Mobility Control by L2.5 Routing

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

IEEE C802.16e-02/09r1

Date Submitted:

2003-01-15

Source:

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Venue: San Jose (Fairmont Hotel)

Base Document: IEEE PAR 802.16e (http://grouper.ieee.org/groups/802/16/docs/02/80216-02_48r4.pdf)

Purpose:

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.

Mobility Control by L2.5 Routing

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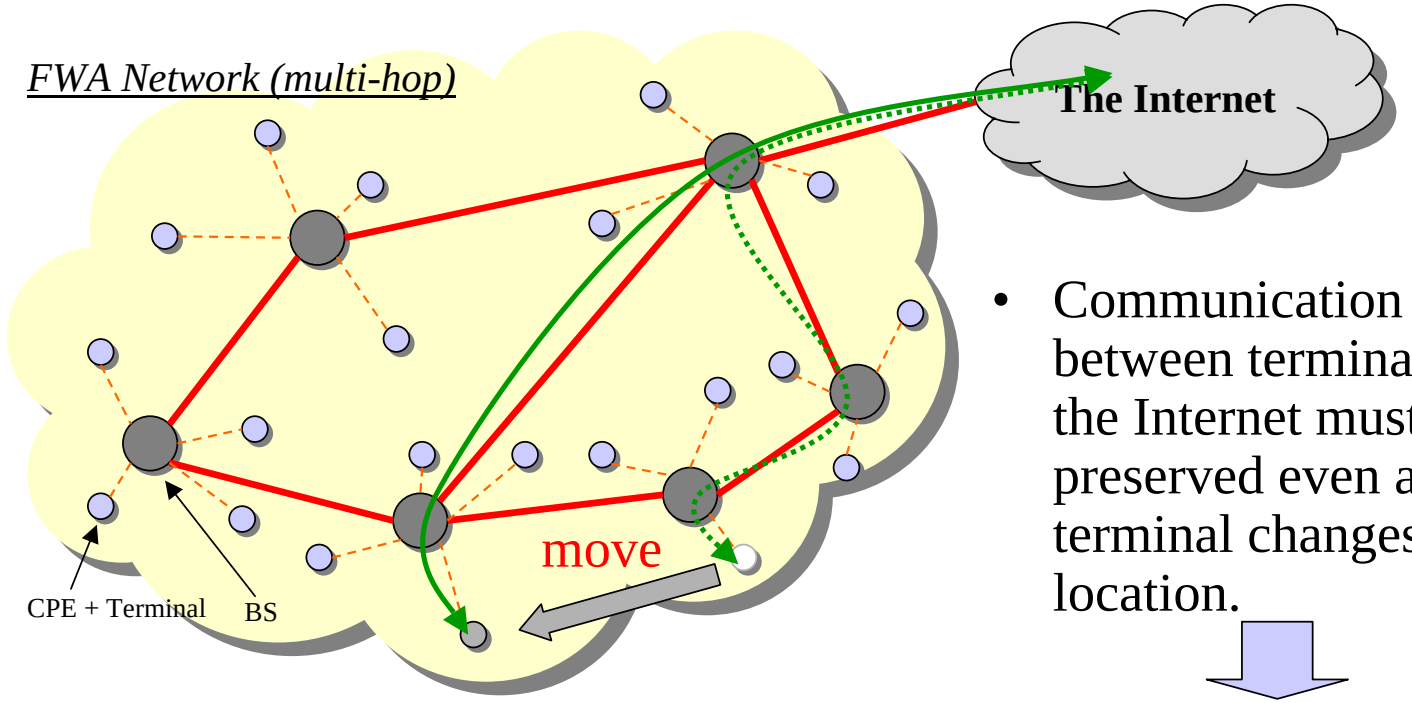
Our Goal: Mobility Control



- Communication link between terminal and the Internet must be preserved even a terminal changes its location.

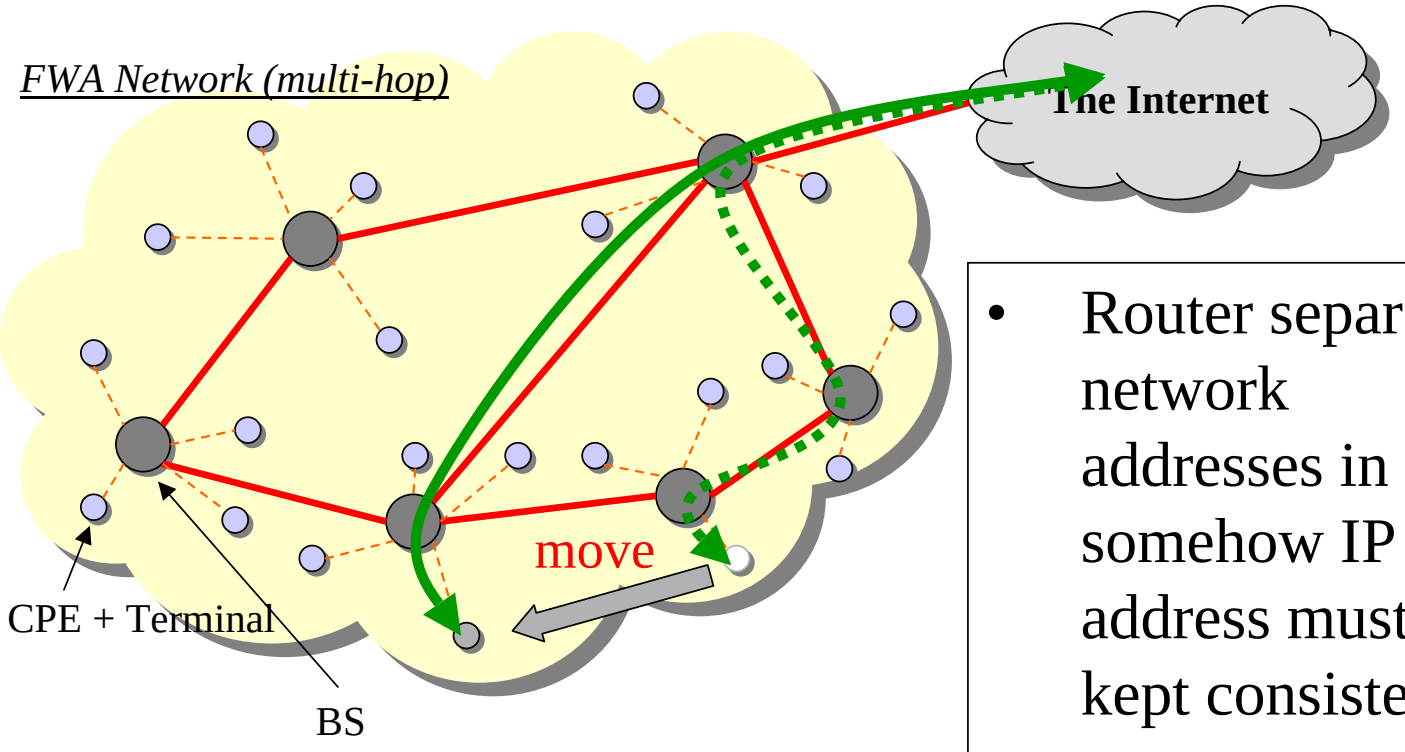
- IP address should stay the same.

