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## How Mobile IP uses IPv6 SHARE Session



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#### **IPv6 Status?**

# ARIN ISP Members with IPv4 and IPv6



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#### **Number 1 Application Driver: Mobile IP**



**Global Handset Shipments by Technology** 

8/11/2013



#### **IPv6 – New Information Types – Critical to LTE**



#### Voice is 12% of usage



**T** · · Mobile ·

& france telecom

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China unicom中国联通

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TELUS

#### **LTE – 4G**

Flat IPv6 network

High Throughput

Low Latency

Increased spectrum flexibility



verizon

Unlimit Yourself

TeliaSonera

ТІМ

**T**elstra

**metro**PC



#### **Future of LTE**













### **IPv4 Mobile IP Problems**

#### Performance

Triangulation increases response times

#### Firewalls

Normally block external packets that emanate from 'internal computers'

#### Routers

Ingress filtering discards packets coming from within the enterprise if the packets do not contain a source IP address configured for one of the enterprise's internal networks

#### Security Issues

Insider, DDOS, and replay attacks Passive eavesdropping Session stealing





#### **IPv6 Functions to Exploit**

Mobile IPv6 (MIPv6) nodes must support IPv6 decapsulation address autoconfiguration neighbor discovery



MIPv6 must use care-of-address as source address in foreign links

Correspondence Node uses IPv6 routing header rather than IP encapsulation

All new messages in MIPv6 are defined as IPv6 Destination Options Binding update – Update Home Agent of care-of-address Binding acknowledgement – Acknowledge receipt of binding update Binding request – Node requests current care-of-address Home address – MIPv6 node relays information of its hone address

**Data Structures** 

Binding cache, binding update list, home agent list



## **MIPv6 Operation**

- Will have one or more home address
- Will acquire a care-of address when it discovers it is in a foreign network
  - uses auto-configuration
  - registers the care-of address with a home agent
    - Binding update destination option
- Packets sent to the MIPv6 home address(es) are intercepted by the home agent and forwarded to the care-of address, using encapsulation
- Home agent uses proxy Neighbor Discovery and Neighbor Solicitations on behalf of the MIPv6 node
- Mobile IPv6 hosts sends binding-updates to correspondent to remove home agent from flow



















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## **MIPv6 Originated Packet Delivery**

Correspondent



Src: MIPv6 Care-of Address DST: CN;s address Destination Options – Home Address Option: MIPv6 home address Src: MIPv6 home address DST: CN's address

MIPv6

Src: MIPv6 Care-of-address DST: CN's address Destination options – Home Address Option: MIPv6 home address

Src: MIPv6 home address DST: CN's address



#### **MIPv6 Home Agent Discovery**





#### **MIPv6 Handover** Mobile host 2- Home Agent returns a Binding **Acknowledgement** 1- MIPv6 sends a Binding Update to home agent on Correspondent host previous network **3- Home Agent tunnels** Packets to MIPV6 4- MIPv6 sends a **Binding Update to** Correspondent Router as Home Agent

Home location of mobile host



### Handover

Three kinds of handover operations

Smooth Handover Minimizes data loss during the time that the MN is establishing its link to the new access point

Fast Handover

Minimizes or eliminates latency for establishing new communication paths to the MN at the new access router

Seamless Handover Both Smooth and Fast Handover



## **Quality of Service**

IPv6 header has two QoS-related fields 20-bit Flow Label Used by a source to label sequences of packets for which it requests special handling by the IPv6 routers (Geared to IntServ and RSVP) 8-bit Traffic Class Indicator

Used by originating nodes and/or forwarding routers to identify and distinguish between different classes or priorities of IPv6 packets Geared to DiffServ



New IPv6 option – QoS Object

QoS Object describes QoS requirement, traffic volume and packet classification parameters for MIPv6 packet stream

Included as a Destination Option in IPv6 packets carrying Binding Update and Biding Acknowledgment messages



#### **IPv6 Mobility Header**

| IPv6 Header               |            |
|---------------------------|------------|
|                           | Mobility + |
| Next Header<br>= Mobility | Data       |

