## **Mobility Management**

These slides are slightly adapted from those provided by Jim Kurose and Keith Ross with their book "Computer Networking: A Top-Down Approach (7<sup>th</sup> edition)."

What is mobility?

spectrum of mobility, from the *network* perspective:



# Mobility: vocabulary



## Mobility: more vocabulary



## 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 he/she is?
- Facebook!



# 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
- Iet 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 routing table ex scalable
  - routing table to millions of ere each mobile located mobiles
  - no changes to
- Iet 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



### 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-networkmobile
  - 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 update care-of-address for mobile
  - packets continue to be forwarded to mobile (but with new care-of-address)
- mobility, changing foreign networks transparent: on going connections can be maintained!

### Mobility via direct routing



## 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)





- RFC 3344
- has many features we've seen:
  - home agents, foreign agents, foreign-agent registration, care-of-addresses, encapsulation (packet-within-apacket)
- three components to standard:
  - indirect routing of datagrams
  - agent discovery
  - registration with home agent

# Mobile IP: indirect routing



## Mobile IP: agent discovery

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



## Mobile IP: registration example



#### Wireless, mobility: impact on higher layer protocols

- Iogically, impact should be minimal ...
  - best effort service model remains unchanged
  - TCP and UDP can (and do) run over wireless, mobile
- ... but performance-wise:
  - packet loss/delay due to bit-errors (discarded packets, delays for link-layer retransmissions), and handoff
  - TCP interprets loss as congestion, will decrease congestion window un-necessarily
  - delay impairments for real-time traffic
  - limited bandwidth of wireless links