Mobile IP

Henrik Petander
henrik.petander@hut.fi

Mobile IP

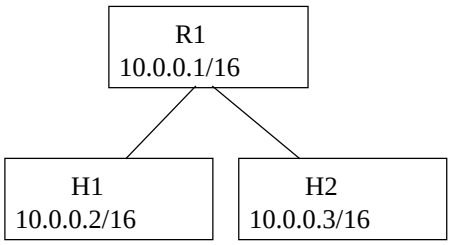
- Mobility Management
- Mobile IPv4
- Extensions to MIPv4
- MIPv4 at HUT
- Mobile IPv6
- Mobile IPv6 security
- Mobile IPv6 extensions
- Mobile IPv6 at HUT

Need for Mobility Support

- A trend towards more mobile computers: laptops, PDAs, cell phones, etc.
- Users want their applications to work in spite of movement
- Connections should not break, required user actions should be minimal (no rebooting)
- Requirements on mobility support depends on the frequency of handoffs

Routing in IP networks

- Routing between networks based on network prefix
- Network topology determines the prefix
- Address depends on the point of attachment
- Hosts need to change their address when changing the network



TCP/IP Connections

- Connections multiplexed by the source and destination address and port
- Changing of either sides address breaks the connection in both ends
- Problem: Address of the mobile node should change to be topologically correct but this would break the connection

On what layer should the mobility be handled?

- User: boot the machine or close applications and restart the networking when moving, current practice
- Application: inefficient, every application needs to be modified
- Transport: Possible, problems with keeping track of the changing IP addresses of the peer, maybe fqdns should be used instead => Dynamic DNS for slowly moving nodes

On what layer should the mobility be handled?

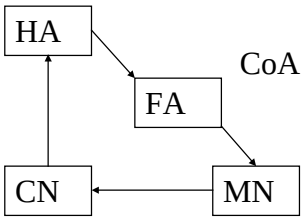
- IP layer: Mobile IP and its extensions, adds some protocol overhead to network connections, but mobility is transparent to transport layers and applications
- Link layer: GPRS, Lucent WLAN extensions, lower overhead, but not feasible for larger movement
- No one perfect solution for all situations, a combination of the above might be a good recipe

Mobile IPv4

- Mobility support built on top of IPv4, signaling done on top of UDP, RFC 2002
- Four entities: Home Agent, Mobile Node, Correspondent Node, Foreign Agent
- Mobility of MNs transparent to Correspondent nodes
- Routing is handled with tunneling of packets sent to home address of MN
- Signaling authenticated with authentication extensions which use HMAC MD5

Mobile IPv4

- CN sends packets to home address
- HA tunnels packets from home address to care-of address
- MN sends packets directly to CN
- Triangular routing



Mobile IPv4

- MN acquires a new care-of address, either a co-located CoA, or FA CoA
- MN sends a registration request to FA which further sends it to HA
- HA sends a reg. reply back and performs gratuitous ARP for home address
- HA tunnels packets to CoA

Mobile IPv4

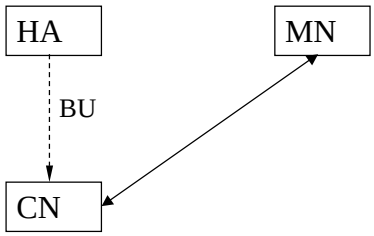
- FA or MN decapsulates packet, depending on the location of CoA
- Problems with triangle routing: asymmetric routes, ingress filtering (home address as the source address is topologically incorrect)
- Solution: Reverse tunneling, RFC 3024

Route Optimization

- Triangle Routing and Reverse Tunneling inefficient if HA and CN are far from each other
- Route Optimization, draft-ietf-mobileip-optim-10.txt, provides direct routing between CN and MN
- Introduces Binding Cache and Binding Update

Route Optimization

- HA sends BU to CN when it receives a packet to MN's home address
- Problem: CN needs to authenticate the BU
- Key management needed
- Changes to OSs of CNs



