

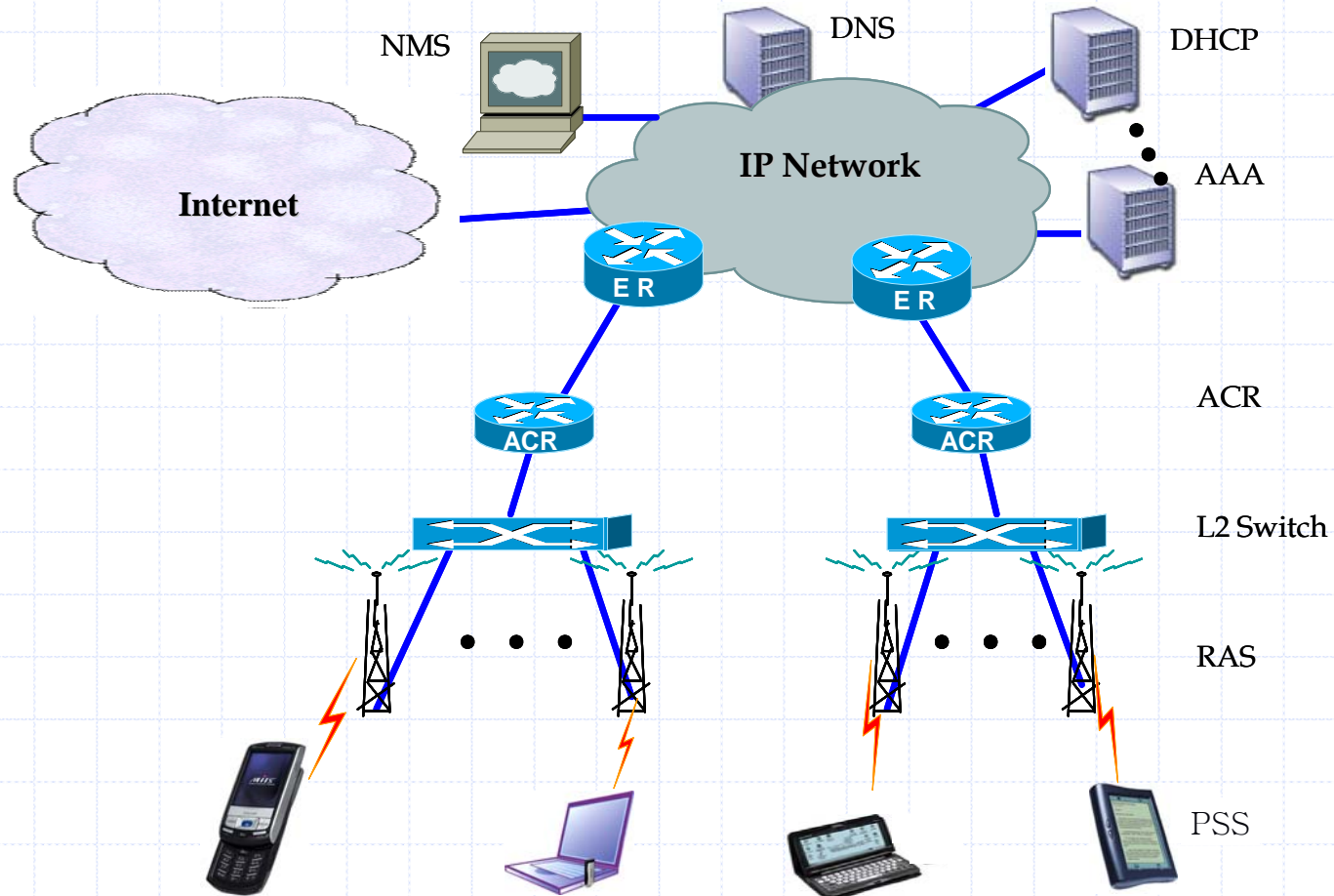
IPv6 over IEEE 802.16 구현 시나리오

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(Co-chair of TTA PG302 WiBro6 WG)

WiBro Network Architecture

◆ Network Model in WiBro/IEEE 802.16



WiBro Network Architecture

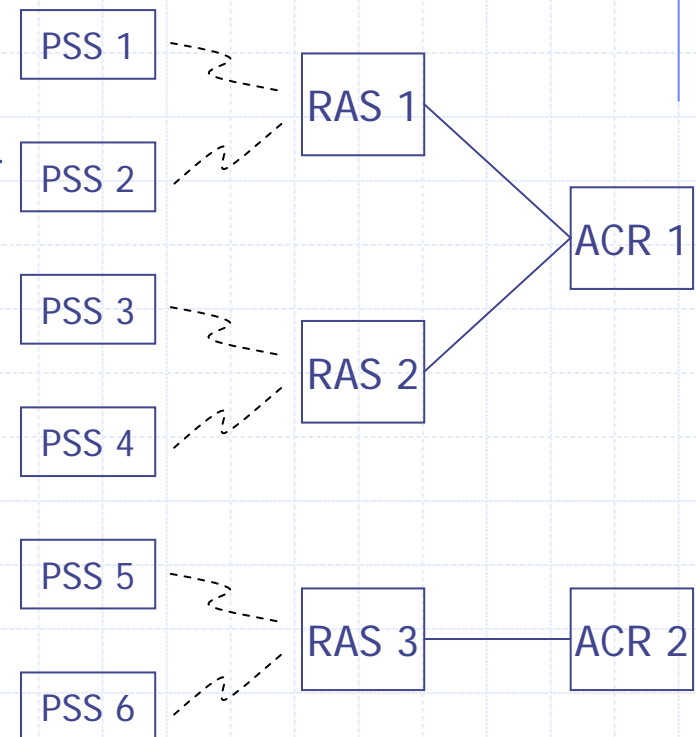
◆ Point-to-multipoint (PMP)

◆ Components

- PSS: Portable Subscriber Station
- RAS: Radio Access Station
- (Omniscient) ACR: Access Control Router
 - ◆ Knows about all PSSs and RASs attached to itself
 - ◆ Only one ACR at any PSS and RAS

