Design Choices for Mobile IP

- Two papers:
  - "Supporting Mobility in Mosquito Net"
    - Discussion and implementation paper
  - "Internet Mobility 4x4"
    - Design choices and discussion paper

Providing Host Mobility

- Ubiquitous network connectivity is a reality today
- Hosts can move, but the connection stays
- Approaches
  - TCP solution
  - IP solution
    - Router change
    - No router change

Maintaining Connectivity

- Involved parties:
  - Mobile Host (MH), Corresponding Host (CH)
  - Home Agent (HA) at home network
  - Foreign Agent (FA) at foreign network
  - Mobile host belongs to home network, has a constant home IP address
  - Mobile host roams around, visiting foreign networks
  - At a foreign network the mobile host gets a "care-of" address

Tunneling

- Encapsulation: wrap one IP packet with another IP packet
- Decapsulation: strip off the outside header

- Who performs tunneling:
  - Host agent
  - Foreign agent or mobile host

Other Mobile IP Systems

- Columbia Mobile IP system: needs Mobile Support Router
- Internet Mobile Host Protocol and Harvard System: converge to optimal route efficiently
- Virtual IP: virtual network layer and physical network layer
- IETF Mobile IP: expects foreign agents to decapsulate packets

Mobile IP in Mosquito Net

- Only mobile host and home agent require mobility support
  - Mobile host acquires a temporary care-of IP address from foreign network (through DHCP), notifies the home agent of the address
  - Home agent tunnels all packets between a mobile host's corresponding host and the mobile host
    - acts as a ARP proxy; maintains mobility binding
  - Software at the IP layer on the mobile host performs all tunneling operations

Triangle Routes

- Mobile host directly responds to corresponding host
  - set source IP address to its home IP address
  - no encapsulation on outgoing packets
- Problem: such packet might get dropped
  - some routers forbid transit traffic
  - Solution: encapsulate with mobile host's care-of address, relying on the receiver to decapsulate them

Route decisions for a Packet

- Should a packet be sent directly to corresponding host or tunneled through the home agent
- If the packet is sent directly, should it be encapsulated
- Should the home IP address or the local address be used as the corresponding address

Adding Mobility to Linux

- Change the ip_rt_route function
  - Determines the route for a packet, to whom the packet should be sent to, and via which interface; Called at least once for each IP packet
- Add a Mobile Policy Table
  - decides whether a packet requires mobile IP based on source and destination address
- Add a virtual link-level interface
  - Encapsulates and hands packet back to IP

Changes to Host Agent

- Mobility binding table
- Virtual Interface device
- Decapsulation layer and IP forwarding

Performance Evaluation

- Mobile host: 40MHz Pentium with Metricom radio modems
- Home agent: 90MHz Pentium
- Results:
  - Switching care-of address takes ~ 10ms
  - Cold switching between network interfaces takes 1.25 sec
  - Hot switching < 250ms
  - Mobile host registering a new care-of address takes 7.39ms

4x4 Design Choices in Mobile IP

- Mobile IP route optimizations depend on:
  - the characteristics of the protocol
  - the permissiveness of the network routers
    - Routers should drop packets that come from outside but claims to be from the internal network
    - Transit traffic may be forbidden
  - the level of mobile awareness of the corresponding host
    - Can it encapsulate/decapsulate packet or not?
    - Can it learn the care-of address via ICMP or DNS or not?

Choices of Outgoing Packets

- Out-IE: Indirect (goes to home agent), encapsulated (with home agent as dest address)
- Out-DE: Direct (to corresponding host), encapsulated (with corresponding host as dest)
- Out-DH: Direct, Home Address
- Out-DT: Direct, Temporary Address
  - Good for HTTP requests or other short connections

Choices of Incoming Packets

- In-IE: indirect (through home agent), encapsulated (with home agent as source)
- In-DE: direct, encapsulated
  - requires mobile-aware corresponding host
- In-DH: direct, home address
  - When the hosts are on the same network segment
- In-DT: direct, temporary address

Evaluating the 16 Choices

- (Figure 10 on page 9 of the paper)

Making the Decisions

- Mobility-aware software binds to a particular interface
- Rule-based specification on which encapsulation method to use