Mobile Communications Chapter 8: Network Protocols/Mobile IP

- Motivation
- Data transfer
- Encapsulation
- Security
- IPv6
- Problems
- Micro mobility support
- DHCP
- Ad-hoc networks
- Routing protocols

Motivation for Mobile IP

Routing

- based on IP destination address,
- network prefix (e.g. 129.13.42) determines physical subnet
- change of physical subnet => change of IP address to have a topological correct address (standard IP)

Solution: Temporarily change routing table entries for mobile host

- Problem: does not scale if many mobile hosts or frequent location changes

Solution: Change mobile host IP-address

- adjust the host IP address depending on the current location
- DNS updates take to long time
- Old TCP connections break

Requirements to Mobile IP (RFC 3344, was: 3220, was: 2002)

Transparency
- mobile end-systems keep IP address
- Continuous service after link interruption
- point of connection to the fixed network can be changed

Compatibility
- No changes to current hosts, OS, routers
- mobile end-systems can communicate with fixed systems

Security
- authentication of all registration messages

Efficiency and scalability
- only few additional messages to mobile system (low bandwidth)
- Global support for large number of mobile systems

Terminology

Mobile Node (MN)

- Laptop, PDA, etc.. that may move about

Home Agent (HA)

- Router in home network of the MN, helps in forwarding
- registers current MN location, tunnels IP datagrams to COA

Foreign Agent (FA)

- Router in current foreign network of MN
- forwards tunneled datagrams to the MN

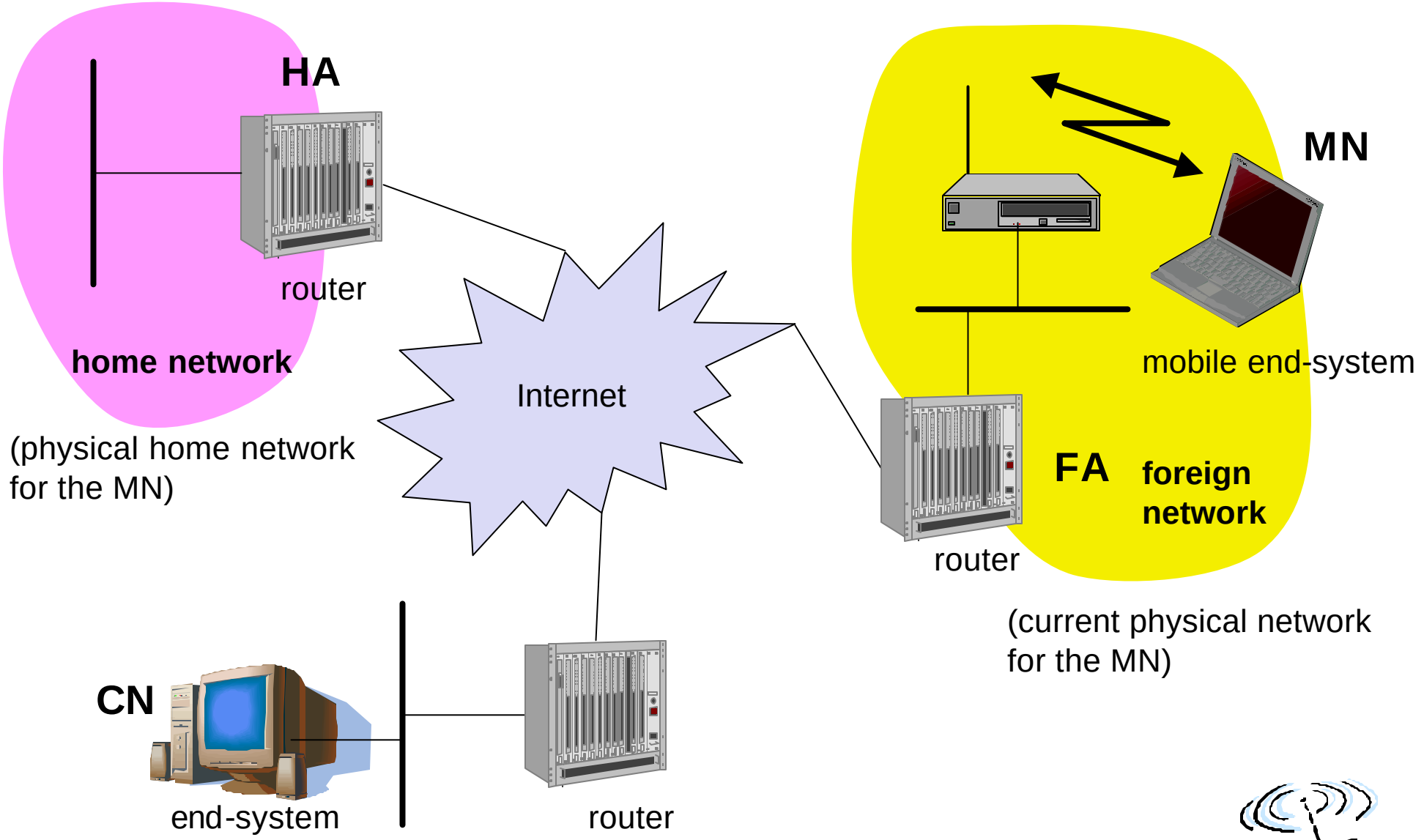
Care-of Address (COA)