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

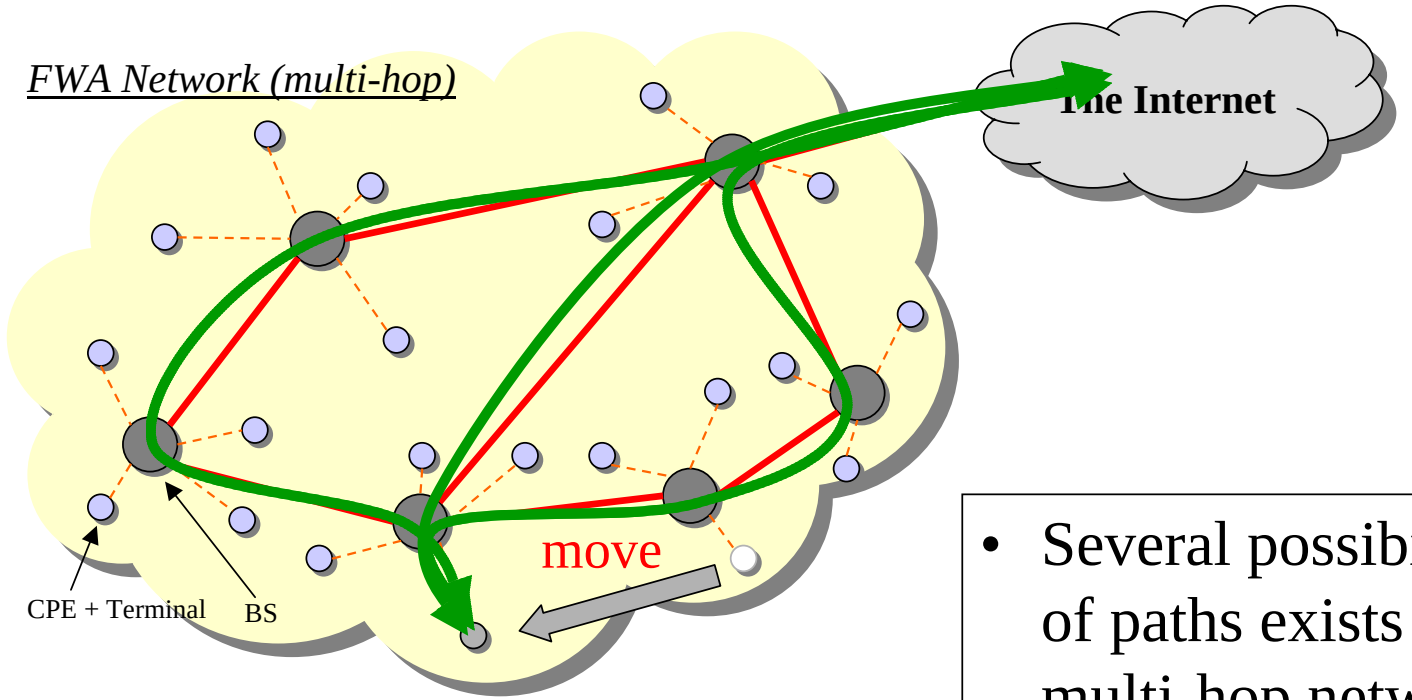
How to Keep IP Address consistent



BS: Base Station
CPE: Customer Premise Equipment

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

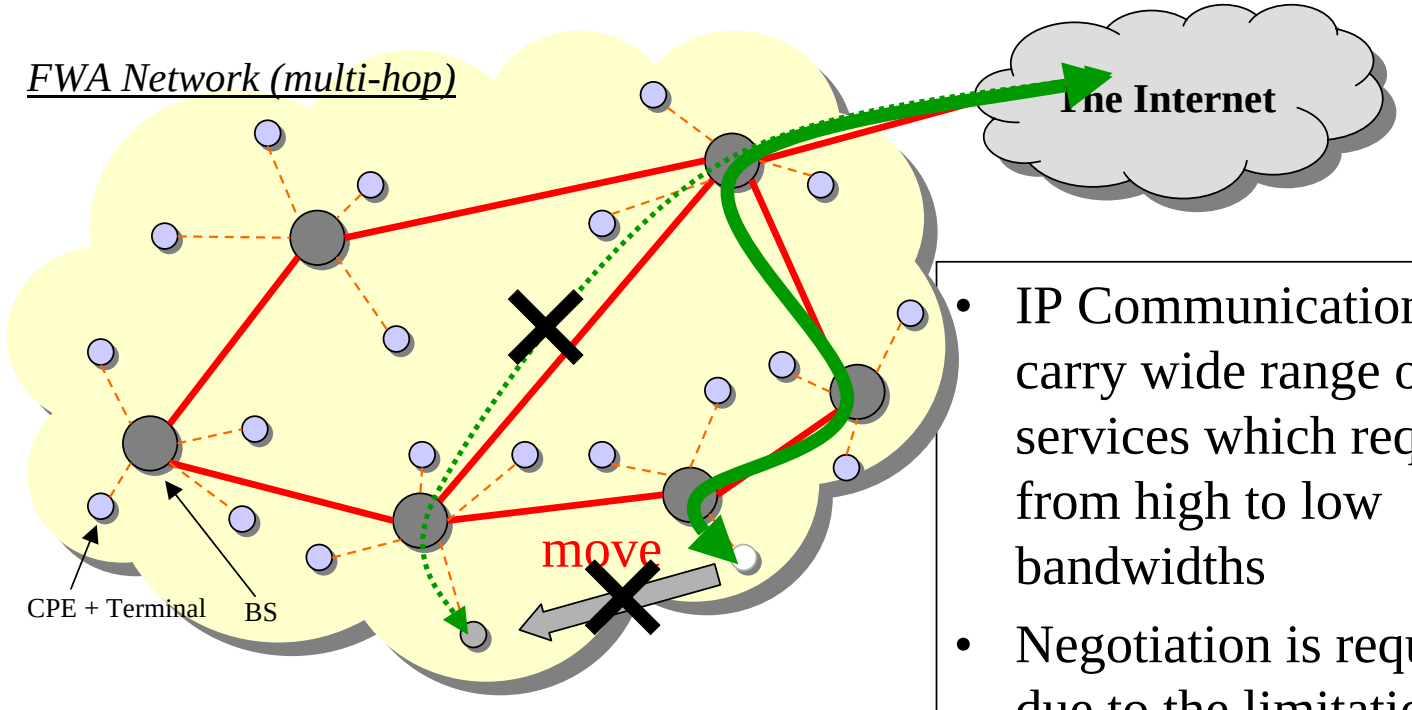
How to Find the Best Path



