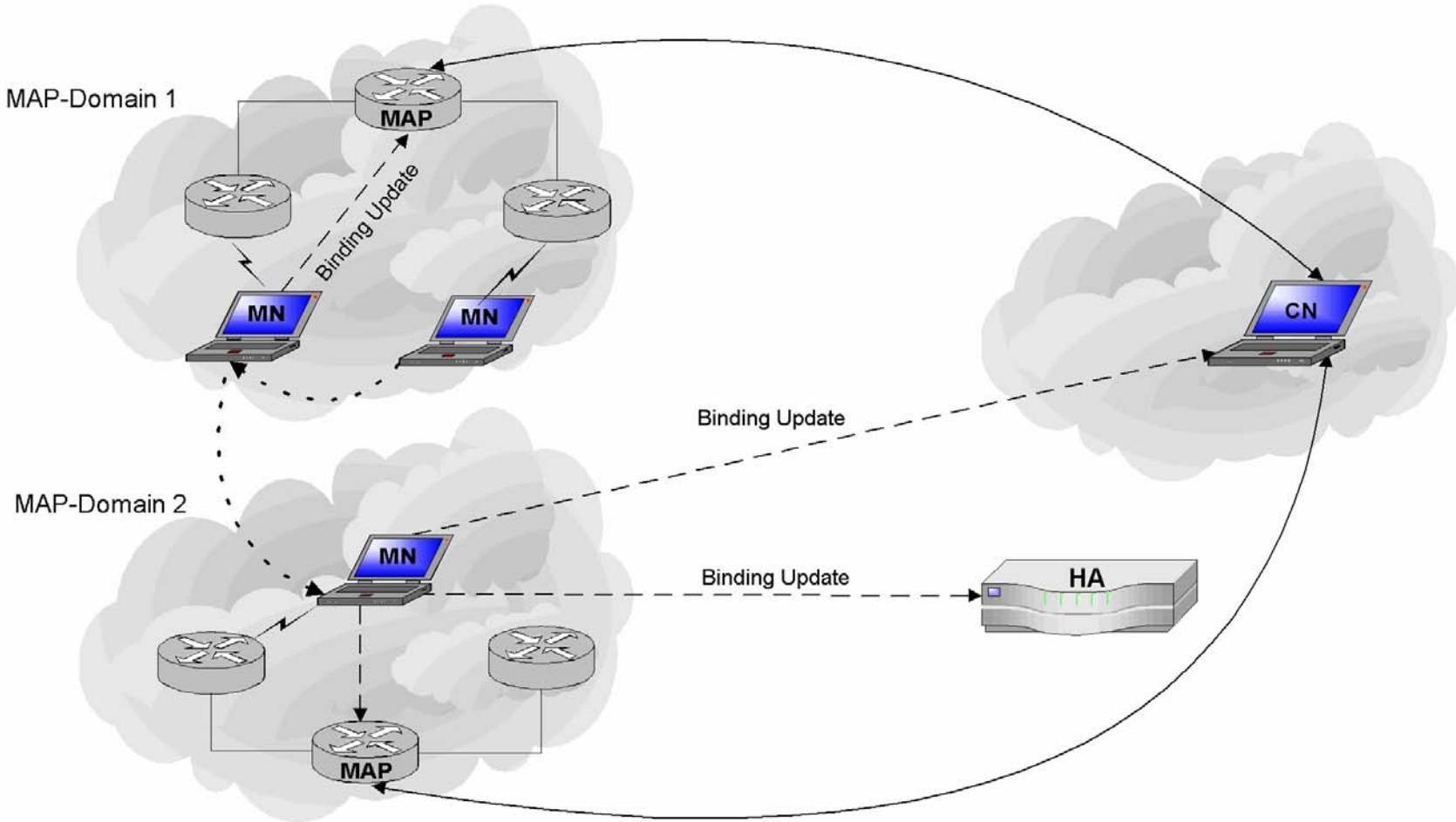
o Jitter Enhancement:

$$\frac{Jitter_{handoff}}{Jitter_{stationary}} \approx \frac{t_{HA} + t_{CN}}{t_{CN}}$$

Essential: Eliminate HA/CN RTT Dependence

Proxy: Hierarchical MIPv6

FHTW Rechenzentrum



Binding Updates with HA and CN preserve t_{CN}, t_{HA} dependence!