- address of the current tunnel end-point for the MN (at FA or MN)
- can be chosen, e.g., via DHCP

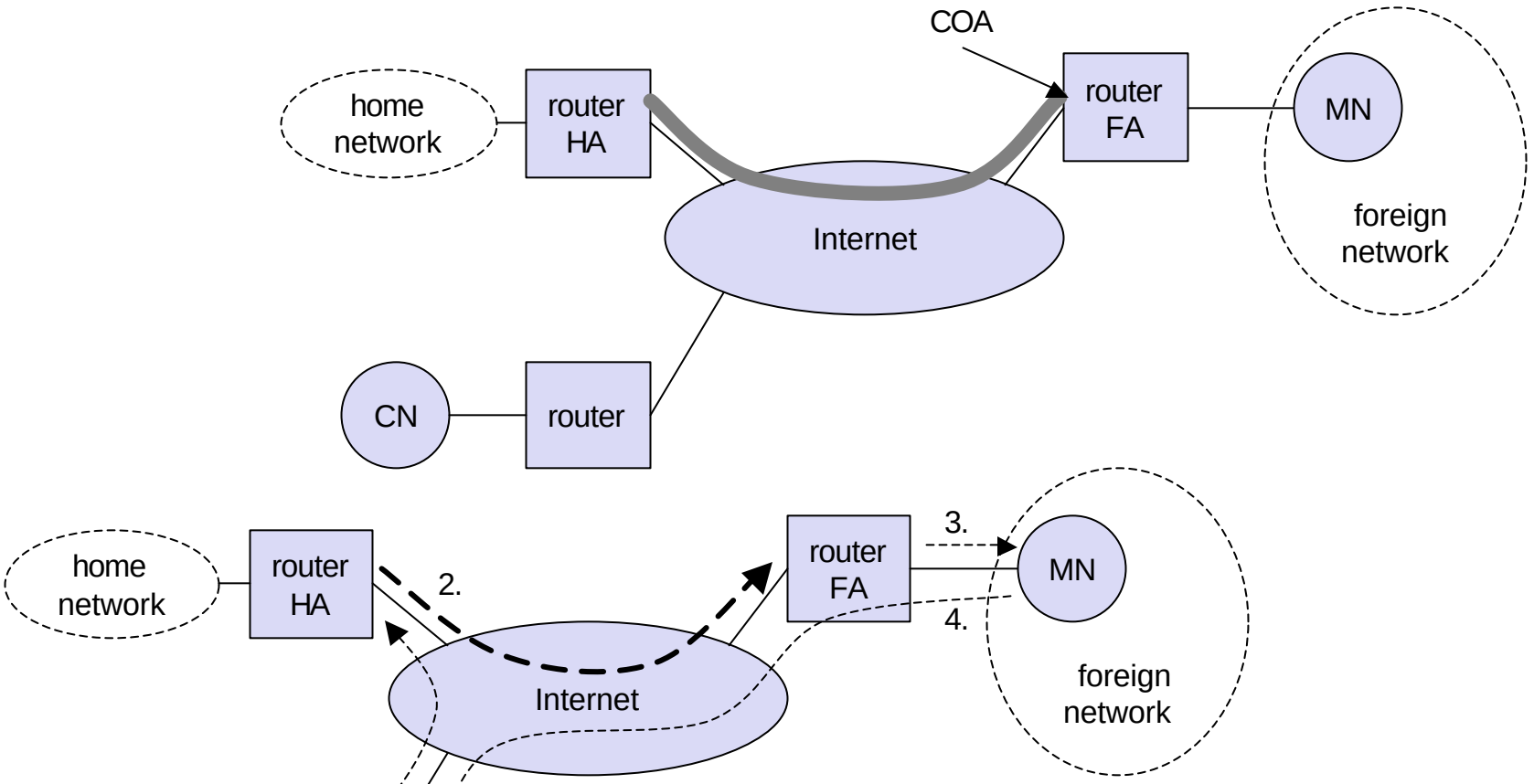
Correspondent Node (CN)

