# IPv6 over WiBro
# 기술 이슈 및 표준화 동향

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2006.05.03

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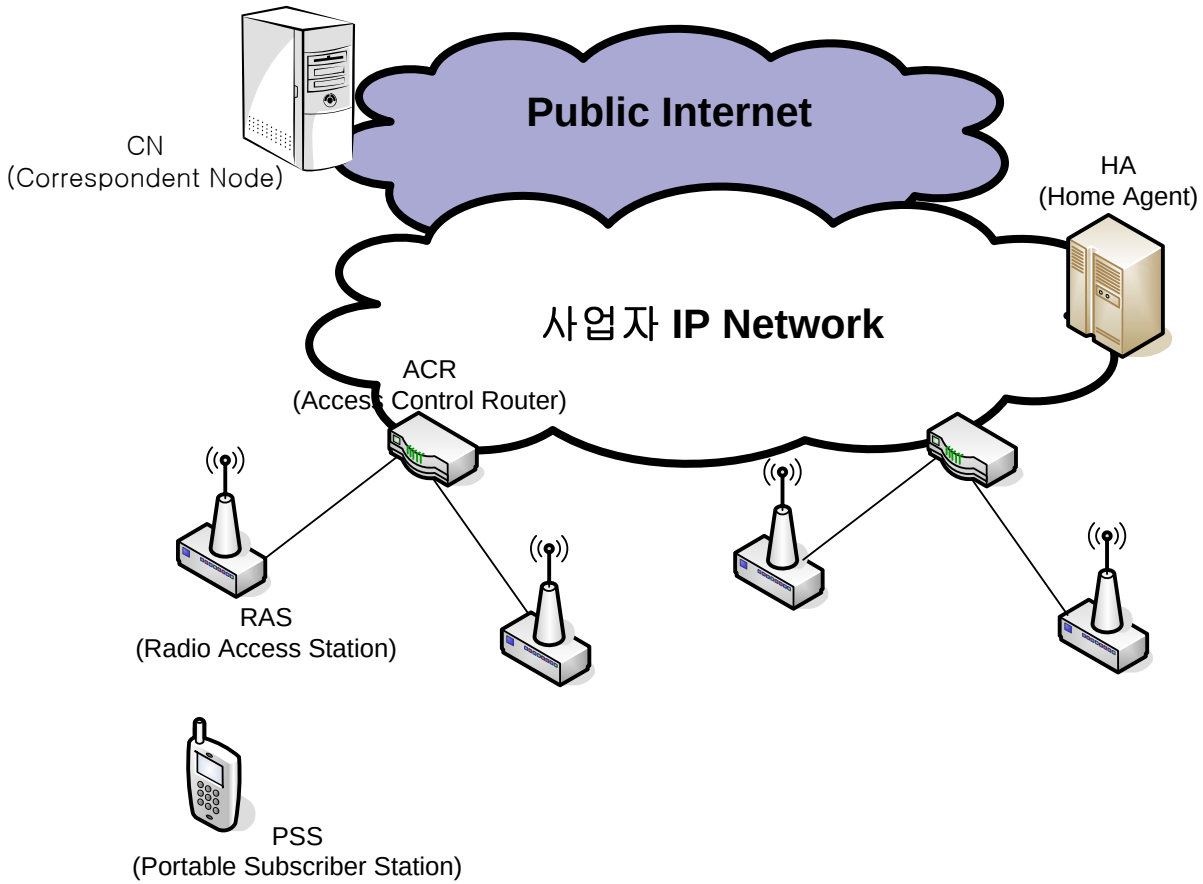
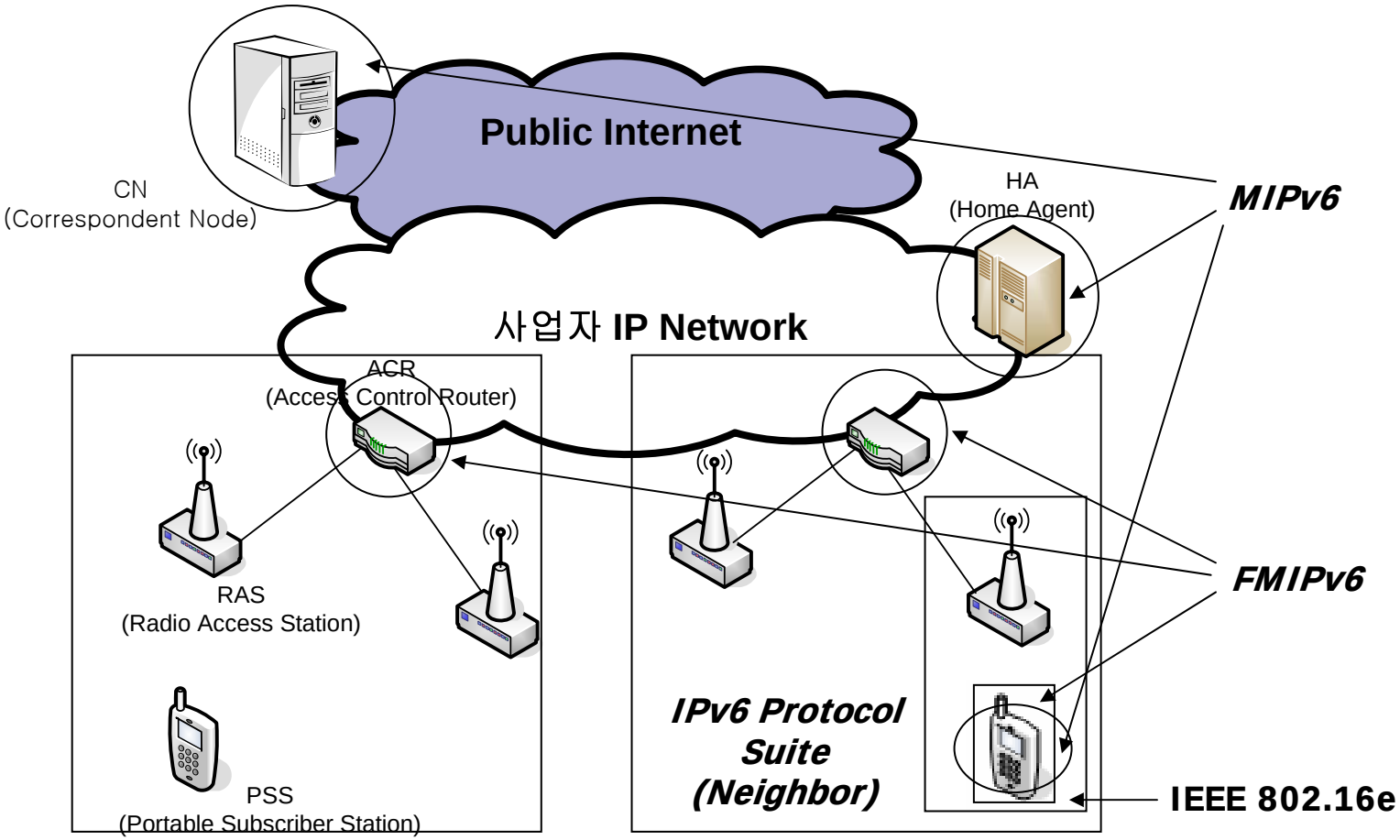
- Network Model in WiBro