- Several possibility of paths exists in multi-hop network

BS: Base Station
CPE: Customer Premise Equipment

How to make sure that terminal gets enough bandwidth?



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

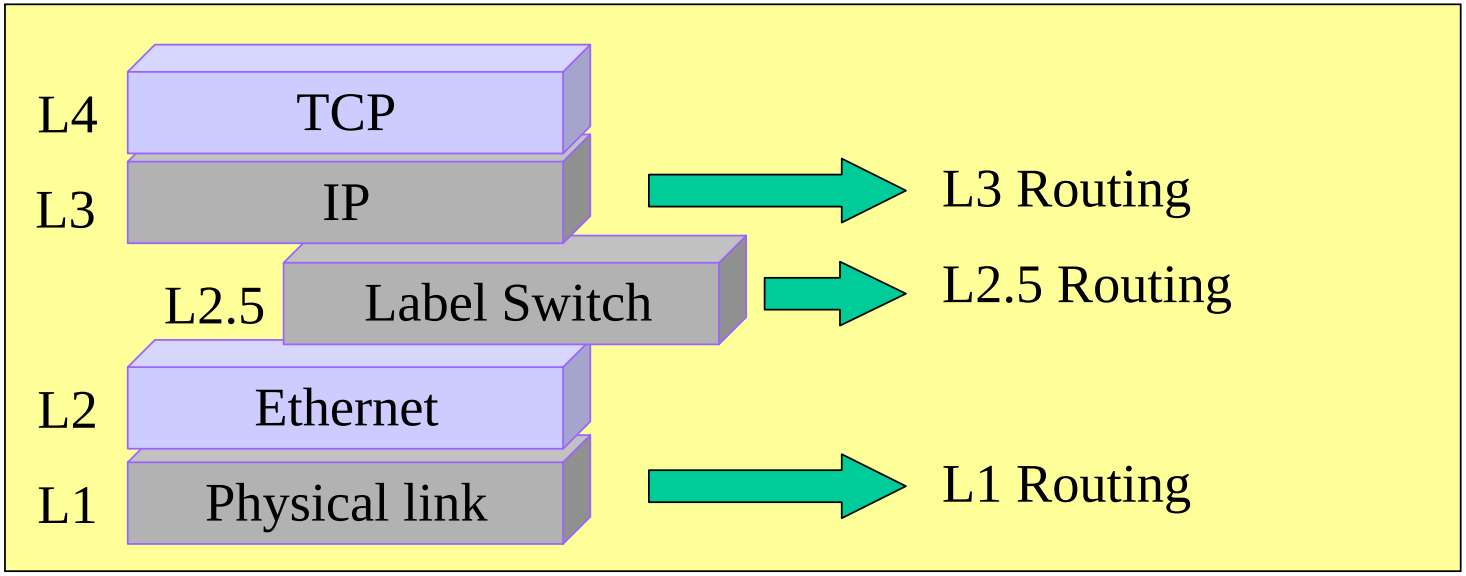
BS: Base Station
CPE: Customer Premise Equipment

In “Mobility Control”

