Mobility on IPv6 Networks

Pedro M. Ruiz
Project Manager
Agora Systems S.A.

Global IPv6 Summit
Madrid 13-15 March 2002
Motivation

- Mobile computing is getting widespread
- GPRS and 3G mobile devices are packet-switched

Wireless Internet E-mail subscribers

© Phone.com
Motivation

- IP address has topological meaning
- IP assumes always the same point of attachment
- If B does not change its IP address, new routes need to be injected towards the Internet
- Hierarchical routing principle is broken
Mobile-IPv6 architecture

A lot of terminology:
HA.- Home Agent
MN.- Mobile Node
CN.- Correspondent Node
Home Network
Foreign Network
Home Address
CoA.- Care of Address

General idea:
a.- MN gets a new CoA in a foreign network
b.- MN registers the new CoA in its HA
c.- CN sends to HA, HA tunnels towards MN
d.- MN sends Binding Update (BU) and CN sends directly
IPv6 facilities

- Stateless Address Autoconfiguration
  - to configure the Care-of-Address
  - there is no need of Foreign Agent

- Neighbor Discovery
  - to detect movement

- Route optimization
  - IPv6 Routing Headers

- IP security
  - implements strong authentication and encryption features

- Additional facilities
  - Coexistence with Internet Ingress Filtering
  - Smooth Handoffs as part of route optimization
  - Renumbering of home networks
  - Automatic home agent discovery
Messages and structures

- **Binding Update**
  - Used for binding any of the owned CoA

- **Binding ACK**
  - Generated only if requested by the BU

- **Binding Request**
  - Eventually a host may request a BU

- **Home Address**
  - Option in a MNs generated packet to inform the destination about its home address

- **Binding Cache**
  - Consulted by CN before sending an IPv6 packet

- **Binding Update List**
  - Maintained by MN for non-expired BUs

- **Home Agent List**
  - Maintained by a HA
  - Lists every HA in the home network
Attaching to a foreign network

- Configure a new Care-of-Address
  - Use Stateless Address Autoconfiguration (Router Advertisement)
    - If after some time no advertisements are received, the MN sends a Router Solicitation message
  - Use Stateful Address Autoconfiguration (DHCP)
- Register this “primary” Care-of-Address with its HA.
  - Sends a BU to HA with ACK flag on
  - HA answers with a BU Acknowledgement
HA detailed operation

- After the MN registers its CoA, the HA performs “proxy Neighbour Discovery”
  - HA multicasts a Neighbor Advertisement on behalf of MN
- Sends packets for MN with IPv6 encapsulation

<table>
<thead>
<tr>
<th>Source (S)</th>
<th>Destination (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S=HA IPv6 add</td>
<td>D=MN pri CoA</td>
</tr>
<tr>
<td>S=CN IPv6 addr</td>
<td>D=MN H. addr</td>
</tr>
</tbody>
</table>

Payload
Triangle routing

- MNs sends to CN (uses Home Address extension)
  - So, no problem with ingress filtering (anti-spoofing)
- CN sends to HA
- HA sends to MN

Internet

Home network

Pedro M. Ruiz  (c) Agora Systems S.A, 2002
Route optimisation

- MN can send BUs to CNs
- CNs maintain a BU Cache
  - If destination there, it sends with a routing header of two hops: MNs CoA, MNs HA.
Binding details

- MN needs to set the ACK bit in the BU to trigger the sending of a BU ACK by CN.
- If a packet is coming from the CN to the MN through the HA, it will send a BU.
- Setting the ACK bit is a **MUST** when the BU is addressed to the MNs HA.
- A CN may send a Binding Request towards the MN before the entry expires in its Binding Cache. The MN **MAY** answer with a BU.
- Binding messages **MUST** be authenticated.
  - Not required for Binding Requests.
While the MN is away the home network may change
  - Eventually its home agent can change as well

MN can send “ICMP HA Address discovery request” to “Mobile IPv6 Home-Agents” anycast address for its own subnet prefix

Any HA in its home link will send an “ICMP HA Address discovery reply” including a list of candidate HAs in preference order.

This list is maintained by every HA using the “H” bit in each home agent’s periodic unsolicited multicast “Router Advertisement”.
Return to Home Network

- MN just uses its Home Address
- MN issues an IPv6 Neighbour Advertisement so that:
  - Cancels the proxy Neighbour Advertisement issued by HA
  - IPv6 packets are not intercepted anymore
  - HA detects MN is no longer away
Security

- BUs and Binding Ack. options HAS to contain Authentication Data to prevent forged BU or Binding Ack.
  - At least providing sender auth, integrity and replay protection
  - Extended Security Payload (ESP) is not enough

- Binding requests do not require authentication
MIPv6 advantages wrt MIPv4

- Route optimisation
- Coexistence with ingress filtering
- IPv6 destination options allow piggybacking instead of needing additional signalling messages
- No foreign agents needed because IPv6 autoconfiguration features are used
- Neighbour advertisements issued by HAs to intercept the traffic for a MN are independent from the physical layer (ARP is not)
- Dynamic Home Agent discovery using Anycast

...
IETF is supporting two different streams:
- Macromobility support (Mobile IP)
- Micromobility support (Cellular-IP, HMIP, etc)
What about applications?

- The use of routing headers prevents the application for managing address changes.
  - The MN always is reachable by its home addr.
  - Home Address extension informs CNs
  - CNs sends packets with a two hop routing header
    - HOP1 = CoA
    - HOP2 = Home Address

- However, applications (specially real-time) have to deal with
  - Unplanned handovers
  - Continuous changes in the available bandwith
  - ...
Applications (2)
Conclusions

- Mobility
- µ-Mobility
- Security
- Vertical Handovers
- Services & Applications
- RRM
- QoS
- Anycast
- Mcast, ...
- Anycast
- Mcast, ...
References