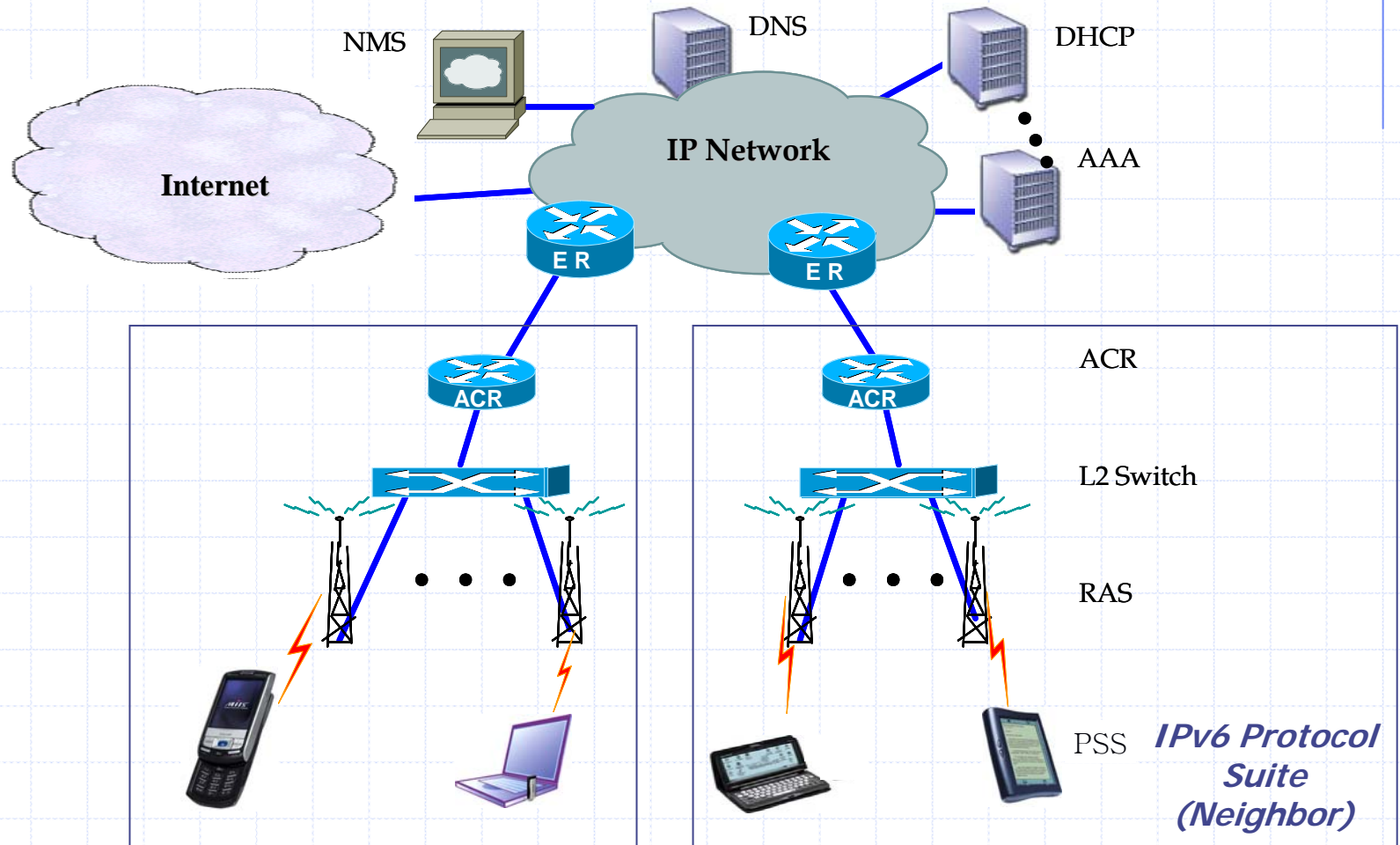
◆ A transport connection always exists between PSS and ACR

- PSS – RAS: IEEE 802.16 MAC connection
 - ◆ Connection ID
- RAS – ACR: GRE Tunnel
 - ◆ Traffic is delivered all the way to ACR by using GRE tunnel between RAS and ACR



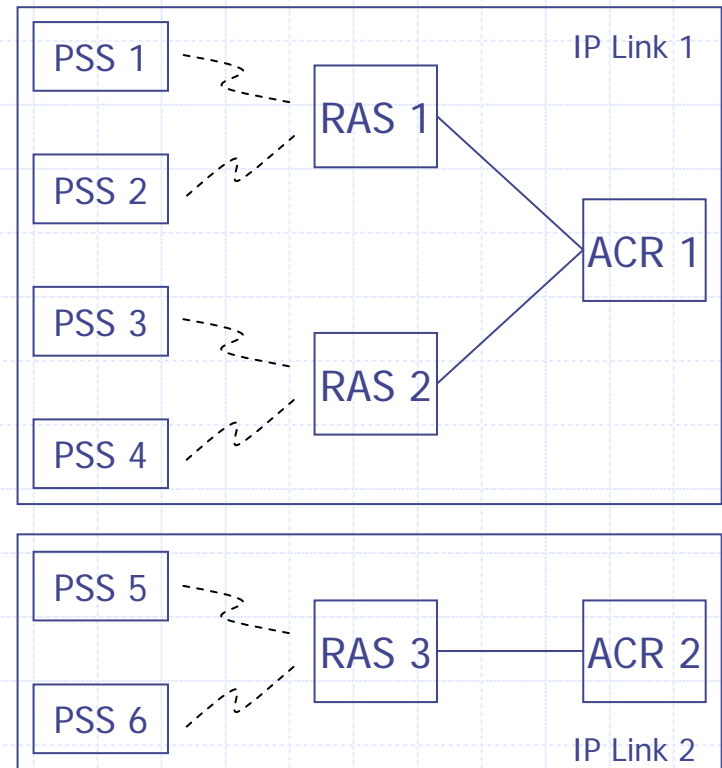
IPv6 Link over WiBro Network Architecture

◆ IPv6 & Network Model in WiBro/IEEE 802.16



IPv6 Link over WiBro Network Architecture

- ◆ IP Link
 - An ACR
 - Multiple RASs attached to the ACR
 - Multiple PSSs attached to these RASs
- ◆ ACR is the first hop access router of a PSS.
- ◆ Even from IP perspective, an PSS cannot communicate with another PSS directly. All traffic go through an AR.
 - It implies that an PSS's on-link neighbor is only an AR.