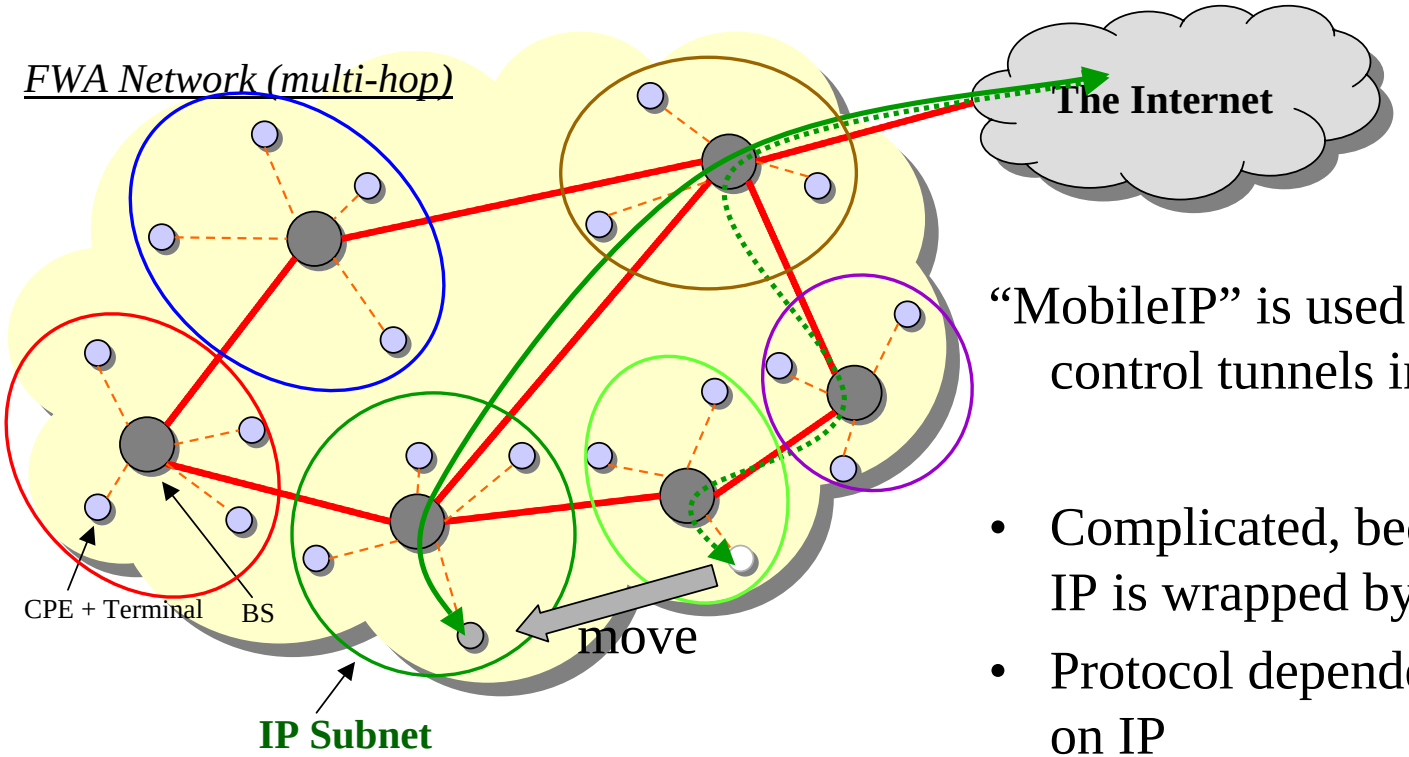
- Create a tunnel to allow send/receive packets from/to apparent IP address of a terminal
- The tunnel must track the movement of the terminal
- If possible, the tunnel must be the best path and the bandwidth must be guaranteed

Layer to be used to create “Tunnel”

