Scalable Mobility Support for Overlay Networks

Venkata N. Padmanabhan
Randy H. Katz

(Includes collaborative work with Ramon Caceres)

University of California at Berkeley
Objectives

• Scalable mobility support over a wide area

• Support for fast handoffs within a local environment
  • real-time audio/video across handoffs

• Support for overlay networks
  • using multiple NIs simultaneously
  • vertical handoffs
Mobile IP

• Entities
  • Mobile host
  • Home agent
  • Foreign agent
  • Correspondent host

• MH registers its care-of-address with its HA after each handoff

• Normal data flow: tunneled from HA to FA or MH

• Route optimization: tunneled from CH to FA or MH
Why Mobile IP is inadequate?

- Excessive communication with the home agent
  - latency of communication
  - load on home agent and backbone network
- Local handoff protocol is coupled with the global mobile routing protocol
- No support for multiple care-of-addresses for a mobile host
  - simultaneous registrations is not quite the same thing
Hierarchical Mobility Agents

- Hierarchy of mobility agents (MA) in a domain (like UCB)
  - incorporate some functionality of both home agents and foreign agents

- MH uses address of top-level MA as care-of-address

- Common case: local mobility
  - changes confined to subtree rooted at common ancestor MA
  - protocol between lower-level and higher-level MAs
Hierarchical Mobility Agents
Issues

• Security
  • MA hierarchy should coincide with security domain
  • authentication protocol between MAs in a domain

• Routing
  • host routes maintained by MAs to avoid repeated encapsulation/decapsulation
  • can optimize with support from CH and MH

• MA as a multi-protocol agent
  • can use optimized protocol for local handoffs
  • Example: multicast in a local environment for efficient low-latency handoff
Overlay Network Issues

- Vertical handoffs may violate locality
  - routes to WaveLAN and Metricom base stations diverge far from the mobile host
  - WaveLAN and IR base stations might be close to each other

- Simultaneous use of multiple overlays
  - Example: CDPD for short, bursty data; cellular modem for bulk data
  - route data to MH via appropriate network based on constraints/preferences
  - demultiplexing at HA, FA, or CH
  - tolerate loss of connectivity on a subset of NIs
Mobility-aware End Hosts

- Desire direct communication between CH and MH
  - efficiency, fault tolerance

- Mobile IP route optimization
  - out-of-band caching scheme

- IPv6 mobility support
  - MH acquires care-of address (auto-configuration)
  - MH sends binding update to CH using destination option
  - CH uses routing header to specify care-of address in source route
  - HA uses encapsulation to route via care-of address
  - overlays not considered
Mobility-aware End Hosts (contd.)

Our approach:

- Decouple transport address from network address
  - Mobility Support Layer (MSL) between TCP/UDP and IP
  - MSL translates between transport and network addresses, perhaps based on port number or flow ID
    - at MH: use appropriate IP source address
    - at CH: use appropriate IP destination address
- extensions to user API to configure MSL at MH
- both TCP/UDP and IP are unaware of MSL

- MSL header added to packets when needed to inform peer of change in care-of address or routing constraints
Mobility-aware End Hosts (contd.)

- CDPD
- Metricom

Internet

- 204.161.78.60
- 192.63.133.42
- 211.32.33.7
- 192.63.133.42
- 204.161.78.60
- 211.32.33.7

Sockets API
- TCP/UDP
- MSL
- IP
- Ethernet

CDPD MCOM

Scalable Mobility for Overlays

University of California at Berkeley
Open Issues

• Hierarchical mobility agents
  • security for local handoffs
  • MA as a multi-protocol agent
    – translation between Mobile IP and proprietary protocol
      (Metricom, CDPD, etc.)

• End-host support for mobility
  • clean separation of transport and network layer addressing
  • authentication of routing updates
    – does IP spoofing protection help?