# IPv6 over IEEE 802.16/WiBro

- IPv6 & Network Model in WiBro



# Why IPv6 over WiBro?

## IPv6

- 무한대에 가까운 주소 공간
- 효율적인 이동성 지원
- 주소 자동 구성 기능
- 효율적인 라우팅
- 보안측면 강화

All-IP
네트워킹

IP 기반
유무선 통합

유비쿼터스

## WiBro

- 시간과 공간의 제약 없이 인터넷 이용
- Link(BS)/IP 이동성 지원
- 무선 IP 기반의 Personal Broadband 서비스

Efficient and Complete Support for Peer-to-Peer (P2P) applications

이동 (휴대) IP 기반 TPS (Triple Play Service) 실현으로 새로운 디지털 패러다임 창출

TPS: 초고속 인터넷, 전화(VoIP), 방송(IP-TV)

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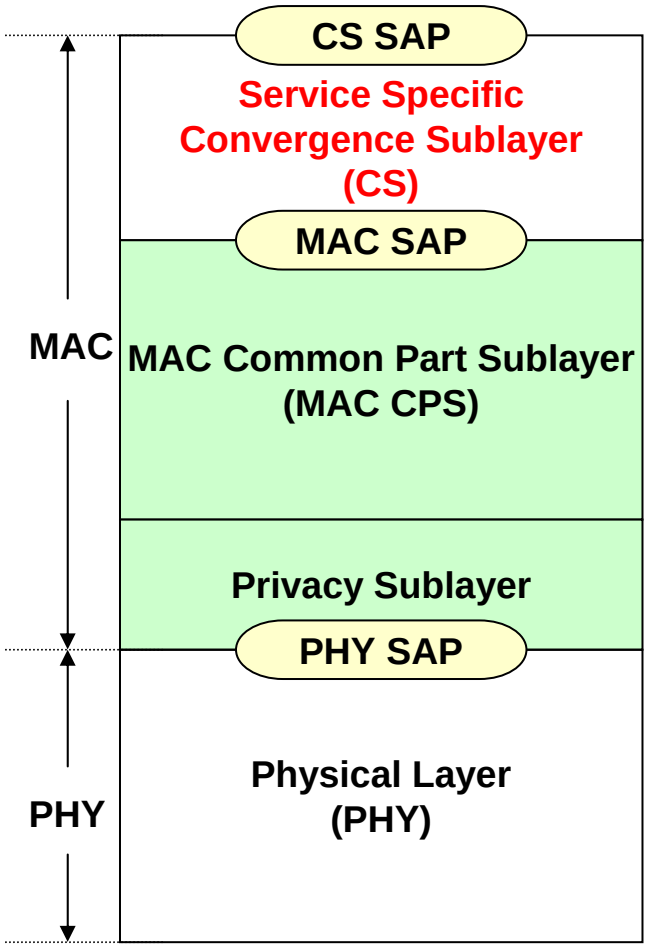
# What are IPv6 Technical Issues?