What are Technical Issues ?

- ◆ Subnet Model Determination
 - CS (Convergence Sub-layer) Determination
 - Packet Transmission

- ◆ IPv6 Multicast Address Mapping

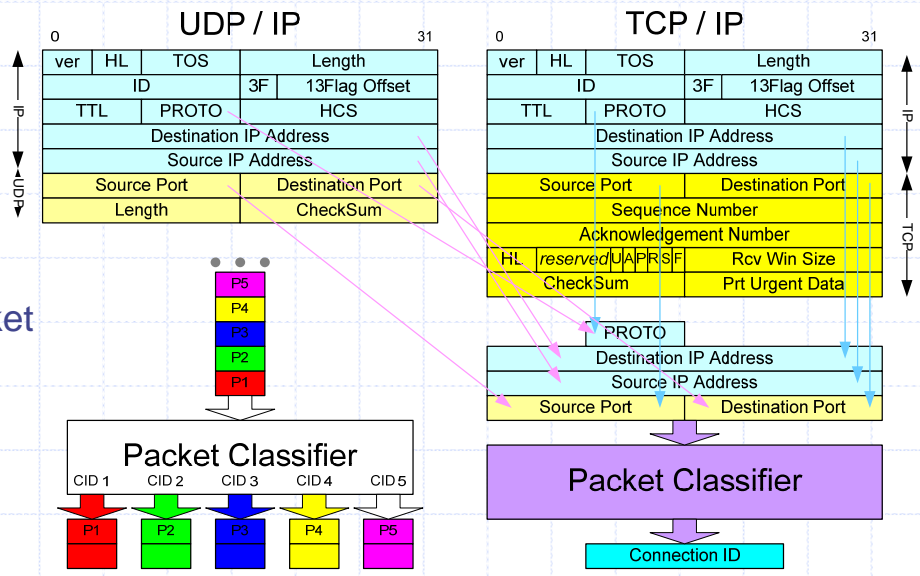
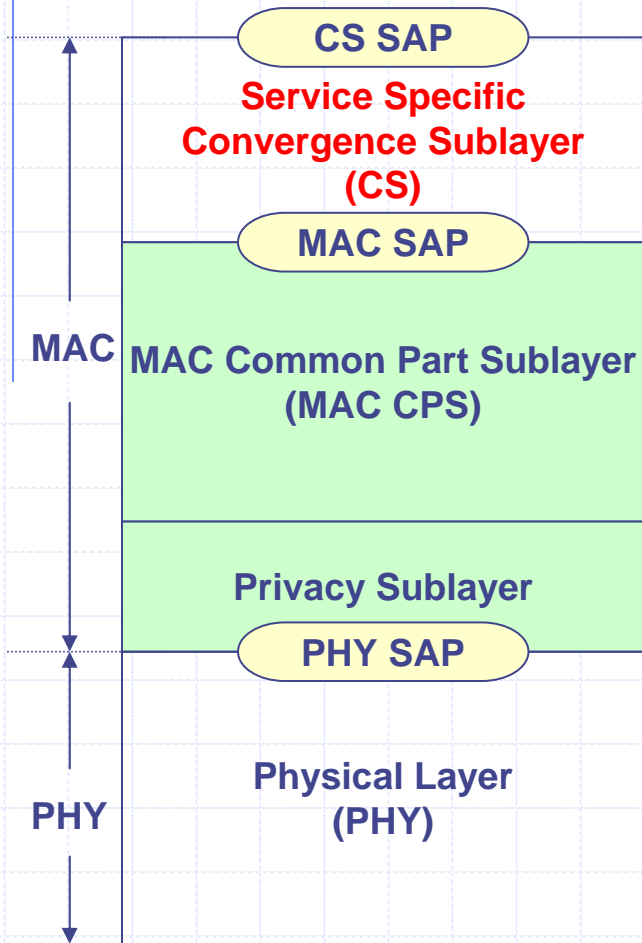
- ◆ IPv6 Neighbor Discovery Service

- ◆ IPv6 Mobility Service
 - Host-based vs. Network-based

Subnet Model Determination

Convergence Layer & IPv6 Packet Transport

- 1) Transformation or mapping of external network data
- 2) Classifying external network SDUs and associating them to the proper MAC service flow and Connection ID



IPv4 Packet Mapping

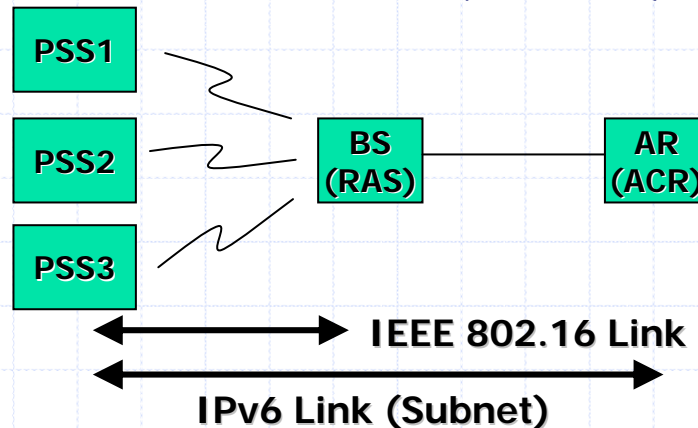
IPv6 Packet header

Version	Class	Flow Label	
Payload Length		Next Header	Hop Limit
128 bit Source Address			
128 bit Destination Address			