Fast MIPv6 Handover

FHTW
Rechenzentrum

Attempt to hide handover procedure by

- Anticipation of Handover from Layer 2
- Directing traffic to new location (Layer 3!)

Problems:

- Layer 2 : Layer 3 topology map needed
- Handover moment not reliably predictable

Conclusions & 'Fast HMIP' Proposal

FHTW Rechenzentrum

Conclusions:

→ Local proxy agent needed

→ Handover hiding needed, as well

Proposal for handover hiding:

→ Use previously established communication path

→ Send and receive via prev. MAP (until BU finished)

→ CN needs to preserve last Binding Cache entries

Resolves t_{CN}, t_{HA} dependency, covers rapid movement

Packet Processing: Tunneling

FHTW Rechenzentrum

Jitter and Delay rely on packet processing

Problems caused by tunneling approach

- extra overhead
- fragmentation at tunnel entry
- QoS parameters lost by encapsulation

Avoid tunneling by

⇒ Forward & readdress at MAP (mobility ext. hds.)

⇒ Rebuild or tunnel only other packets at MAP

Mobile Multicasting

FHTW
Rechenzentrum

- o Bi-directional multicast capabilities needed
- o Problem: asymmetric, slow convergence
  - up to ≈ 30 s at listener
  - up to ≈ 3 min at sender
  - no information on mcast tree completion
- o Use: multicast is stateless and unreliable
- o Use: unicast mobility infrastructure

Mobile Multicast Listener Proposal

FHTW Rechenzentrum

Mobile multicast listener anchored at MAP:

- Submits MLD Listener Report through (new) MAP
- Sends BU to previous MAP on handover (forwarding)
- BU with 0 Lifetime to previous MAP on MLD LR completion

MAP anchoring mobile multicast listeners

- Record subscribed group addresses in binding caches
- Answer MLD queries/sustain mcast tree membership
- Forward multicast packets to the mobile nodes (as unicasts)