- Node that wants to communicate with MN

Example network



Overview



1. Sender sends to the IP address of MN, HA intercepts packet
2. HA tunnels packet to COA by encapsulation
3. FA forwards the packet to MN
4. Reverse: Sender sends to IP address of receiver, FA is default router

Network integration

Agent Advertisement

- HA and FA periodically send advertisement messages into their subnets
- MN reads a COA from the FA advertisement messages

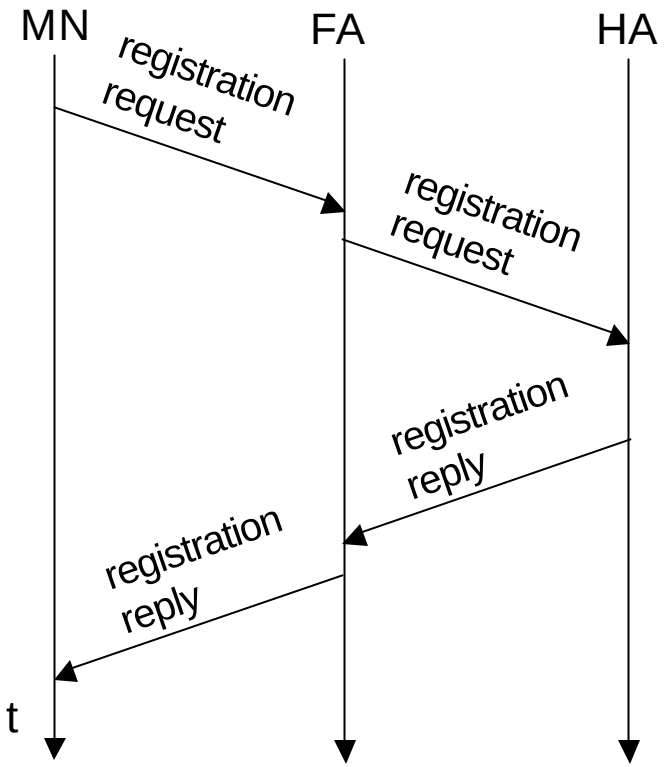
Registration (always limited lifetime!)

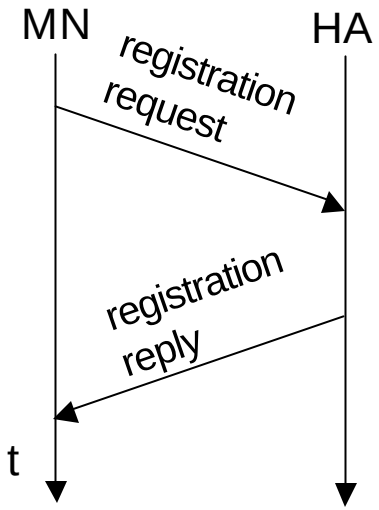
- MN signals COA to the HA via the FA, HA acknowledges
- Messeges need to be secured by authentication

