CS236/NetSys230
Wireless Networking

Mobile IP

Kasper B. Rasmussen
Computer Science Department
University of California, Irvine
Announcements

- Final (still almost a month away)
  - Closed book
  - Bring (buy/borrow) a calculator.
Agenda

- Mobile IP
  - Discovery
  - Registration
  - Tunneling
Mobile IP Uses

- Enable computers to maintain Internet connectivity while moving from one Internet attachment point to another

  - **Mobile** – user's point of attachment changes dynamically and all connections are automatically maintained despite the change

  - **Nomadic** - user's Internet connection is terminated each time the user moves and a new connection is initiated when the user dials back in
    - New, temporary IP address is assigned
Operation of Mobile IP

- **Mobil node** is assigned to a particular network – **home network**
- IP address on home network is static – home address
- Mobile node can move to another network – **foreign network**
- Mobile node registers with network node on foreign network – **foreign agent**
- Mobile node gives **care-of address** to agent on home network – home agent
Wireless Networking

Mobile IP Scenario
Capabilities of Mobile IP

- **Discovery** – mobile node uses discovery procedure to identify prospective home and foreign agents
- **Registration** – mobile node uses an authenticated registration procedure to inform home agent of its care-of address
- **Tunneling** – used to forward IP datagrams from a home address to a care-of address
Protocol Support

- **Registration**
  - User Datagram Protocol (UDP)

- **Discovery**
  - Internet Control Message Protocol (ICMP)

- **Tunneling**

**Internet Protocol (IP)**
Discovery

- Mobile node is responsible for ongoing discovery process
  - Must determine if it is attached to its home network or a foreign network
- Transition from home network to foreign network can occur at any time without notification to the network layer
- Mobile node listens for agent advertisement messages
  - Compares network portion of the router's IP address with the network portion of home address
### ICMP Router Advertisement

<table>
<thead>
<tr>
<th>Bit: 31</th>
<th>24</th>
<th>16</th>
<th>8</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Checksum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Num addr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Entry size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to live</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Router address 1**

**Preference level 1**

...  

**Router address n**

**Preference level n**

**Type** | **Length** | **Sequence number**  
---|---|---
| Lifetime | R | B | H | F | M | G | r | T | reserved |

**Zero or more care-of addresses**

**Type** | **Length** | **Prefix length [1]** | **Prefix length [2]**
---|---|---|---

**Additional prefix lengths if needed**
Agent Solicitation

- Foreign agents are expected to issue agent advertisement messages periodically.
- If a mobile node needs agent information immediately, it can issue ICMP router solicitation message.
  - Any agent receiving this message will then issue an agent advertisement.

<table>
<thead>
<tr>
<th>Type</th>
<th>Code</th>
<th>Checksum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Unused</td>
</tr>
</tbody>
</table>
Mobile node may move from one network to another due to some handoff mechanism without IP level being aware

- Agent discovery process is intended to enable the agent to detect such a move

**Algorithms to detect move:**

- Use of lifetime field - mobile node uses lifetime field as a timer for agent advertisements
- Use of network prefix - mobile node checks if any newly received agent advertisement messages are on the same network as the node's current care-of address
Co-Located Addresses

- If mobile node moves to a network that has no foreign agents, or all foreign agents are busy, it can act as its own foreign agent
- Mobile agent uses co-located care-of address
  - IP address obtained by mobile node associated with mobile node's current network interface
- Means to acquire co-located address:
  - Temporary IP address through an Internet service, such as DHCP
  - May be owned by the mobile node as a long-term address for use while visiting a given foreign network
Registration Process

- Mobile node sends registration request to foreign agent requesting forwarding service
- Foreign agent relays request to home agent
- Home agent accepts or denies request and sends registration reply to foreign agent
- Foreign agent relays reply to mobile node
Registration Operation Messages

- Registration request message
  - Fields = type, S, B, D, M, V, G, lifetime, home address, home agent, care-of-address, identification, extensions

- Registration reply message
  - Fields = type, code, lifetime, home address, home agent, identification, extensions
Registration Procedure Security

- Mobile IP designed to resist attacks
  - Node pretending to be a foreign agent sends registration request to a home agent to divert mobile node traffic to itself
  - Agent replays old registration messages to cut mobile node from network
- For message authentication, registration request and reply contain authentication extension
  - Fields = type, length, security parameter index (SPI), authenticator
Types of Authentication Extensions

- **Mobile-home** – (required) provides for authentication of registration messages between *mobile node* and *home agent*
- **Mobile-foreign** – may be present when a security association exists between *mobile node* and *foreign agent*
- **Foreign-home** – may be present when a security association exists between *foreign agent* and *home agent*
Tunneling

- Home agent intercepts IP datagrams sent to mobile node's home address
  - Home agent informs other nodes on home network that datagrams to mobile node should be delivered to home agent

- Datagrams forwarded to care-of address via tunneling
  - Datagram encapsulated in outer IP datagram
Mobile IP Encapsulation Options

- **IP-within-IP** – entire IP datagram becomes payload in new IP datagram
  - Original, inner IP header unchanged except TTL decremented by 1
  - Outer header is a full IP header

- **Minimal encapsulation** – new header is inserted between original IP header and original IP payload
  - Original IP header modified to form new outer IP header

- **Generic routing encapsulation (GRE)** – developed prior to development of Mobile IP
Unshaded fields are copied from the inner IP header to the outer IP header.

(a) IP-within-IP encapsulation

Unshaded fields in the inner IP header are copied from the original IP header. Unshaded fields in the outer IP header are modified from the original IP header.

(b) Minimal encapsulation