Mobile Multicast Source Proposal

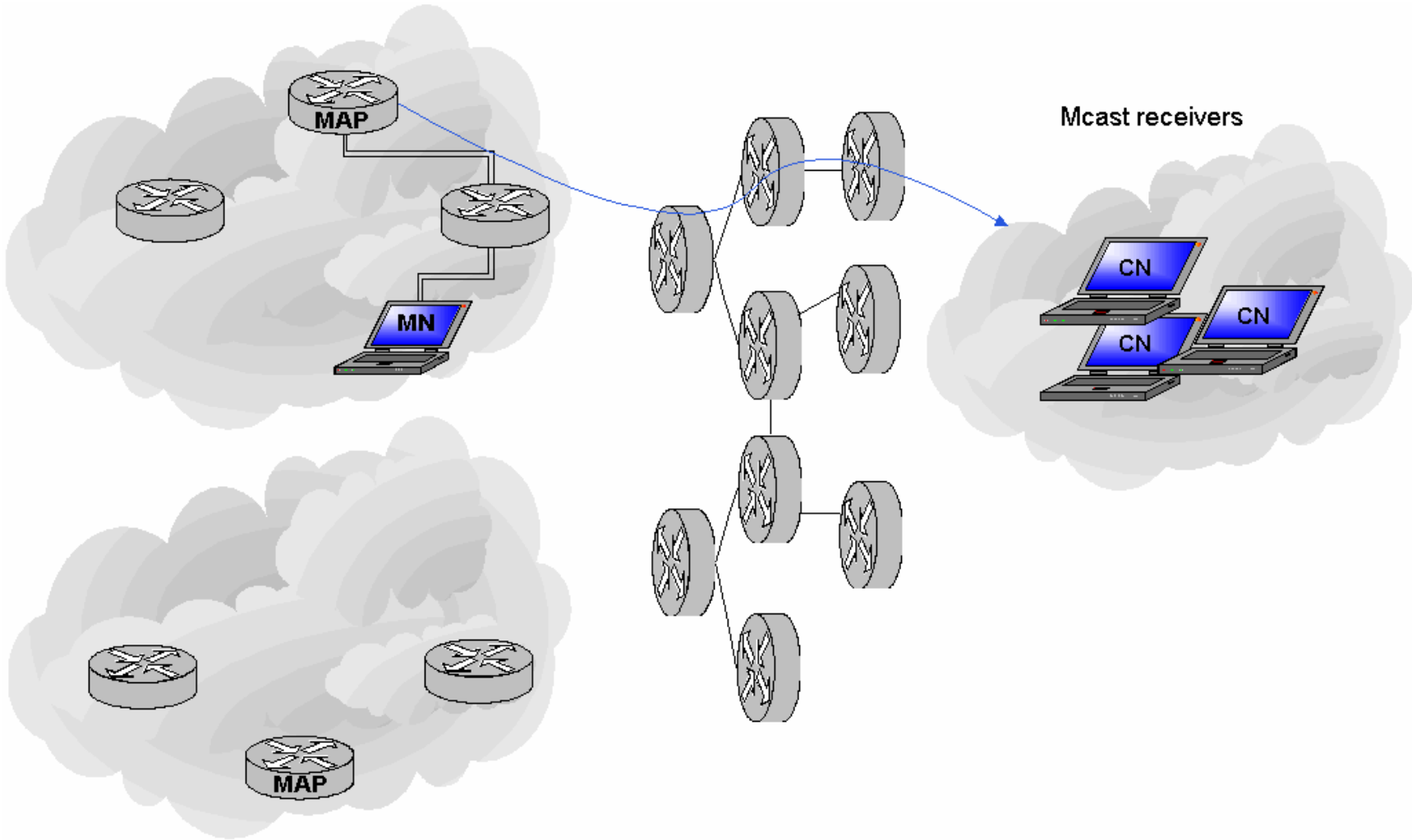
FHTW
Rechenzentrum

Mobile multicast source anchored at MAP:

- Use Home Address Option
  (CN must not verify BC on mcast)
- Send mcast packets exactly as unicast (through MAP)
- On handover continue sending via previous MAP
- On handover start sending via new MAP
- Stop sending via previous MAP on timeout
- On rapid Movement: stay with established MAP