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



BS = L3 Router

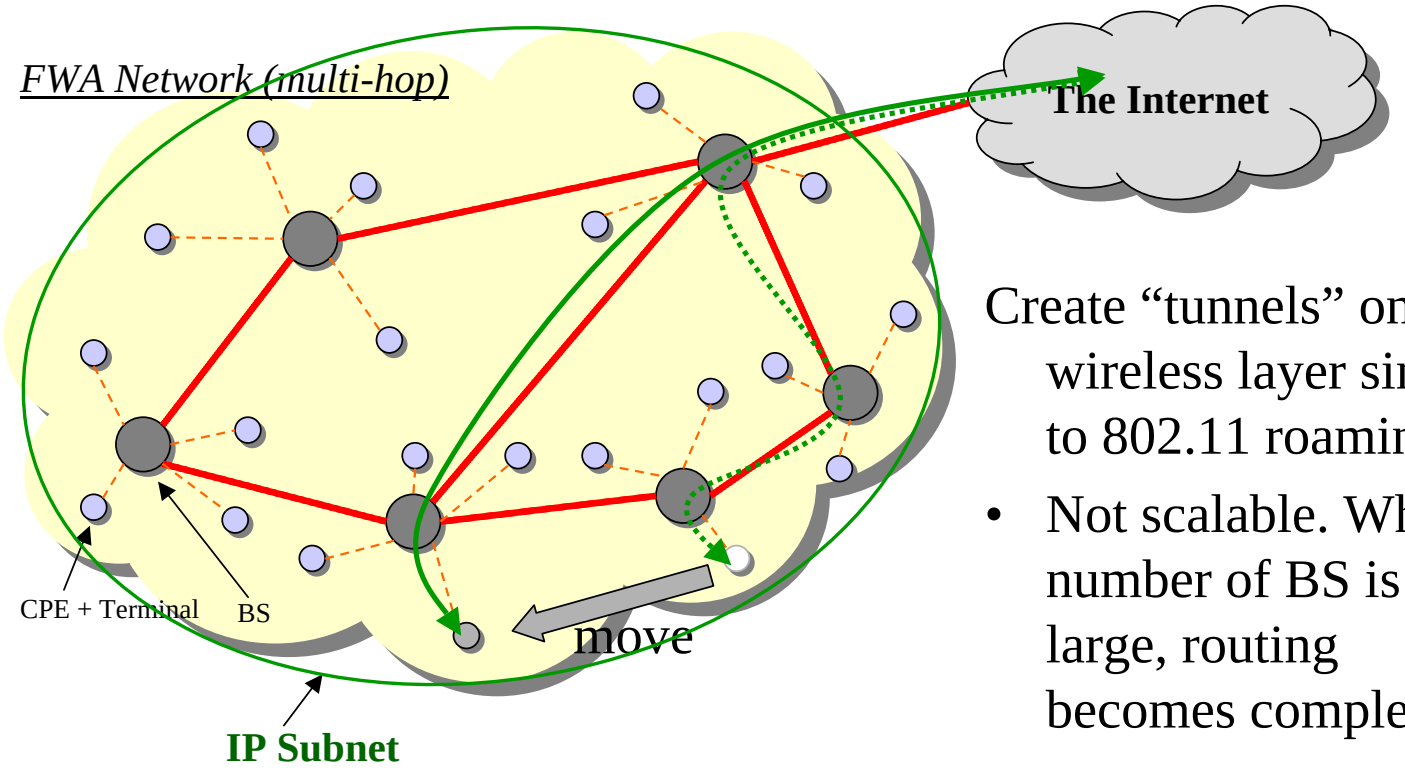


"MobileIP" is used to control tunnels in L3

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

BS: Base Station CPE: Customer Premise Equipment

BS = L1 Router

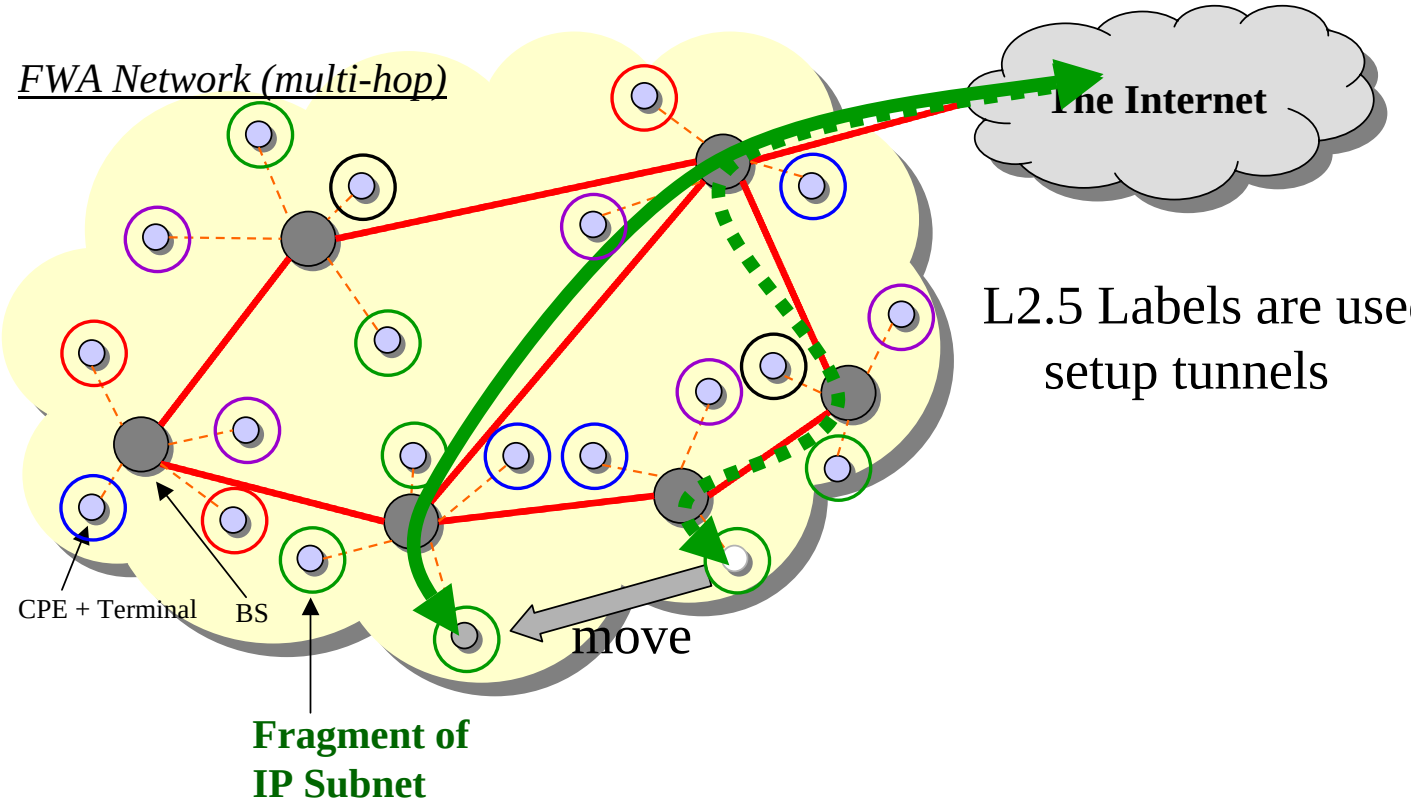


Create “tunnels” on wireless layer similar to 802.11 roaming

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

BS: Base Station CPE: Customer Premise Equipment

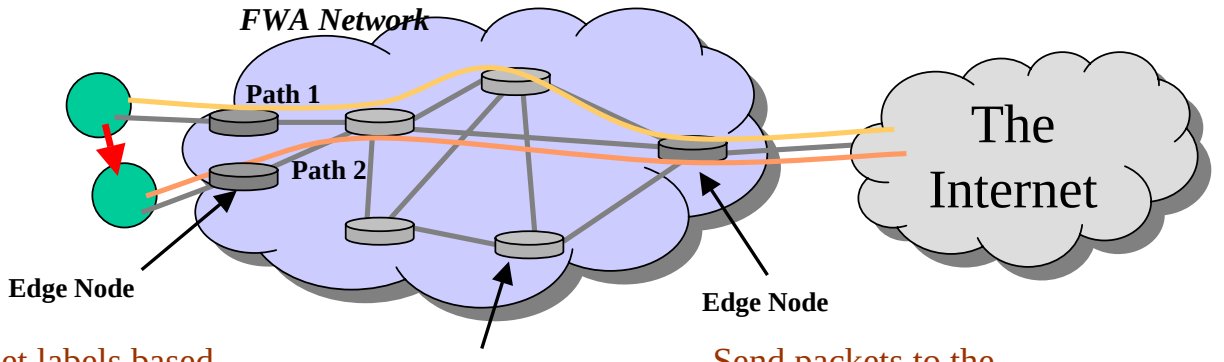
BS = L2.5 Router (Our Proposal)



BS: Base Station

CPE: Customer Premise Equipment

Path Control with L2.5



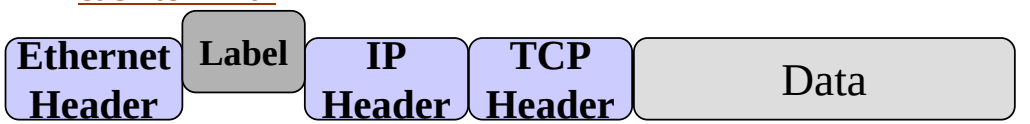
