Fast and Scalable Handoffs for Wireless Internetworks

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Motivation

Mobility management goals

- Scalability
- Low latency
- Little or no data loss

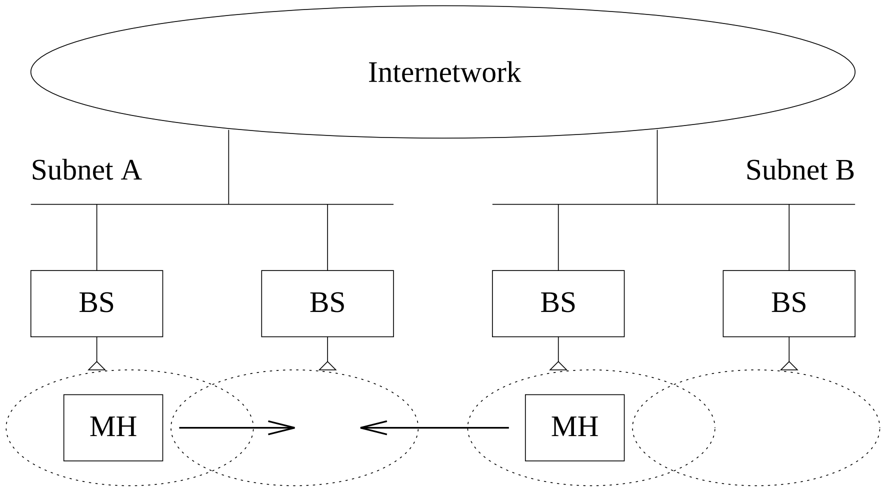
Mobile IP does not currently meet these goals

- Need to contact HA on every change of subnet
- Need to update CHs on every change of subnet when route optimization is used
- Control traffic adds load to the internetwork
- Control traffic can suffer long delays
- Data in transit to MH may be lost

Proposed solutions to these problems

- Hierarchical mobility management
- Fast and reliable local handoffs

Hierarchical Mobility Management



Local mobility management

- Handles common case of motion within a subnet
- Transparent to higher levels

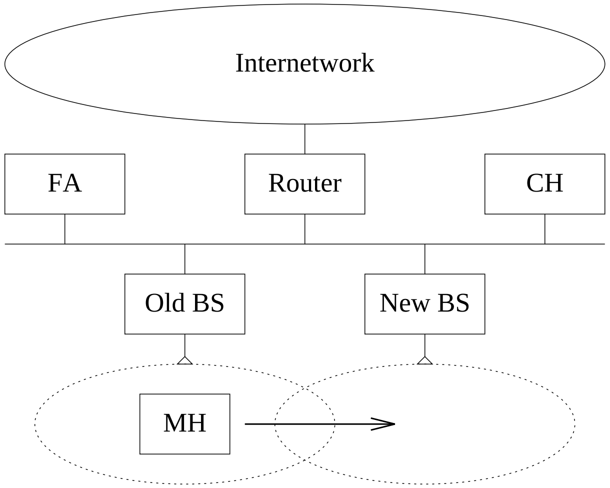
Campus mobility management

- Handles motion across subnets within an administrative domain
- Requires extensions to Mobile IP standard
- Does not involve the home domain

Global mobility management

- Handles motion between domains
- Uses unmodified Mobile IP standard

Fast and Reliable Local Handoffs



Local handoff mechanism

- Based on a lightweight handoff protocol
- Aims to support mobile Internet audio