Advertisement

- HA advertises the MN IP address (as for fixed systems)
- routers adjust their entries, (HA responsible for a long time)
- All packets to MN are sent to HA

Registration

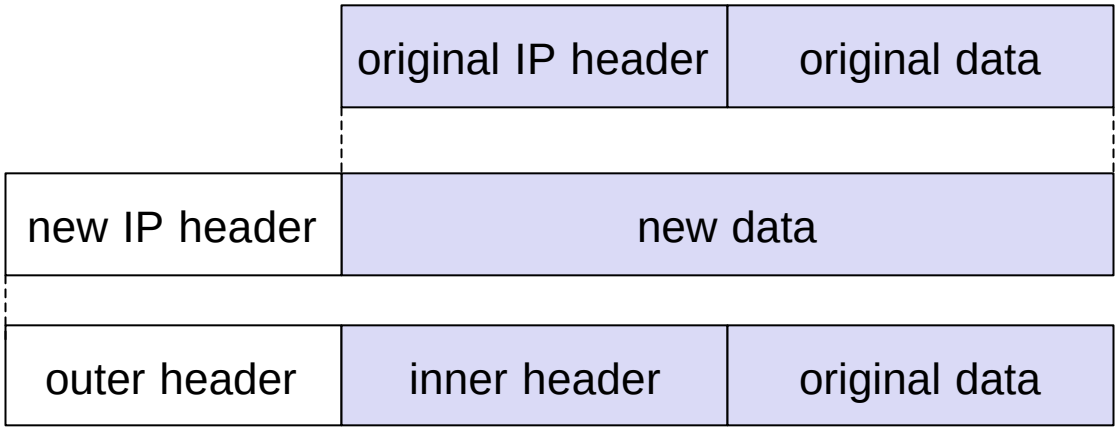




Encapsulation

Encapsulation of one packet into another as payload

- e.g. IP-in-IP-encapsulation (mandatory, RFC 2003)
- tunnel between HA and COA



Optimization of packet forwarding

Triangular Routing

- sender sends all packets via HA to MN
- Triangular routes longer, higher latency and network load

“Solutions”

- HA informs a sender about the location of MN
- sender learns current location of MN
- direct tunneling to this location
- big security problems!

Change of FA

- packets on-the-fly during the change can be lost
- new FA informs old FA to avoid packet loss
- old FA forwards remaining packets to new FA
- Update also enables old FA to release resources for MN

Mobile IP and IPv6

Mobile IP was developed for IPv4, but IPv6 simplifies the protocols

- security is integrated, not add-on, authentication of registration included
- COA can be assigned via auto-configuration (DHCPv6 is one candidate)
- every node has address autoconfiguration
- no need for a separate FA, **all** routers perform router advertisement
- MN can signal a sender directly the COA, without HA
- „soft“ hand-over, i.e. without packet loss supported
  - MN sends the new COA to its old router
  - old router encapsulates all packets for MN, forwards them to new COA
  - authentication is always granted

Problems with mobile IP

Security
- FA typically belongs to another organization
- authentication with FA problematic
- patent and export restrictions

Firewalls
- Firewalls filter based on IP addresses
- FA encapsulates packets from MN
- Home firewalls rejects packet from MN (unless reverse tunneling)
- MN can no longer send packets back to home network

QoS, etc..

Security, firewalls, QoS etc. are topics of current research and discussions!

IP Micro-mobility support

Micro-mobility support:

- Efficient local handover inside foreign domain without involving a home agent
- Reduces control traffic on backbone
- Especially needed for route optimization

Example approaches:

- Cellular IP
- HAWAII
- Hierarchical Mobile IP (HMIP)

Cellular IP

Operation:

- „CIP Nodes“ maintain routing entries (soft state) for MNs
- Multiple entries possible
- Routing entries updated based on update packets sent by MN

CIP Gateway:

- Mobile IP tunnel endpoint
- Initial registration processing

- Other micromobility protocols
  - HAWAII
  - Hierarchical Mobile IPv6 (HMIPv6)