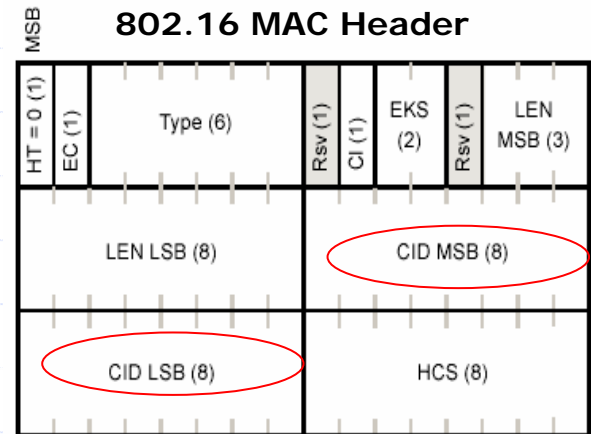
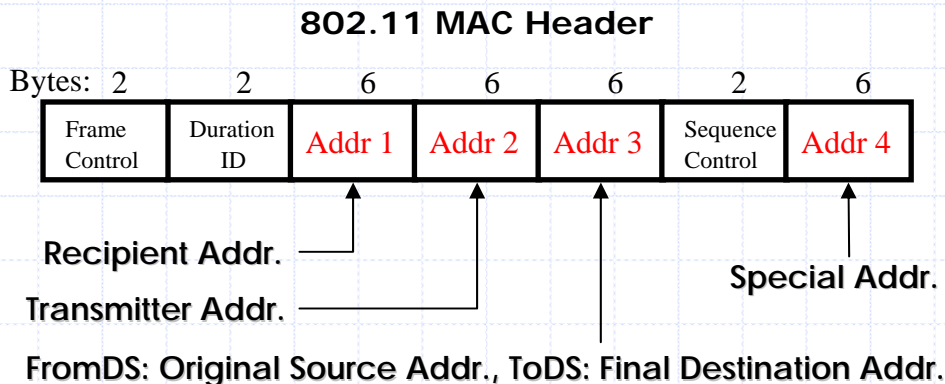
How to efficiently map ?

Subnet Model Determination

IEEE 802.16 Link vs. IPv6 Link (Subnet)

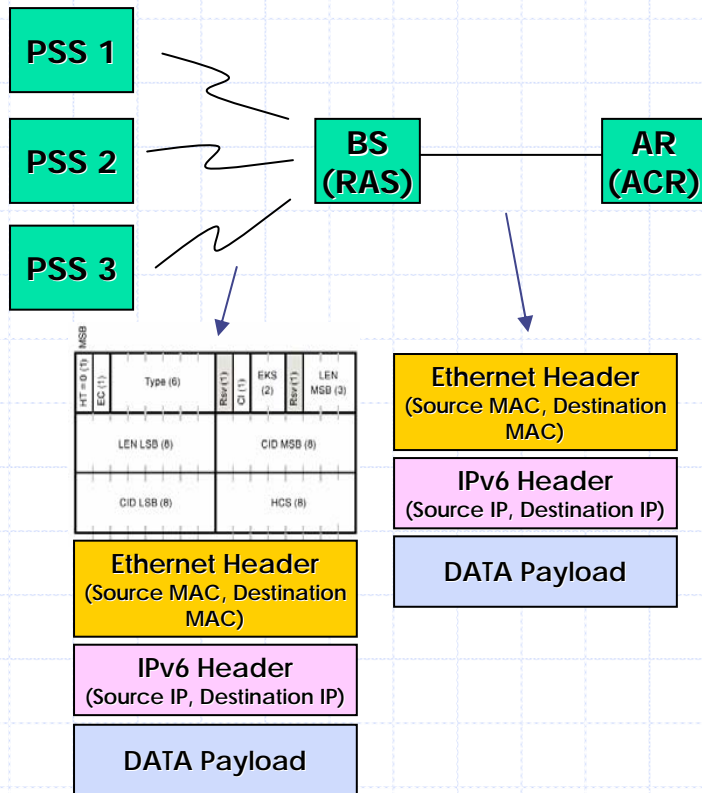


From the viewpoint of IPv6 ND, BS is just link-level bridge. Unlike IEEE 802.11, however, IEEE 802.16 BS is always acting as the termination point for a communication by using **Connection ID** instead of MAC address