Set labels based on terminal information

Packet forwarding using labels only

Send packets to the appropriate ISP based on labels

Frame Format

Identify the path for each terminal



Mobility Control by L2.5
= Setup appropriate path to meet Mobility requirement

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 is independent from an IP layer routing policy.
- Both IPv4 and IPv6 can be used at the same time.

Comparison of 3 Methods

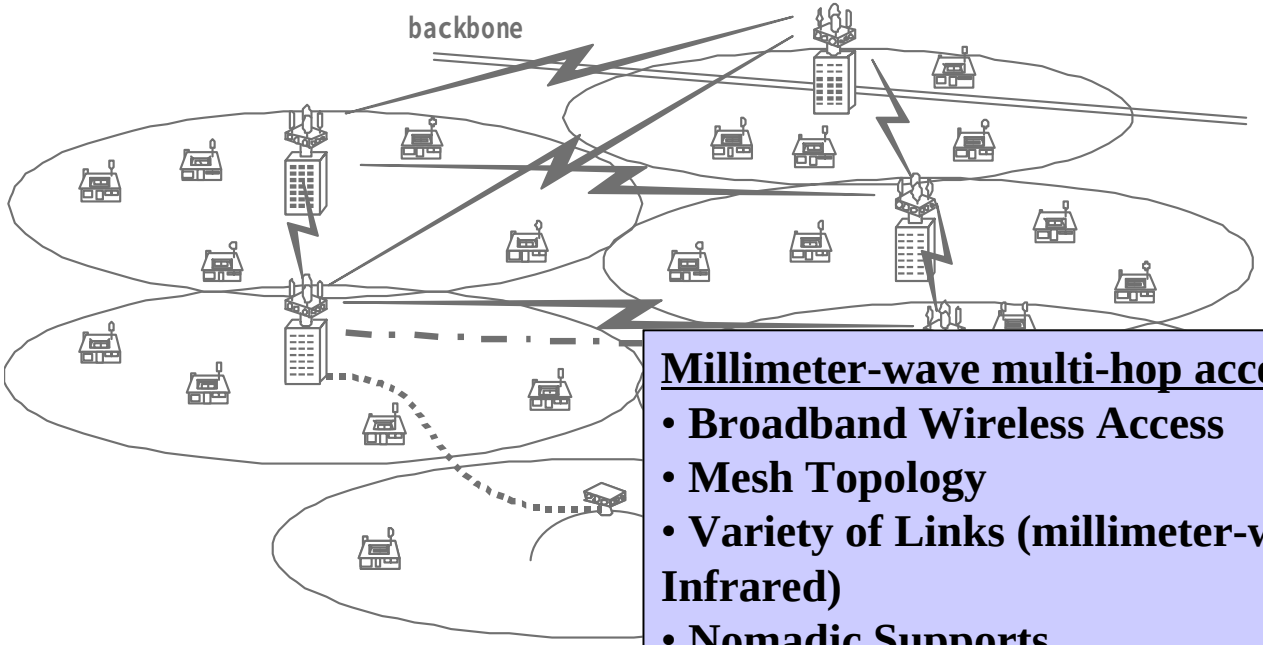
	Mobility Control	Find the best path	Control based on the bandwidth	Heterogeneous Physical Layer	IPv4 and IPv6 at the same time	Load Balancing	Scalability
L1 Routing	✓	✗	✗	✗	✓	✓	✗
L2.5 Routing	✓	✓	✓	✓	✓	✓	✗
L3 Routing	✓	✗	✗	✓	✗	✗	✓