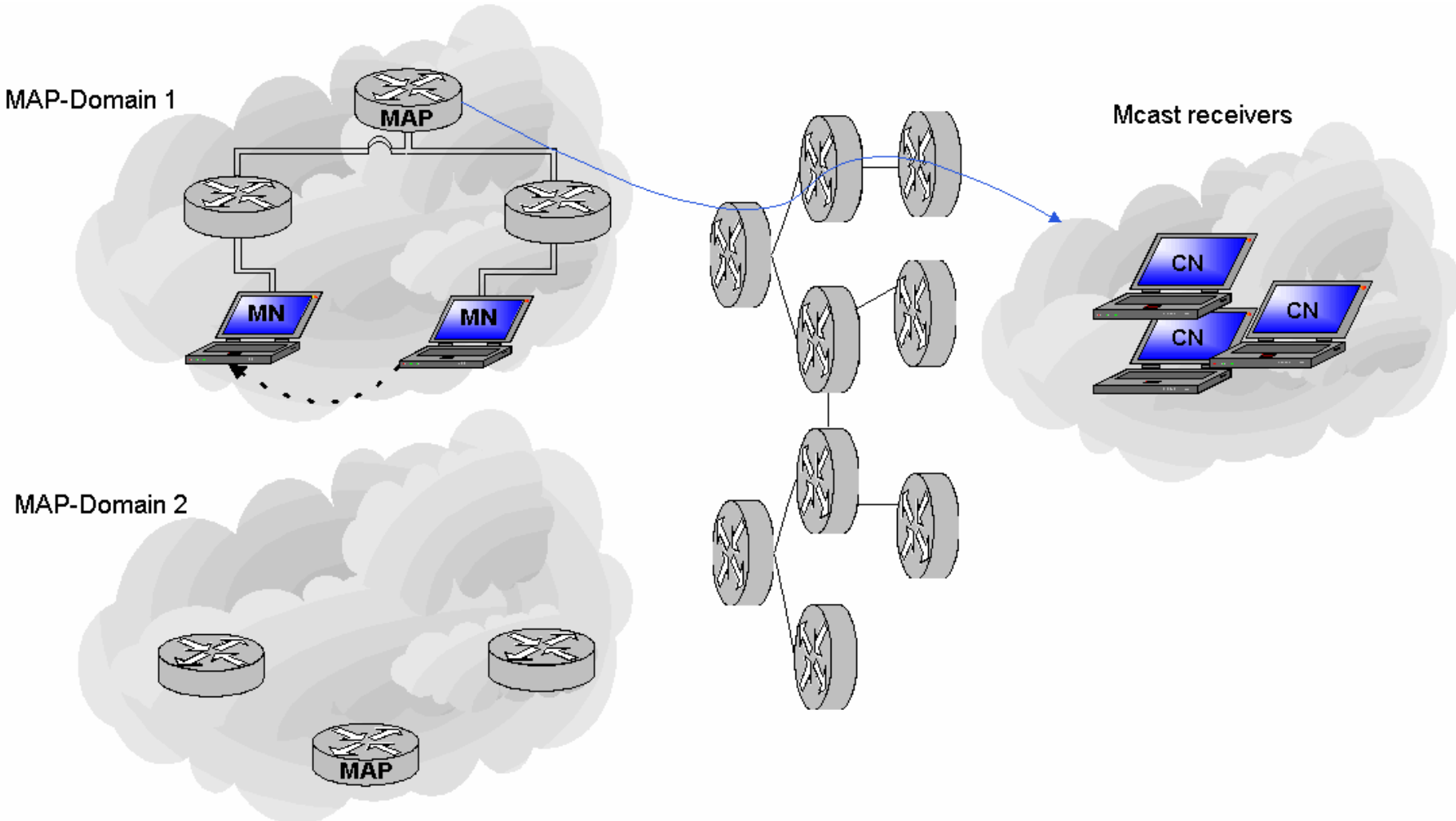
HMIP Multicast Source

FHTW
Rechenzentrum



