Mobility Control by L2.5 Routing

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Base Document:

This document is intended to inform IEEE 802.16e Task Group Member of the issues surrounding standardization of the routing, provide a discussion and make a recommendation.

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Mobility Control by L2.5 Routing

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Yoshihiro SUZUKI
Our Goal: Mobility Control

- Communication link between terminal and the Internet must be preserved even a terminal changes its location.
- IP address should stay the same.

FWA Network (multi-hop)

BS: Base Station
CPE: Customer Premise Equipment
To Achieve the Goal

• Requirements to achieve our goal is as follows:
  – Keep IP Address consistent
  – Find the best path between terminal and gateway node
  – Negotiate bandwidth need to be allocated for various services
How to Keep IP Address consistent

- Router separates network addresses in IP, somehow IP address must be kept consistent.

FWA Network (multi-hop)

BS: Base Station
CPE: Customer Premise Equipment

CPE + Terminal

move

The Internet
How to Find the Best Path

- Several possibility of paths exists in multi-hop network

**FWA Network (multi-hop)**

- The Internet

BS: Base Station
CPE: Customer Premise Equipment
How to make sure that terminal gets enough bandwidth?

- IP Communication may carry a wide range of services which requires from high to low bandwidths.
- Negotiation is required due to the limitation of bandwidths.

**FWA Network (multi-hop)**

BS: Base Station
CPE: Customer Premise Equipment
In “Mobility Control”

• Create a tunnel to allow send/receive packets from/to apparent IP address of a terminal

• The tunnel must track the movement of the terminal

• If possible, the tunnel must be the best path and the bandwidth must be guaranteed
Layer to be used to create “Tunnel”

To setup appropriate paths on multi-hop network, 3 possibility can be considered.

L1 Routing
L2.5 Routing
L3 Routing

L1
- Physical link
L2
- Ethernet
L2.5
- Label Switch
L3
- IP
L4
- TCP
“MobileIP” is used to control tunnels in L3

- Complicated, because IP is wrapped by IP
- Protocol dependency on IP

BS: Base Station  CPE: Customer Premise Equipment
BS = L1 Router

Create “tunnels” on wireless layer similar to 802.11 roaming

• Not scalable. When a number of BS is large, routing becomes complex

FWA Network (multi-hop)

The Internet

BS: Base Station
CPE: Customer Premise Equipment
BS = L2.5 Router (Our Proposal)

FWA Network (multi-hop)

L2.5 Labels are used to setup tunnels

BS: Base Station
CPE: Customer Premise Equipment
Path Control with L2.5

**Frame Format**

- **Ethernet Header**
- **Label**
- **IP Header**
- **TCP Header**
- **Data**

**Mobility Control by L2.5**

= Setup appropriate path to meet Mobility requirement

**Identify the path for each terminal**

**Set labels based on terminal information**

**Send packets to the appropriate ISP based on labels**

**Packet forwarding using labels only**
Characteristics of L2.5 Routing

When L2.5 is used, the advantages are as follows:

• Path control over heterogeneous physical layer is possible.
• Path control independent to an IP layer routing policy.
• Both IPv4 and IPv6 can be used at the same time.
Comparison of 3 Methods

<table>
<thead>
<tr>
<th></th>
<th>Mobility Control</th>
<th>Find the best path</th>
<th>Control based on the bandwidth</th>
<th>Heterogeneous Physical Layer</th>
<th>IPv4 and IPv6 at the same time</th>
<th>LoadBalancing</th>
<th>Scalability</th>
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<td>L1 Routing</td>
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</tbody>
</table>
Status of L2.5 Standard in IETF

• Base Specification
  – IETF Sub-IP Area, MPLS WG
    • RFC3031 (MPLS Architecture)
    • RFC3032 (MPLS Encoding)

• Application Notes
  – IETF Sub-IP Area, PPVPN WG
  – IETF Transport Area, PWE3 WG
    • draft-martini-l2circuit-trans-mpls-10.txt
    • draft-martini-ethernet-encap-mpls-mpls.txt
    • draft-kompella-ppvpn-l2vpn-02.txt

N.B. The working groups above discuss about L2VPN (L2 Virtual Private Network) only. No discussion on Mobility Control by L2.5.
Millimeter-Wave Broadband Wireless Access Network System

Millimeter-wave multi-hop access network
• Broadband Wireless Access
• Mesh Topology
• Variety of Links (millimeter-wave, ROF, Infrared)
• Nomadic Supports

Provide “Internet Access Services”
Our System Architecture

- Connect to arbitrary ISP
- Support both IPv6 and IPv4
- Find the best path
- Maximize utility of network capacity
- Nomadic Support
YRP Collaboration Research Project on Millimeter-Wave Broadband Wireless Access Network System

• Communications Research Lab.
• Central Research Institute of Electric Power Industry
• Hitachi Cable
• Japan Radio Corporation
• NTT Advanced Technology
• Osaka University
• Panasonic
• Panasonic Mobile Communications
Demonstration at TSMMW 2002

TSMMW: Topical Symposium on Millimeter-Wave
Conclusion

• We have done research to figure out possibility of L2.5 path control
• L2.5 path control is independent to IP Layer
• L2.5 path control can be adapted to “Mobility Control”

• CRL and Panasonic would like to propose L2.5 mobility control specification to the group