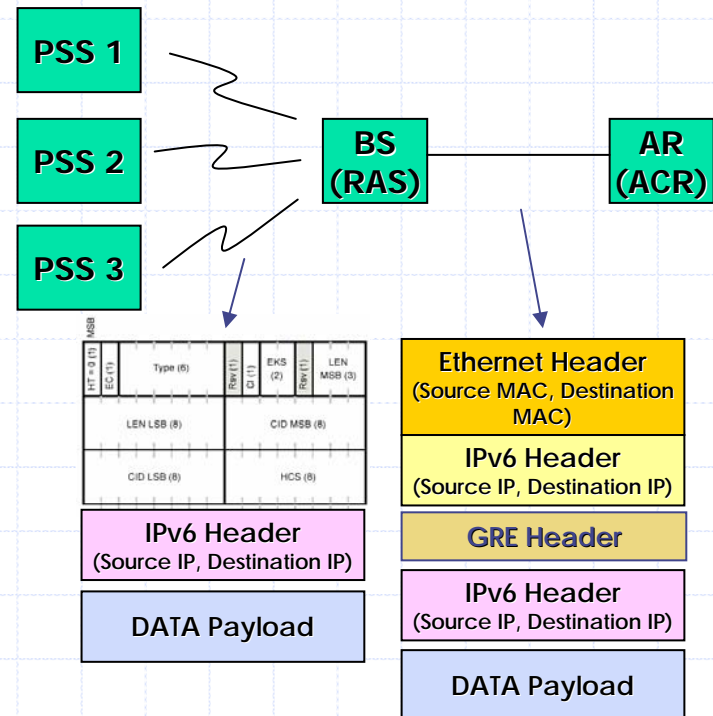


Subnet Model Determination

Ethernet CS/Bridging



IP CS/GRE Tunnel

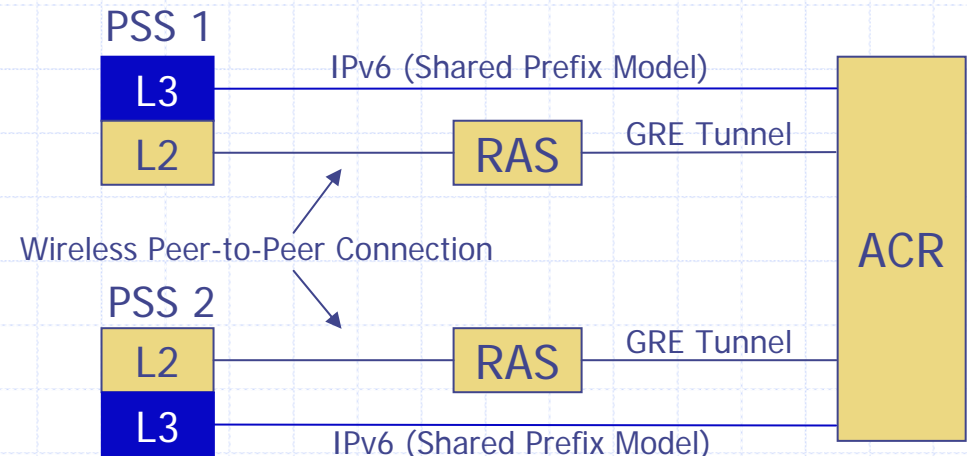


Subnet Model Determination

◆ IPv6 subnet models

■ Shared Prefix Model

- ◆ One (or more) prefixes advertised on the link
- ◆ No native on-link multicast is possible with this method.
 - However ACR can implement proxy mechanism
- ◆ All PSSs send the packets to ACR irrespective of the destination
 - link local scope packets are relayed by ACR
- ◆ IP CS
- ◆ WiMAX has chosen it.
But, doesn't decide yet.



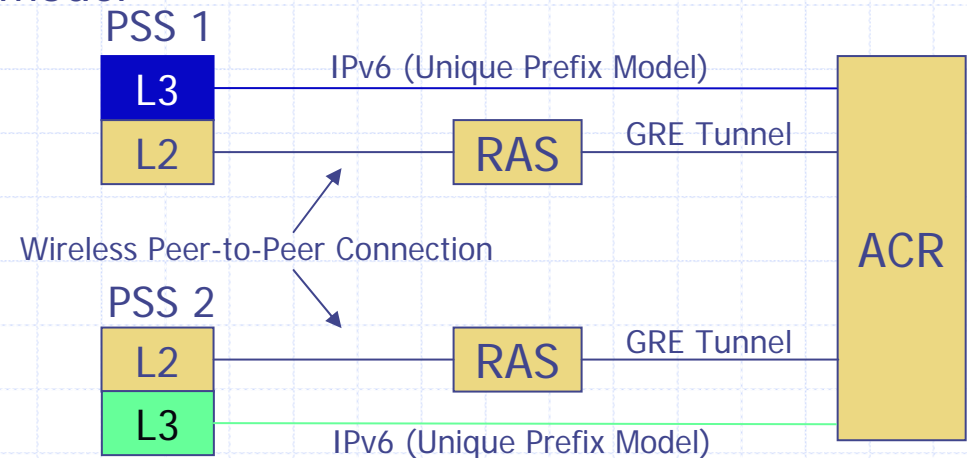
[draft-madanapalli-16ng-subnet-model-analysis-00.txt, Sept. 6, 2006]

Subnet Model Determination

◆ IPv6 subnet models

■ Unique Prefix Model

- ◆ the unique prefix per PSS
- ◆ Only an ACR and a PSS belong to an IPv6 link.
- ◆ Many IPv6 functionalities can be implemented without difficulty.
- ◆ If PPP is used between PSS and ACR, most look straightforward. But, PPP CS is not available yet.
- ◆ DAD might be needless
- ◆ Suitable to Cellular-like model



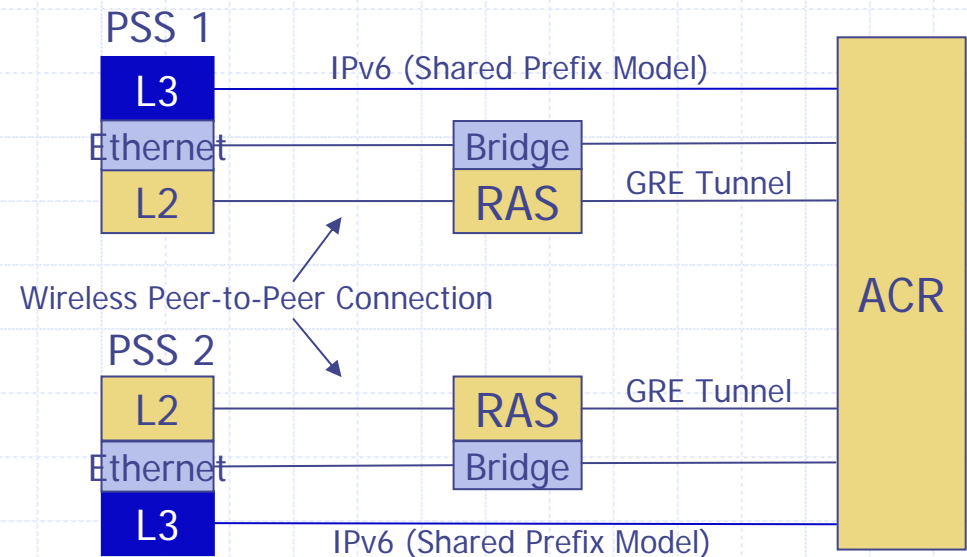
[draft-madanapalli-16ng-subnet-model-analysis-00.txt, Sept. 6, 2006]