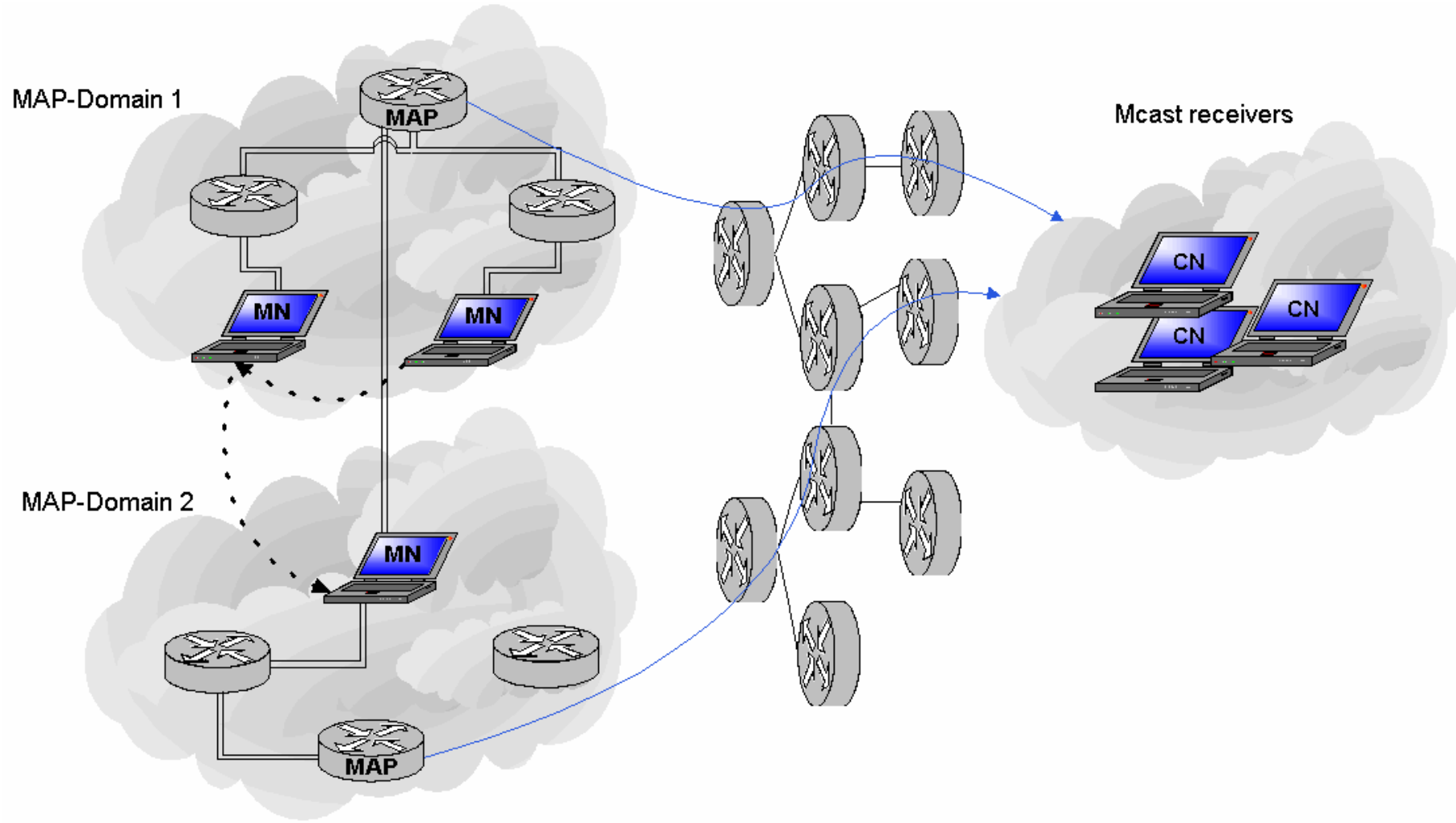
HMIP Multicast Source MAP-Local Handover