Movement detection

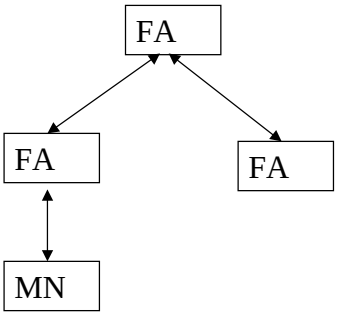
- MN detects movement based on agent advertisements, also learns of Fas
- Long HO delays, packet loss, TCP mistakes for congestion control
- Link & transport layer information can be used for HO decisions
- Buffering in FAs, bicasting, state transfer, etc., for better performance

Issues with MIPv4

- Inefficient routing, tunnel soft states, triangle routing...
- No key management, no key establishment
- Missing support in OSs, implementations available but not as part of OS (except Solaris 8)
- Vendors more interested in MIPv6?

Mobile IPv4 at HUT

- Dynamics MIP implementation with hierarchical FAs
- FAs deployed in the mediapoli wireless network
- MART-nodes, Embedded Linux systems, act as Fas
- http://www.cs.hut.fi/Research/Dynamics & http://www.mediapoli.com

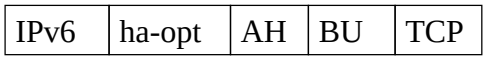


Mobile IPv6

- Provides significant improvements to MIPv4, one of the key incentives for transitioning to IPv6
- An integral part of the IPv6 stack
- Uses IPv6 destination options for signaling
- Route optimization is a part of the protocol
- IPSec is used for authenticating the signaling
- No FAs, just routers

Mobile IPv6 signaling

- Binding Update binds home address to current CoA
- HA sends Binding Acknowledgement
- CNs can send a Binding Request for getting a BU
- Home Address option
- Piggybacking possible

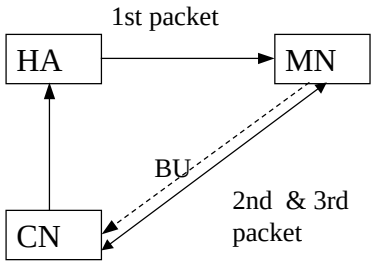


MIPv6 and Security

- IPSec AH used for authentication of BUs and Bas and replay protection
- Protection against forced delay attacks missing
- IKE, RFC 2409, used for key negotiation
- Key management still a problem, DNSSec a possible solution
- Authorization of BUs, IKE identity vs address

MIPv6 Route Optimization

- Reduces the delay between MN and CN, probably also increases the throughput
- MN sends BUs to CNs, when it receives a tunneled packet
- Privacy issues, location tracking possible
- A good policy for sending of BUs eases the protection of privacy



MIPv6 Extensions

- Fast handoff schemes
- Homeless Mobile IPv6, Pekka Nikander
- Regional registrations
- Mobile Networks
- Use with IPSec ESP
- Drafts available at: http://www.ietf.org/html.charters/mobileip-charter.html

Issues with MIPv6

- Deployment of IPv6: Most OS and network equipment vendors have their own implementations: Sun, MS, Nokia, Ericsson, BSDs, Kame, Compaq etc.
- Missing key management infra: DNSSec or PKI
- Access control and billing in foreign networks

MIPv6 at TML

- MIPL implementation, originally tik-76.115 sw project, developed further as part of GO-project
- Supports route optimization, also limited IPSec AH support with FreeS/WAN IKE implementation
- Works with Linux kernels 2.4.xx as a kernel module, source package available at http://www.mipl.mediapoli.com

MIPv6 at TML

- Plans to add IPv6 support to mediapoli WLAN
- Ongoing research:
  - fast handoffs,
  - use with Ad Hoc networking,
  - security issues,
  - transition mechanisms,
  - access control and billing issues