Mobile IP

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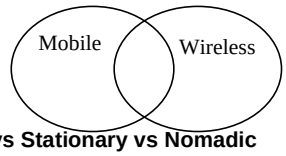
- **Wireless: Introduction**
- **Problem: IP Addresses and location**
- **Solution: Mobile IP**

Mobile vs Wireless



- **Mobile vs Stationary vs Nomadic**
- **Wireless vs Wired**
- **Wireless ⇒ media sharing issues**
- **Mobile ⇒ routing, location, addressing issues**
- **Nomadic => terminate existing communications before leaving point-of-attachment. Later, reconnect.**

Wireless link layers

- Cellular Digital Packet Data (CDPD):
  - Send IP packets over unoccupied radio channels within the analog cellular-telephone systems
  - Not circuit switched => no per-call/call-duration charges
  - Usage-based billing (contract w/ CDPD providers who have roaming agreements w/ other providers) => a wide area mobility solution (limited by availablility)
  - Carrier provides IP address, but link layer protocols are responsible for ensuring packets are delivered
  - Max data rate of 11 kbps

Wireless link layers (contd)

- IEEE 802.11
  - Wireless LANs: 1-2 Mbps.
  - Defines a set of transceivers which interface between wireless/wired
  - Link layer protocols make entire network of transceivers appear as one link at network layer => mobility in 802.11 invisible to IP
  - Changing router boundaries => interrupts communications => need to support mobile IP
- Mobile IP: independent of link layer technology
- Goal: “seamless” roaming.
  - Radio LAN connections in premises
  - Cellular telephone for out-of-range

Drivers for Mobile IP

- IP Address is used for two purposes:
  - To identify an endpoint
  - To help route the packet
- Move from subnet ("link") => need to change address to allow routing
- Problem 1: How to route packets to this node at its new link ?
- Problem 2: Can we avoid changing the addresses seen by higher layer protocols ?
  - Several protocols affected by address change: DNS, TCP, UDP.

Naïve solutions

- Why not have host-specific routes ?
  - Routers aggregate and use network prefixes for routing. Having host specific routes does not lend to this kind of aggregation => scalability problem
- Why not change the address of the mobile as it moves?
  - Query/Update traffic to DNS increases.
  - TCP/UDP assume that the IP address is constant for the same endpoint

Mobility Wish list vs Mobile IP scope

- Mobility Wish list
  - Scalability: millions of mobile nodes, minimum router state
  - Allow mobile node to frequently change links
  - Do not tear down sessions as mobile node changes links
  - Automatically configure (find routers/addresses etc) when it moves
  - Withstand security attacks
- Mobile IP scope:
  - Provide efficient, transparent routing to mobile node
  - Allow applications/transports to use one IP address for communication

IP mobility model

- *Two-level addressing:*
  - Home address : fixed (permanent) address used by other nodes to communicate with the mobile node.
  - Care-of-address: address on a (foreign) link to which the mobile is currently attached.
- *Home agent:*
  - Tracks care-of-address of mobile
  - Re-addresses packets destined to home address and tunnels them to the care-of-address {proxy functionality}
- *Foreign agent:*
  - Gives mobile node its care-of-address. Optimizes IP address use.Terminates tunnel from home agent
  - Default router for packets from mobile node

Mobile IP: Processes

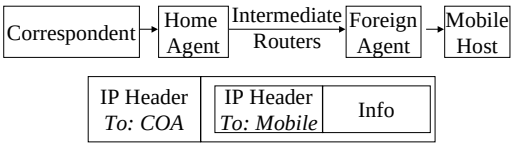
- Agent Discovery: To find agents
  - Home agents and foreign agents advertise periodically on network layer and optionally on data link
  - They also respond to solicitation from mobile node
  - Mobile selects an agent and gets/uses care-of-address
  - If mobile on home link, no other mobile IP feature is used
- Registration:
  - Mobile registers its care-of-address with home agent. Either directly or through foreign agent
  - Home agent sends a reply to the mobile node via FA

Processes (Cont)

- Each "Mobility binding" has a negotiated lifetime limit
- To continue, reregister within lifetime
- Return to Home:
  - Mobile node de-registers with home agent sets care-of-address to its permanent IP address
  - Lifetime = 0 $\Rightarrow$ De-registration
- De-registration with foreign agents is not required. Expires automatically
- Simultaneous registrations with more than one COA allowed (for handoff)

Encapsulation/Tunneling

- Home agent intercepts mobile node's datagrams (using proxy ARP) and forwards them to care-of-address. Called “triangle routing”: sub-optimal
- Home agent tells local nodes and routers to send mobile node's datagrams to it
- De-capsulation: Extracted datagram sent to mobile node



Mobile IPv6

- No need for foreign agent
  - Use IPv6 auto-configuration to quickly obtain care-of-address
  - Enough address space in IPv6 => no need for optimization done by typical FAs
- Routing header is implemented more efficiently & securely
  - Route optimization (triangle routing avoidance) can be done with less security concerns
  - Source routing and tunneling can be used.
- The mobile can send registration (binding) messages to peer (as well as home agent)

TCP considerations

- Timer initial value can lead to spurious retransmissions
  - Need to make the timer configurable or user needs to be aware of the problems
- Congestion management: handoff interpreted as loss by Van Jacobson's algorithm
  - Use of SACK option helps: prevents unnecessary retransmissions
  - Transparency => mechanisms outside the network layer. Eg snoop protocol
- Transmission and timeout freezing on wireless links
- TCP spoofing or connection segmentation

Summary

- Wireless vs mobile
- IP: Transparent mobility via home/foreign agents
- Mobile IPv6 allows easier configuration, better security and optimization
- Mobile IP is not a complete mobility solution

Mobile IP: References

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