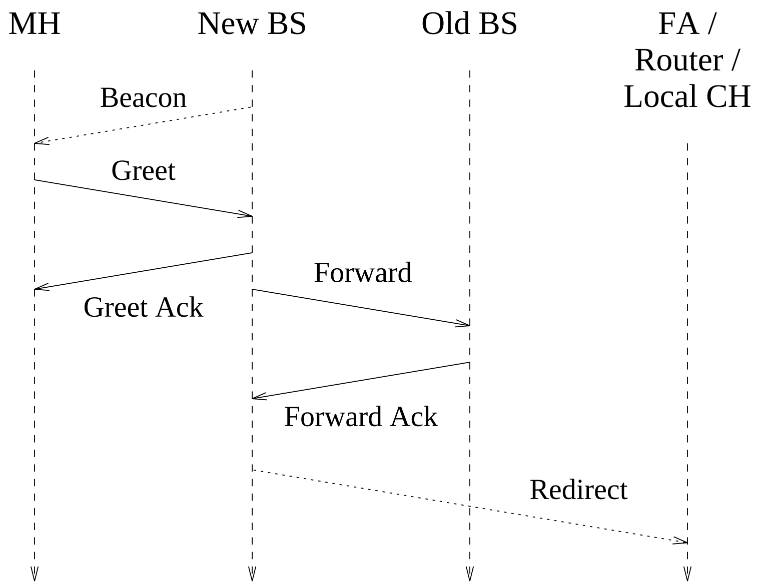
Base stations are IP routers

- Can filter packets based on IP multicast groups
- Can schedule packets based on IP type-of-service (and later based on IPv6 priority and flow id)

Base stations recover from packet losses suffered during handoffs

- BSs buffer packets recently sent to MHs
- Old BS forwards buffered packets to new BS

Lightweight Handoff Protocol



BSs periodically broadcast beacons

MHs initiate handoffs based on beacon strengths

Gratuitous and *proxy* ARP maintain illusion that MHs reside on wired link

- A BS acts as a proxy ARP agent for MHs currently in its cell
- New BS broadcasts gratuitous proxy ARP for arriving MH
- Single ARP packet updates router, FA, and CHs on local subnet
- ARP maintains only soft state

Handoff Performance

Experimental platform

- Solaris kernel implementation
- Pentium PCs as base stations
- Pentium laptops as mobile hosts
- WaveLAN as wireless network

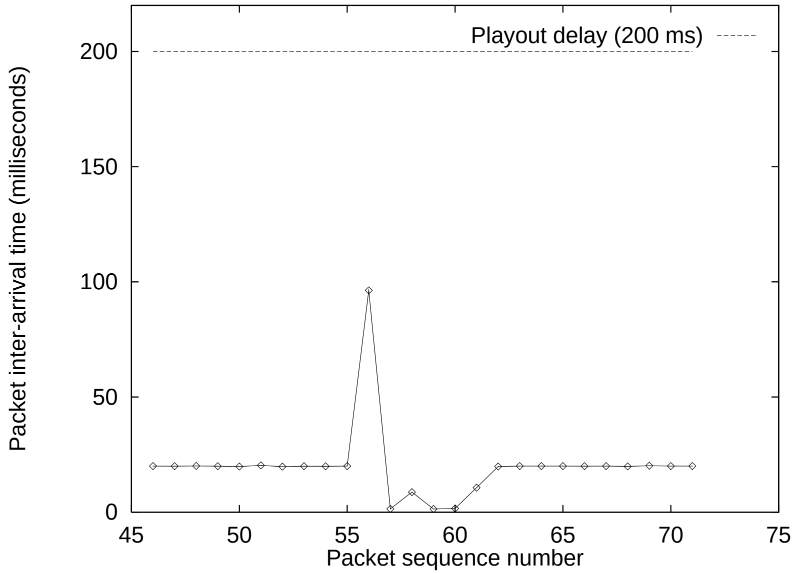
Handoff delay has two components

- Rendezvous delay
- Protocol delay

Rendezvous delay is bounded by beacon period

Protocol delay is < 10 msec

Support for Mobile Internet Audio



Internet audio applications introduce a playout delay

- Used to mask jitter in the network
- Should be $<$ 200 msec for interactive speech

Our handoffs support interactive speech

- 100-msec beacon period with 4-packet handoff buffer
- Maximum jitter is ˜100 msec, well below the playout delay
- Occasional duplicate packet
- No lost packets

Conclusions

Hierarchical handoffs are necessary in large internetworks

Should add hierarchy to Mobile IPv4 and Mobile IPv6

Simple handoffs can support interactive speech

This work helps extend Internet telephony and teleconferencing to mobile devices that communicate over wireless networks

More detail in "Fast and Scalable Handoffs for Wireless Internetworks," to appear in Mobicom '96, November 1996