FHTW
Rechenzentrum



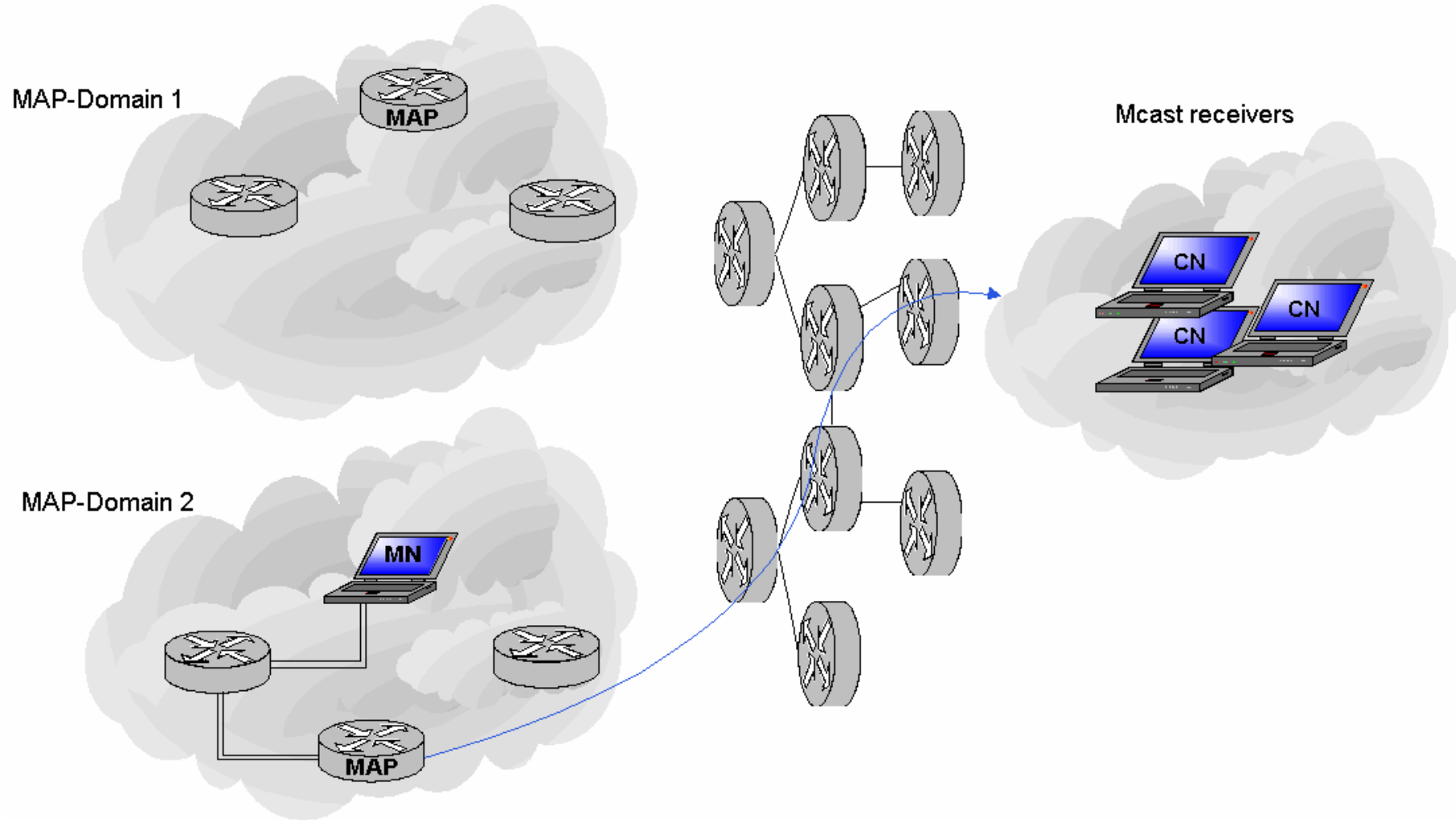
HMIP Multicast Source Inter-MAP Handover (1)

FHTW
Rechenzentrum



HMIP Multicast Source Inter-MAP Handover (2)

