6.896 Lecture 12: Mobility and Wireless: Part I

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1 Outline

- **Readings: MJP95, BSK97**
- Mobility and Mobile IP
- Overview of wireless technologies
- Wireless TCP: problems and solutions

2 Mobility

- The problem: continuous IP-level connectivity while mobile.
- Addresses reflect the network topology, so as a node moves, its IP address keeps changing. But on the Internet, we assume that a node's address remains relatively static.
- How do we tell everyone else in the Internet that our address has changed?
  1. Changing DNS entries: impractical. And end communicating hosts need to realize that addresses could change in the middle of a conversation.
  2. Link-layer mobility: E.g., CDPD network. One IP address and the underlying CDPD system's "link-layer" arranges to take care of mobility. But this is CDPD-specific mobility. Another example: learning bridges in wireless LANs. Neat local area solution, don't work in the wide area.
  3. Use the multicast infratructure: exercise for you to think through!
  4. Level of indirection: This is the Mobile IP approach.
- Mobile IP: RFC 2002 defines spec; RFCs 2003-2006 are companion RFCs.

- What problem does Mobile IP solve? Continuous connectivity in th global Internet, independent of link types.
- Terminology: *mobile host (MH), correspondent host (CH), home agent (HA), foreign agent (FA).* Draw a picture showing this.
- Terminology: *care-of address, home address, foreign network/link.*
- 10000-ft view: CH sends packets to MHs home address; they are intercepted by HA, who turns around and tunnels them to FA where the MH is, and the FA locally delivers the packet to MH after detunneling it. "A level of indirection solves most problems!"
- Details:
  1. HAs and FAs periodically broadcast (or multicast) their presence using special Mobile IP *agent advertisements.*
  2. MHs listen to these advertisements and determine whether they are at home or away from home. At this point, the MH knows its home address (and therefore network). Q: what if you hear multiple advertisements?
  3. If MH is at home, then no problem. (HA doesn't proxy ARP).
  4. If not, then it acquires a foreign care-of address from the agent advertisement. Q: what else does the MH need to know? (collocated care-of address; how does it get this?). Performs authenticated visitor registration with FA.
  5. HA registration: MH sends an authenticated message to HA with its care-of address.
  6. HA (or technically any router on home link) performs *proxy ARP* and snarfs all packets intended for MH. HA *tunnels* packets to care-of address, which therefore gets to FA. Q: what are proxy ARP and gratuitous ARP?
  7. Q: what are the tunnel entry and exit points?
  8. What does FA do with packet? Detunnels then forwards to MH's collocated address.
  9. In reverse direction, FA is default router.
- Some issues:
  1. Authentication: schemes basically preserve current level of insecurity. MH to HA communication can be quite secure using a shared secret; MH to FA less secure. Simple authentication based on a random authenticator.
  2. In addition to agent advertisements, also have *agent solicitations* for better response. (Both use ICMP).
  3. *Route optimization.*

4. Can we use source routing?
5. Registrations are reliable.
6. Path MTU discovery: important, else packets could get black-holed. Why?
7. Q: Why do we need tunneling from FA? Why not simply change destination address? Will this work if collocated address were known to HA? Why or why not?

- A cynical critique:
  - Long handoff latencies. (Lots of research to overcome this).
  - Can't you simply use DHCP and be done? Most connections are short anyway!
  - Are the rewards commensurate with the efforts (complicated protocol)?
  - Personal view: has definite benefits (e.g., mobile servers,etc.).

3 Wireless technologies

- Infrared (IR)
- Wireless LANs (RF, e.g, Wavelan, Radiolan)
- Campus area (RF, e.g, Ricochet)
- Wide-area (e.g., GSM, CDPD)
- Wireless cable (e.g., Hybrid)
- Satellites (e.g., DBS)
- Widely different range, bandwidth, latencies, error rates, cost, etc.

4 Wireless TCP

- Despite promise, wireless data floundering. Why? Price/performance lousy! Is this impossible to solve? No — can greatly improve performance!
- Problems:
  1. Errors and congestion.
  2. Asymmetry: bandwidth, latency, media-access, etc.
  3. Pipe sizes: too large is a problem. Too small is a problem.

- Errors:
  - Errors mistaken for congestion; movement causes packet drops.
  - Suboptimal throughput.
  - Approaches: traditional link-layer; split connections, Snoop protocol.
- Snoop protocol: transport-aware link protocol and link-aware transport.
- Explain higher-level view of how protocol works.
- Transfer from a mobile uses ELN (scheme in original paper flaky). Also works for wireless transit links.
- Critique. Ask questions to class!
- (If there's time: explain multicast-based handoffs).
- Asymmetry
- Large pipes
- Small pipes