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**

Base station

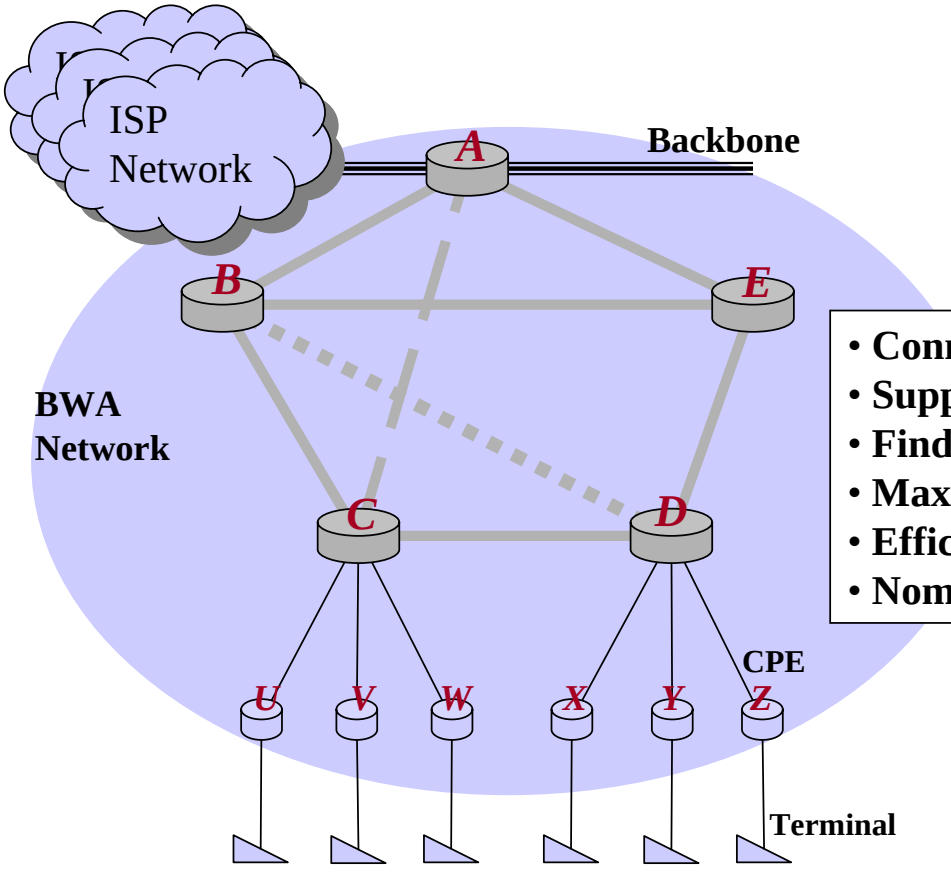
Customer premises equipment

Radio on Fiber link

Wireless optical Infrared link

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**
- **Efficient use of frequency**
- **Nomadic Support**

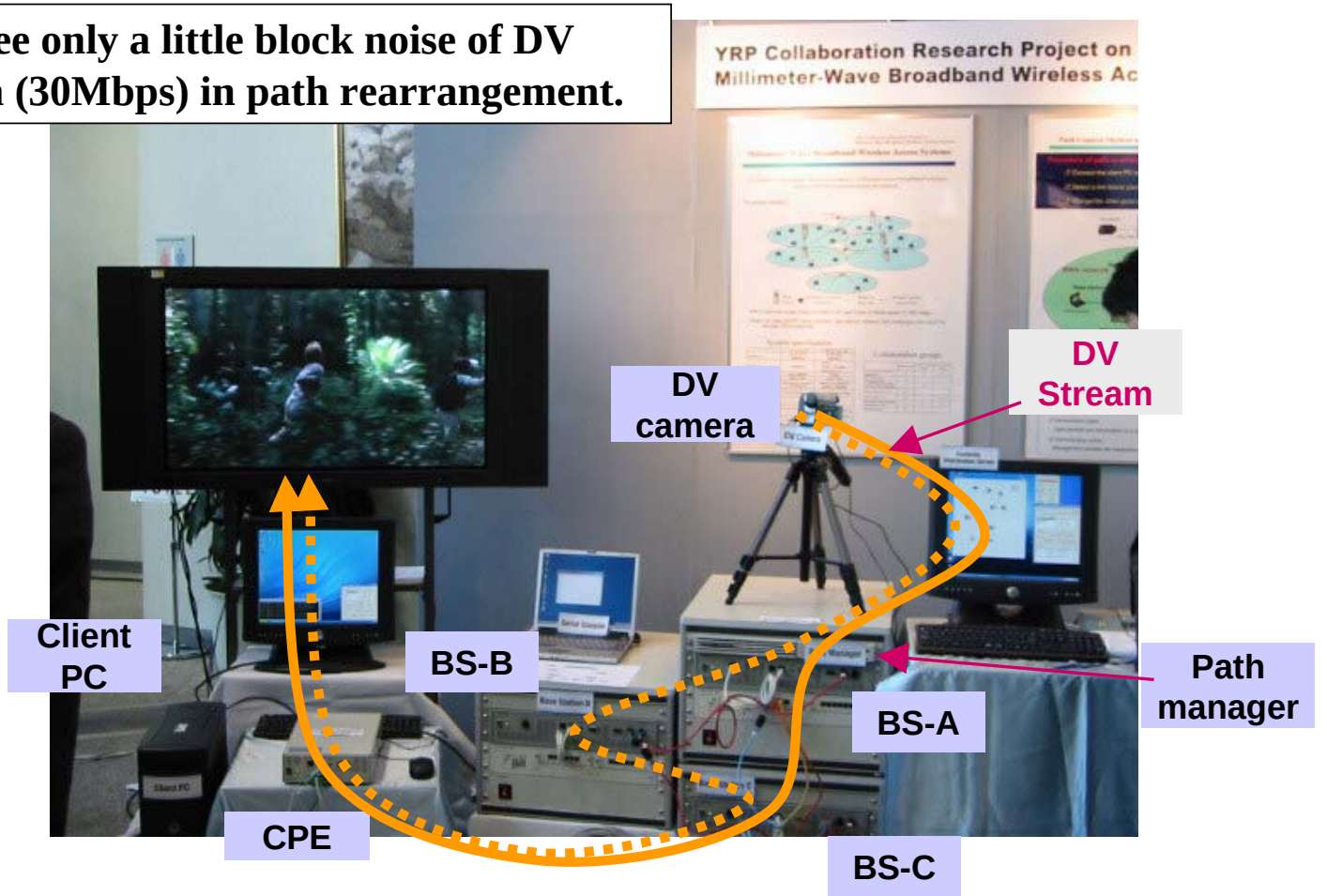
YRP Collaboration Research Project on Millimeter-Wave Broadband Wireless Access Network System