**Mobility Messages** 

| Туре | Description                      | References                |
|------|----------------------------------|---------------------------|
| 0    | BRR, Binding Refresh<br>Request. | <u>RFC 3775</u>           |
| 1    | HoTI, Home Test Init.            | <u>RFC 3775</u>           |
| 2    | CoTI, Care-of Test Init.         | <u>RFC 3775</u>           |
| 3    | HoT, Home Test.                  | <u>RFC 3775</u>           |
| 4    | CoT, Care-of Test.               | <u>RFC 3775</u>           |
| 5    | BU, Binding Update.              | <u>RFC 3775, RFC 4140</u> |
| 6    | Binding<br>Acknowledgement.      | <u>RFC 3775</u>           |
| 7    | BE, Binding Error.               | <u>RFC 3775</u>           |
| 8    | Fast Binding Update.             | <u>RFC 4068</u>           |
| 9    | Fast Binding<br>Acknowledgment.  | <u>RFC 4068</u>           |
| 10   | Fast Neighbor<br>Advertisement.  | RFC 4068                  |
| 11   | Experimental Mobility<br>Header. | RFC 5096                  |
| 12   | Home Agent Switch<br>Message.    | RFC 5142                  |
| 13   | Heartbeat Message.               | RFC 5847                  |
| 14   | Handover Initiate.               | <u>RFC 5568</u>           |
| 15   | Handover<br>Acknowledge.         | RFC 5568                  |
| 16   | Binding Revocation<br>Message.   | RFC 5846                  |



#### **Return Route Verification**

**Purpose :**Enables the correspondent node to obtain some reasonable assurance that the mobile node is in fact addressable at its claimed care-of address as well as at its home address.

Only with this assurance is the correspondent node able to accept Binding Updates from the mobile node.





#### **MIPv6 Headaches**

Biggest vulnerability is authorization of Binding Updates

Firewalls and Mobile IPv6 do not work well together

Number of Problems for securing Neighbor discovery

Problem arises when roaming with a dualstack architecture and interoperating between Mobile IPv4 and Mobile IPv6





## **Mobility – IPv4 versus IPv6**

| Mobile IPv4                                                        | Mobile IPv6                                                                            |  |
|--------------------------------------------------------------------|----------------------------------------------------------------------------------------|--|
| Mobile node, home agent, home link, foreign link                   | (same)                                                                                 |  |
| Mobile node's home address                                         | Globally routable home address and link-local home address                             |  |
| Foreign agent                                                      | A "plain" IPv6 router on the foreign link<br>(foreign agent no longer exists)          |  |
| Collocated care-of address                                         |                                                                                        |  |
| Care-of address obtained via Agent<br>Discovery, DHCP, or manually | Care-of address obtained via Stateless Address<br>Autoconfiguration, DHCP, or manually |  |
| Agent Discovery                                                    | Router Discovery                                                                       |  |
| Authenticated registration with home agent                         | Authenticated notification of home agent and other correspondent nodes                 |  |
| Routing to mobile nodes via tunneling                              | Routing to mobile nodes via tunneling and source routing                               |  |
| Route optimization via separate protocol specification             | Integrated support for route optimization                                              |  |



#### Conclusion

Mobile IPv6 is

An efficient and deployable protocol for handling mobility with IPv6

Lightweight protocol

To minimize the control traffic needed to effect mobility







#### **IPv6 References**

#### **IPv6 Home Page**

#### http://www.ietf.org/

http://playground.sun.com/pub/ipng/html/ipng-main.html

http://www.getipv6.info/index.php/IPv6\_Presentations\_and\_Documentshttp://www.6ren.net

http://www.ipv6forum.com

http://arin.net

http://www.internet2.edu

http://www.ipv6.org

http://ipv6.or.kr/english/natpt.overview

http://www.research.microsoft.com/msripv6

http://www.ipv6.org.uk

#### **Books**

New Internet Protocol - Prentice Hall - ISBN 0-13-241936-x IPNG and the TCP/IP Protocols - John Wiley and Sons - ISBN-0-471-13088-5 IPv6 The New Internet Protocol - ISBN-0-13-24-241936 IPNG Internet Protocol Next Generation - ISBN-0-201-63395-7 Internetworking IPv6 with Cisco Routers - ISBN 0-07-022831-1







#### **IPv6 RFCs**

View any IPv6 RFC

http://datatracker.ietf.org/doc/search/

| datatracker.ietf.org                                                             |                                                    |                                                                                                |  |
|----------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------|--|
| Accounts<br>New Account                                                          | Internet-Drafts                                    | and RFCs                                                                                       |  |
| Working Groups   Applications   Internet   Ops & Mgmt   RAI   Routing   Security | Name/number/title:<br>Types:<br>Advanced<br>Search | ipv6<br>✓ RFCs<br>✓ Internet-Drafts (active)<br>✓ Internet-Drafts (expired/replaced/withdrawn) |  |