FHTW
Rechenzentrum



Conclusions & Outlook

FHTW
Rechenzentrum

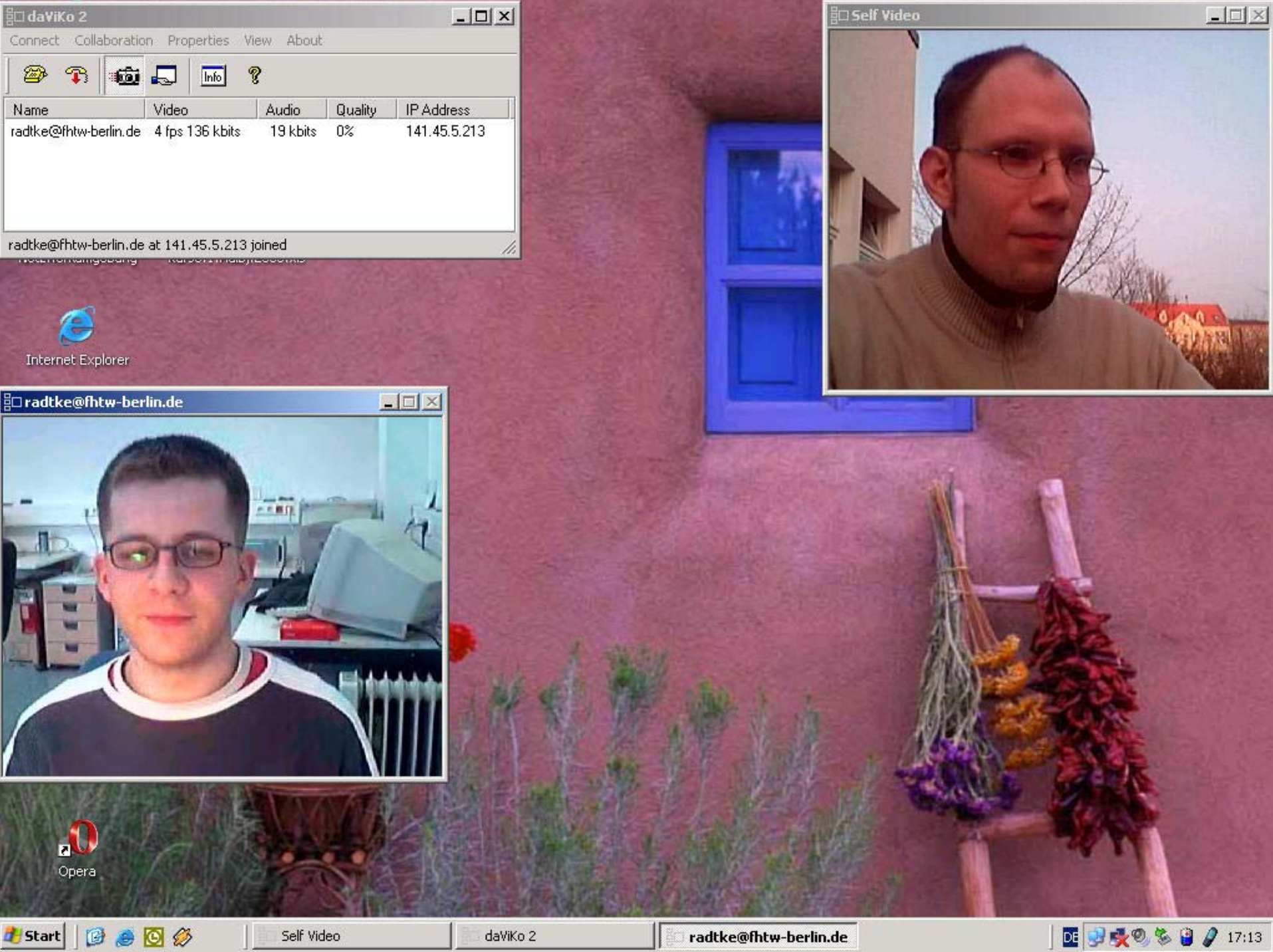
√ MIPv6 can be made suitable for real-time communication.