- 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

You see only a little block noise of DV stream (30Mbps) in path rearrangement.

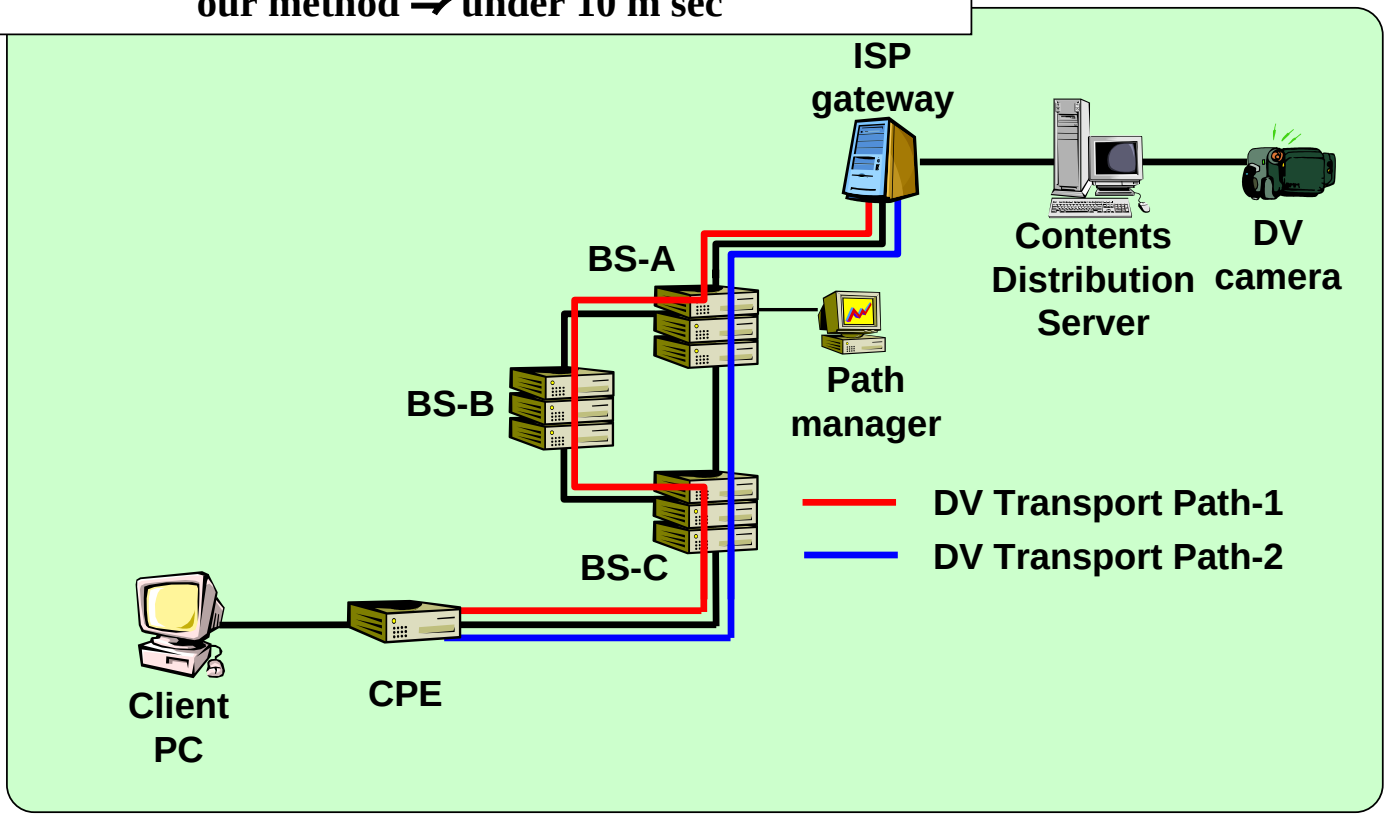


Demo System

Under the conventional IP-routing method, "fast" rearrangement of subscriber's path is impossible.

conventional IP method ⇒ over 1 min

our method ⇒ under 10 m sec



DEMO: Fast Path Re-arrangement

- Under the conventional IP-routing method, "fast" rearrangement of subscriber's path is impossible.

  conventional IP routing method ⇒ 2 or 3 min

  our method ⇒ under 10 m sec

- You see only a little block noise of DV stream (30Mbps) in path rearrangement.

- We apply "Label Switching" concepts to BWA path management, we are proposing our "Label Switching" method to IETF WG.

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”
- 32-GHz Radio Base Station will be configured using L2.5 Router to evaluate its total systems performance by the end of February

- CRL, Panasonic and YRP Collaboration Group would like to propose L2.5 mobility control specification to the group