Subnet Model Determination

◆ IPv6 subnet models

■ Ethernet-like Model

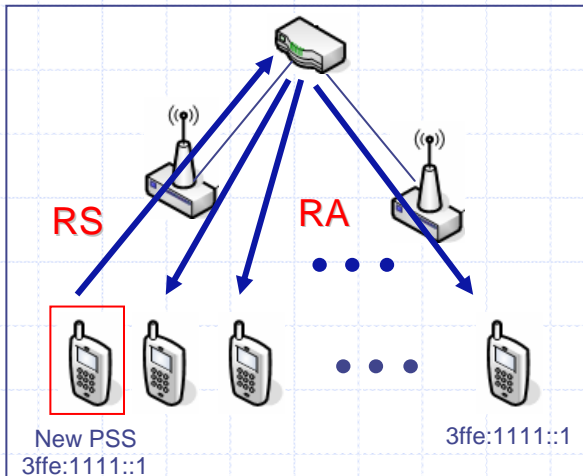
- ◆ it emulates a broadcast network in a manner similar to Ethernet.
 - bridge on top of the BS like switched Ethernet
 - on-link multicast can be emulated
- ◆ IPv6 Prefix will be shared by multiple PSSs
- ◆ All the IPv6 standards can be preserved with a DAD optimization scheme
- ◆ Ethernet CS



[draft-madanapalli-16ng-subnet-model-analysis-00.txt, Sept. 6, 2006]

IPv6 Multicast Address Mapping

- ◆ IPv6 Signaling Multicast may put heavy loads on the wireless link



[Approach]

Option 1: No RS/RA

- Use MAC Singling Message embedding RS&RA info.

Option 2: Unicast RS/RA

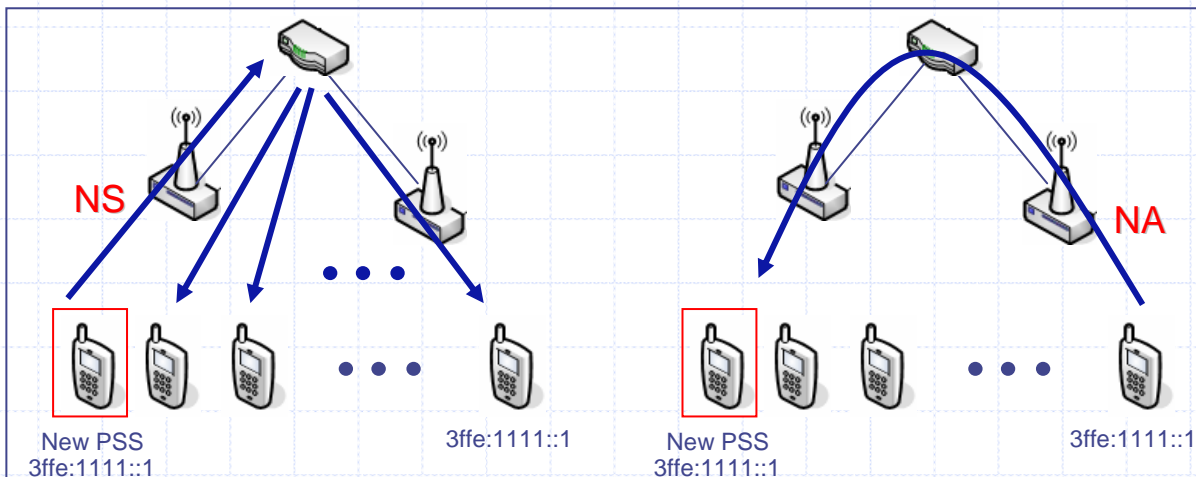
- Whenever needed, unicast it

Option 3: Simulated Multicast using Unicast

- Heavy loads on wireless path

Option 4: New Multicast CID for IP Signaling

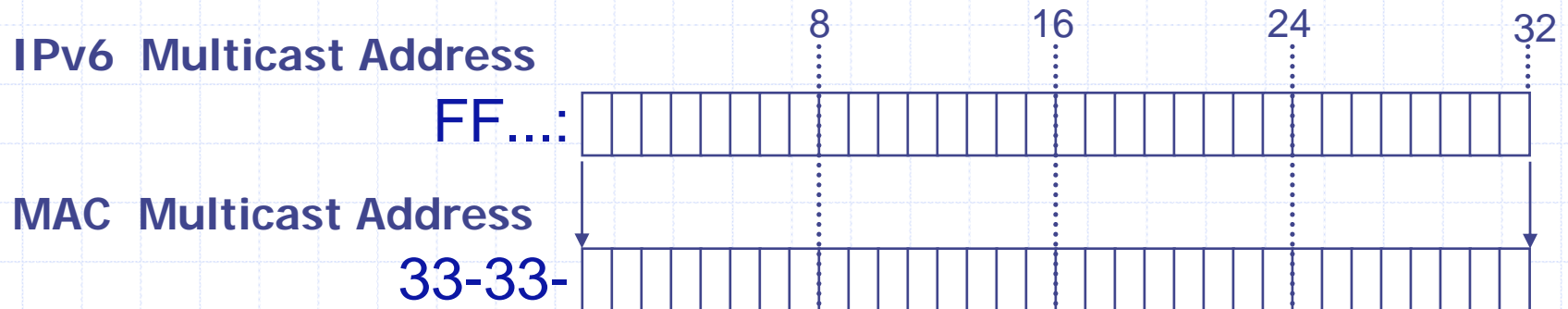
- Efficient, but standard update is needed



RS: Router Solicitation
RA: Router Advertisement
NS: Neighbor Solicitation
NA: Neighbor Advertisement

IPv6 Multicast Address Mapping

- ◆ IPv6 Multicast Address (IPv6 link scope)
 - all-nodes multicast address – FF02::1
 - all-routers multicast address – FF02::2
 - solicited-node multicast address – FF02::1:FFxx:xxxx
 - Specific-purpose multicast address
- ◆ Mapping: IPv6 ↔ IEEE 802 MAC



Transmission of IPv6 packets over Ethernet (RFC 2464)

IPv6 Multicast Address Mapping

◆ How to map into Connection ID?