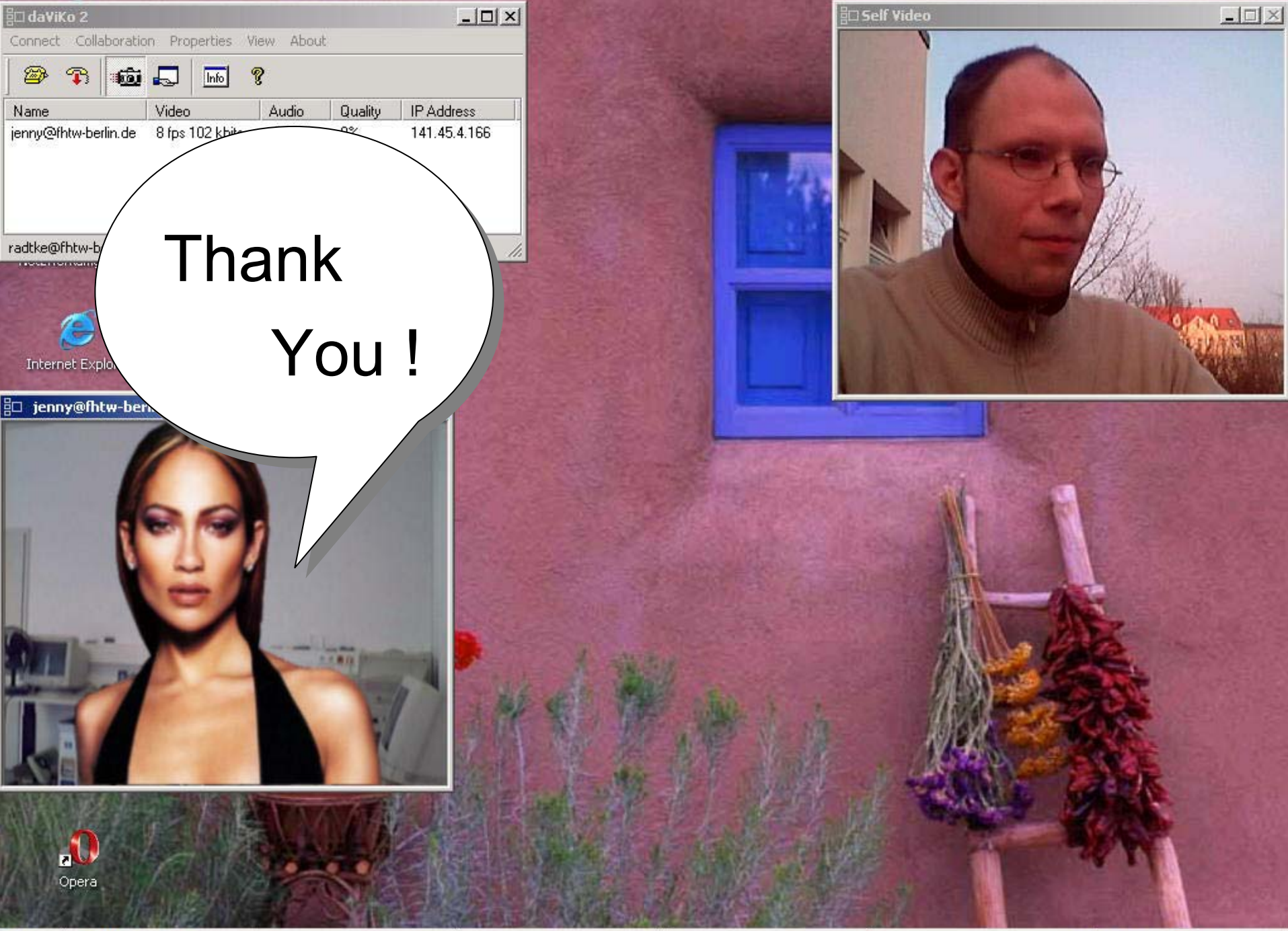
√ Needs proxying and handover hiding.

√ Mobile Multicast approach presented.

Future Development:

- Further analysis & simulation of proposed schemes
- Optimization & refinement


daViKo 2
Connect
Collaboration
Properties
View
About
Info
Name
Video
Audio
Quality
IP Address
radtke@fhtw-berlin.de
4 fps 136 kbits
19 kbits
0%
141.45.5.213
radtke@fhtw-berlin.de at 141.45.5.213 joined
Self Video
Internet Explorer
radtke@fhtw-berlin.de
Opera
Start
Self Video
daViKo 2
radtke@fhtw-berlin.de
17:13


daViKo 2
Connect
Collaboration
Properties
View
About
Info
Name
Video
Audio
Quality
IP Address
jenny@fhtw-berlin.de
8 fps 102 kbit
141.45.4.166
radtke@fhtw-b
Thank
You !
Self Video
jenny@fhtw-ber
Internet Explo
Opera
Start
Self Video
daViKo 2
jenny@fhtw-berlin.de
DE
17:13