Chapter 6
Wireless and Mobile Networks

A note on the use of these ppt slides:
We're making these slides freely available to all (faculty, students, readers).

They're in PowerPoint form so you can add, modify, and delete slides
and organize material in ways that fit your needs. They are not
merely a scan of a printed copy of the book. We've worked hard to
make them comprehensive and self-contained.

We're asking for a small favor in return:
If you use these slides (e.g., in a class) in substantially unaltered form, we
only ask that you mention their source (after all, we'd like people to use
our book!)

If you post any slides in substantially unaltered form on a www site, that
you note that they are adapted from (or perhaps identical to) our slides, and
note our copyright of this material.

Thanks and enjoy! JFK/KWR

All material copyright 1996-2004
J.F. Kurose and K.W. Ross, All Rights Reserved

Chapter 6 outline

6.1 Introduction

Wireless
- 6.2 Wireless links, characteristics
  - CDMA
- 6.3 IEEE 802.11 wireless LANs ("wi-fi")
- 6.4 Cellular Internet Access
  - architecture
  - standards (e.g., GSM)

Mobility
- 6.5 Principles: addressing and routing to mobile users
- 6.6 Mobile IP
- 6.7 Handling mobility in cellular networks
- 6.8 Mobility and higher-layer protocols
- 6.9 Summary

6. What is mobility?

- spectrum of mobility, from the network perspective:
  - no mobility
  - high mobility
  - mobile wireless user, using same access point
  - mobile user, connecting/disconnecting from network using DHCP
  - mobile user, passing through multiple access points while maintaining ongoing connections (like cell phone)
**Mobility: Vocabulary**

- **home network**: permanent "home" of mobile (e.g., 128.119.40/24)
- **permanent address**: address in home network, can always be used to reach mobile (e.g., 128.119.40.186)
- **home agent**: entity that will perform mobility functions on behalf of mobile, when mobile is remote

**Mobility: more vocabulary**

- **visited network**: network in which mobile currently resides (e.g., 79.129.13/24)
- **Care-of-address**: address in visited network (e.g., 79.129.13.2)
- **correspondent**: entity in visited network that performs mobility functions on behalf of mobile

**How do you contact a mobile friend?**

Consider friend frequently changing addresses, how do you find her?
- search all phone books?
- call her parents?
- expect her to let you know where she is?

I wonder where Alice moved to?

**Mobility: approaches**

- **Let routing handle it**: routers advertise permanent address of mobile-nodes-in-residence via usual routing table exchange.
  - routing tables indicate where each mobile located
  - no changes to end-systems
- **Let end-systems handle it**:
  - **indirect routing**: communication from correspondent to mobile goes through home agent, then forwarded to remote
  - **direct routing**: correspondent gets foreign address of mobile, sends directly to mobile
**Mobility: approaches**

- Let routing handle it: routers advertise permanent address of mobile-nodes-in-residence via usual routing table exchange. Routing tables indicate where each mobile located. No changes to end-systems.
- Let end-systems handle it:
  - Indirect routing: communication from correspondent to mobile goes through home agent, then forwarded to remote.
  - Direct routing: correspondent gets foreign address of mobile, sends directly to mobile.

**Mobility: registration**

End result:
- Foreign agent knows about mobile.
- Home agent knows location of mobile.

**Mobility via Indirect Routing**

- Correspondent addresses packets using home address of mobile.
- Home agent intercepts packets, forwards to foreign agent.
- Foreign agent receives packets, forwards to mobile.
- Mobile replies directly to correspondent.

**Indirect Routing: comments**

- Mobile uses two addresses:
  - Permanent address: used by correspondent (hence mobile location is transparent to correspondent).
  - Care-of-address: used by home agent to forward datagrams to mobile.
- Foreign agent functions may be done by mobile itself.
- Triangle routing: correspondent-home-network-mobile is inefficient when correspondent, mobile are in same network.
**Indirect Routing: moving between networks**

- Suppose mobile user moves to another network
  - Registers with new foreign agent
  - New foreign agent registers with home agent
  - Home agent updates care-of-address for mobile
  - Packets continue to be forwarded to mobile (but with new care-of-address)
- Mobility, changing foreign networks transparent: ongoing connections can be maintained!

**Mobility via Direct Routing**

- Correspondent forwards to foreign agent
- Foreign agent receives packets, forwards to mobile
- Mobile replies directly to correspondent

**Mobility via Direct Routing: comments**

- Overcome triangle routing problem
- Non-transparent to correspondent: correspondent must get care-of-address from home agent
- What if mobile changes visited network?

**Accommodating mobility with direct routing**

- Anchor foreign agent: FA in first visited network
- Data always routed first to anchor FA
- When mobile moves: new FA arranges to have data forwarded from old FA (chaining)
Chapter 6 outline

6.1 Introduction
6.2 Wireless links, characteristics
- CDMA
6.3 IEEE 802.11 wireless LANs (“wi-fi”)
6.4 Cellular Internet Access
- architecture
- standards (e.g., GSM)

Mobile IP
- RFC 3220
- has many features we’ve seen:
  - home agents, foreign agents, foreign-agent registration, care-of-addresses, encapsulation (packet-within-a-packet)
- three components to standard:
  - indirect routing of datagrams
  - agent discovery
  - registration with home agent

Mobile IP: indirect routing

Permanent address: 128.119.40.188

Care-of-address: 79.129.13.2

dest: 128.119.40.186

Packet sent by correspondent

dest: 128.119.40.186

Foreign-agent-to-mobile packet

Packet sent by home agent to foreign agent: a packet within a packet

dest: 128.119.40.186

Mobile IP: agent discovery

agent advertisement: foreign/home agents advertise service by broadcasting ICMP messages (typefield= 9)

H,F bits: home and/or foreign agent
R bit: registration required

0 or more care-of-addresses

0 or more care-of-addresses

0 or more care-of-addresses
Mobile IP: registration example

visited network: 79.129.13/24

home agent
HA: 128.119.40.7

foreign agent
COA: 79.129.13.2

Mobile agent
MA: 128.119.40.186

registration req.
COA: 79.129.13.2
MA: 128.119.40.186
Lifetime: 9999
identification: 714

registration reply
HA: 128.119.40.7
MA: 128.119.40.186
Lifetime: 4999
identification: 714

registration req.
COA: 79.129.13.2
MA: 128.119.40.186
Lifetime: 9999
identification: 714

registration reply
HA: 128.119.40.7
MA: 128.119.40.186
Lifetime: 4999
identification: 714