- Case of IP CS
 - ◆ IPv6 Multicast Address \Leftrightarrow Connection ID
- Case of Ethernet CS
 - ◆ IPv6 Multicast Address \leftrightarrow Ethernet MAC \Leftrightarrow Connection ID

◆ It seems to be a standardization item in "IETF"

- If it could be standardized, WiMAX would use the result.
- Two proposals
 - ◆ IPv6 Multicast Packet Delivery over IEEE 802.16 Networks [draft-jeong-16ng-multicast-delivery-01]
 - ◆ Link-local Multicast Packet Transmission in 802.16 Networks [draft-jang-16ng-llm-00.txt]

IPv6 Neighbor Discovery Service

- ◆ Router (ACR)/Prefix/Parameters Discovery
 - How to deliver Router (ACR) information, On-link Prefix, Link MTU to PSS?
 - Original
 - ◆ Unsolicited RA or RS/RA exchange in multicast manner
 - WiMAX/WiBro Approach
 - ◆ Unsolicited Unicast RA when PSS attaches to network
 - ◆ RS/RA exchange in unicast manner
- PSSs may use a prefix for address autoconfiguration but not for on-link determination.

**PIO (Prefix Information Option)
without setting on link flag (L-bit).**

Type	Length	Prefix Length	L	A	I	Res 1
Valid Lifetime						
Preferred Lifetime						
Reserved 2						
Prefix						

IPv6 Neighbor Discovery Service

◆ Stateless Address Auto-configuration & DAD

- Should we support “stateless auto-conf.” in WiBro?
- If it is needed, how to provide it?
 - ◆ How to DAD
 - ◆ How to notify ACR’s CS layer of the auto-configured address?
- Original
 - ◆ PSS makes a new address by combining an on-link prefix and its identifier
 - ◆ NS/NA Exchange for DAD in multicast manner
 - ◆ It takes 1 sec.
- WiMAX/WiBro Approach
 - ◆ Relay DAD
 - Omniscient ACR knows about all PSSs’ addresses attached to itself
 - ACR may relay DAD messages to the destination

IPv6 Neighbor Discovery Service

- ◆ Next-hop Determination & (Neighbor) Address Resolution
 - Next-hop Determination
 - ◆ Mapping: Destination IPv6 Address → A Neighbor or A router?
 - Address Resolution
 - ◆ Mapping: A Neighbor or A router → Link-layer Address (MAC)
 - Original
 - ◆ NS/NA exchange in multicast manner
 - WiMAX/WiBro Approach
 - ◆ ACR is the only neighbor for a PSS
 - ◆ It's simple

IPv6 Neighbor Discovery Service

◆ Neighbor Unreachability Detection

- How to know whether a neighbor node is reachable?
- Original
 - ◆ NS/NA exchange in unicast manner
- WiMAX/WiBro Approach
 - ◆ ACR is the only neighbor for a PSS
 - ◆ It's simple
 - ◆ We may do this from link-layer event notification without NS/NA exchange.

◆ Redirect

- ACR notifies a PSS of the better next-hop
- Original
 - ◆ Redirect message delivery in unicast manner
- WiMAX/WiBro Approach
 - ◆ ACR is the only neighbor for a PSS
 - ◆ No Use

IPv6 Deployment Scenario in IEEE 802.16 Networks

- ◆ How to provide the service?
 - Cellular-like
 - Hot-zone
- ◆ How to define system architecture?
 - Router separation from BS
 - BS and Router in one Box
- ◆ How to allocate prefix?
 - A unique prefix to a SS
 - A single prefix to attached SSs
- ◆ How to make convergence sub-layer?
 - IP CS
 - Etehrent CS

How to provide the service?

◆ Cellular-like [WiMAX/WiBro]

- BS might be deployed with a proprietary backend managed by an operator
- All standard IPv6 functionalities may not survive and some of them might be compromised

◆ Hot Zone

- An area served by one BS is usually termed 'Hot Zone'
 - ◆ Use unlicensed (2.4 & 5 GHz) band as well as licensed (2.6 & 3.5 GHz) band
- Department store, Campus, Factory...
- BS will be deployed using an Ethernet (IP) backbone rather than a proprietary backend like cellular systems.
- Thus, many IPv6 functionalities will be preserved.

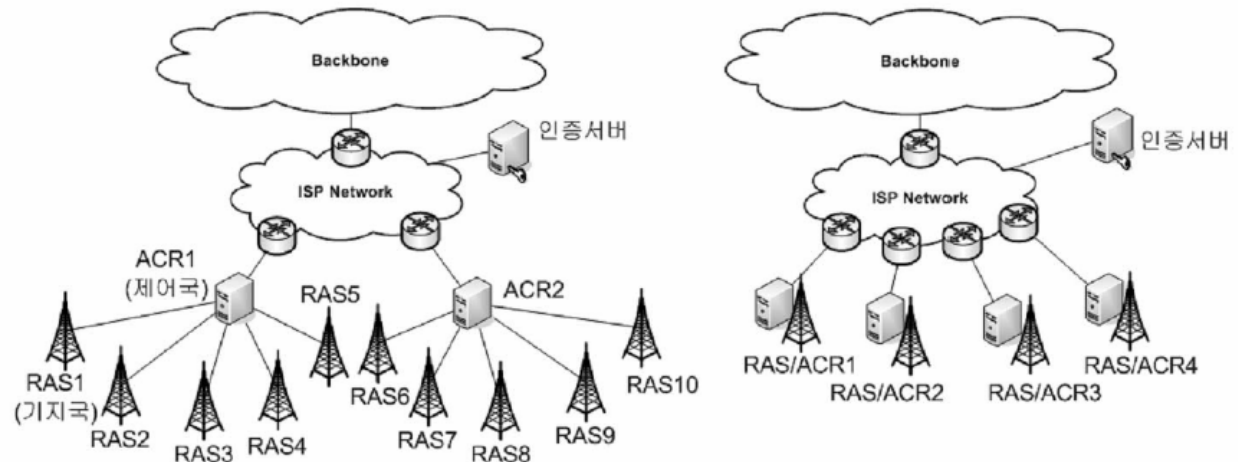
How to define system architecture?

◆ Router separation from BS [WiMAX/WiBro]

- A simple or complex network equipments may constitute the underlying wired network between BSs and router.
- IPv6 adoption to IEEE 802.16 may depend on the underlying network architecture

◆ BS and Router in one Box

- Only IEEE 802.16 link will be taken into consideration for IPv6 adoption.



How to allocate prefix?

- ◆ A unique prefix to a SS
- ◆ A single prefix to attached SSs [WiMAX/WiBro?]

How to make convergence sub-layer?

- ◆ IP CS [WiMAX/WiBro]
- ◆ Ethernet CS

Standardization Trends

◆ IETF

- **16ng WG – IPv6 over IEEE 802.16**
 - ◆ 2번의 BoF 이후 2006년 7월에 신설 – 매번 100여명 참여
 - ◆ 한국 연구자들이 주도적으로 참여 - 박수홍 (삼성전자) 의장
- **MIPSHOP WG**
 - ◆ FMIPv6 over IEEE 802.16e (삼성, ETRI, 한국기술교대) WG Item 채택
- **v6ops WG**
 - ◆ IPv6 Deployment Scenario over IEEE 802.16e Link (ETRI, 한국기술교대) WG Item 채택
 - <http://www.ietf.org/internet-drafts/draft-shin-v6ops-802-16-deployment-scenarios-00.txt>

◆ WiMAX

- **NWG (Network WG)**
 - ◆ Release 2에는 IPv6 및 Mobile IPv6 관련 기술을 넣는 계획 수립
 - IPv6 Subteam 구성
 - ◆ IETF 16ng 의 결과를 WiMAX에서 활용하려고 함

◆ TTA

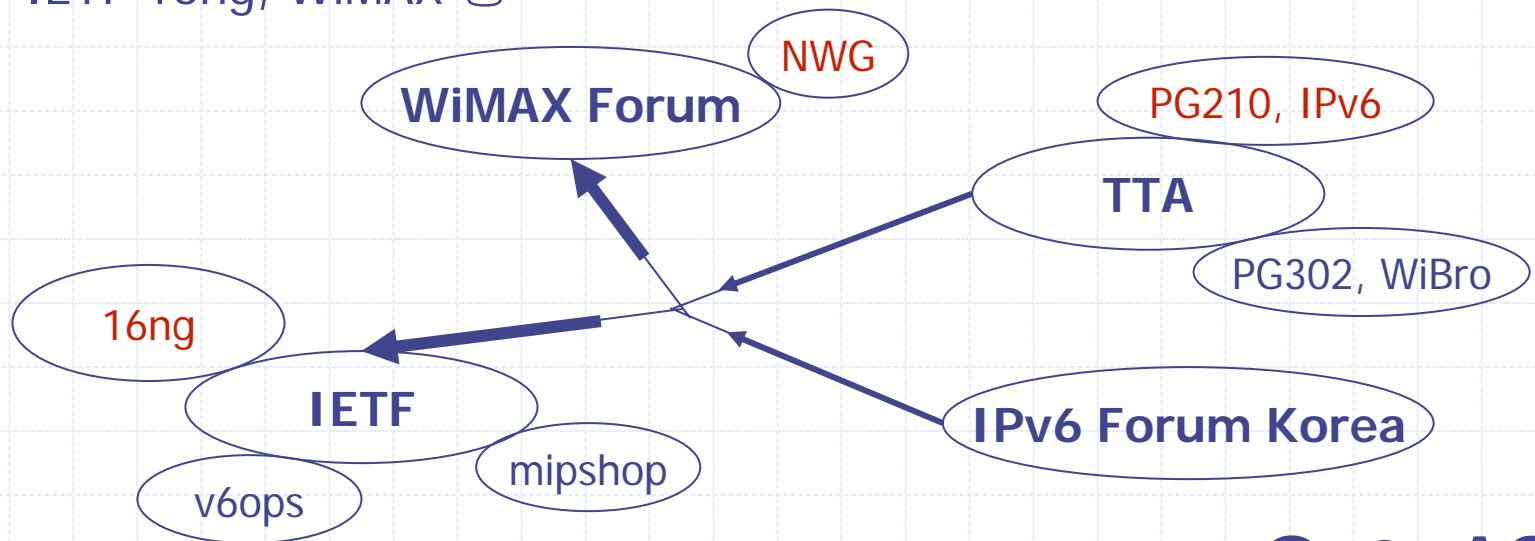
- **WiBro6 WG (IPv6 PG – PG210)**
 - ◆ 2005년 10월경 신설 - 2006년 국내 고유 표준 제정 목표, 현재 1차 드래프트 완성
 - ◆ 국내 WiBro망 관점에서 접근, PG302의 Review 결과 요청 중

◆ IPv6 Forum Korea

- **Mobility WG**
 - ◆ IPv6 over IEEE802.16 연구, WiBro 망에만 한정된 연구가 아님

Conclusions

- ◆ Wibro 시스템에 최적화된 IPv6 Protocols의 Adaptation 기술 개발
 - IPv6 Link Model, Multicast Address Mapping, Neighbor Discovery, Mobility
- ◆ 국내 고유 표준 개발
 - TTA IPv6 PG 산하 WiBro6 표준, IPv6 Forum 표준
- ◆ 국제 표준화 선도
 - IETF 16ng, WiMAX 등



Q & A?