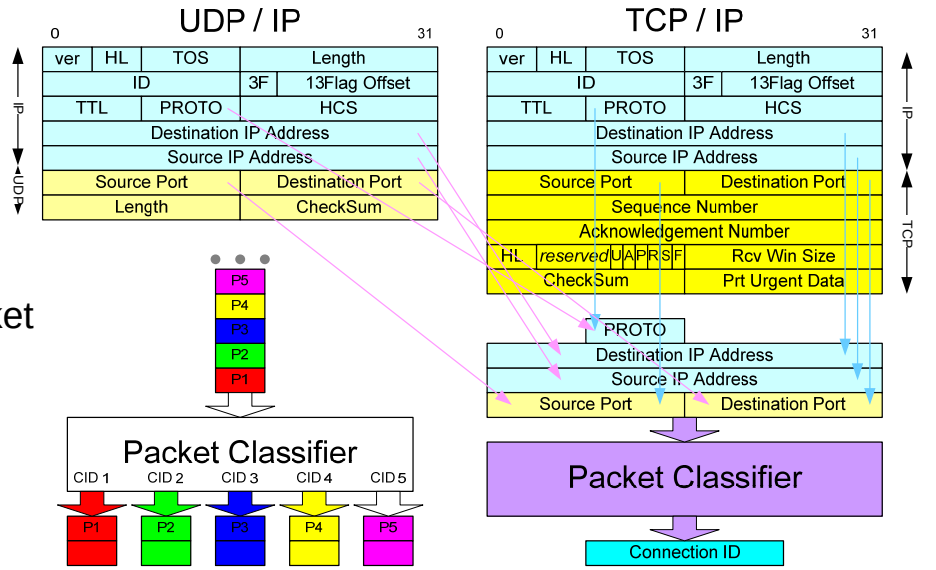
- **IPv6 Link Model Determination**
  - **Packet Transport**
- **IPv6 Multicast Address Mapping**
- **IPv6 Neighbor Discovery Service**
  - **Address Configuration & Confirmation**
- **IPv6 Mobility Service**
  - **Fast IPv6 Mobility over WiBro**

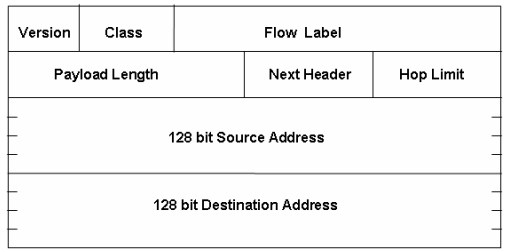
# Link Model Determination

- **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

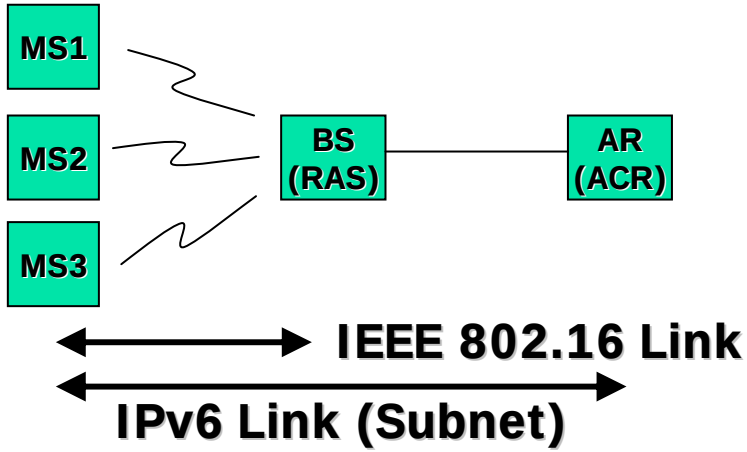



*How to efficiently map ?*

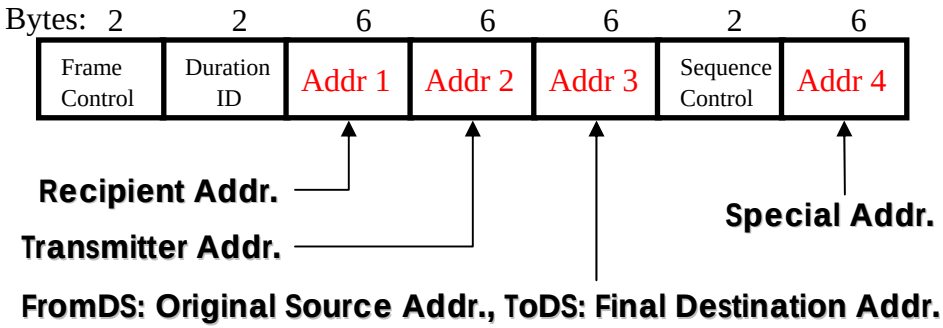
# Link Model Determination

- **IEEE 802.16 Link vs. IPv6 Link (Subnet)**

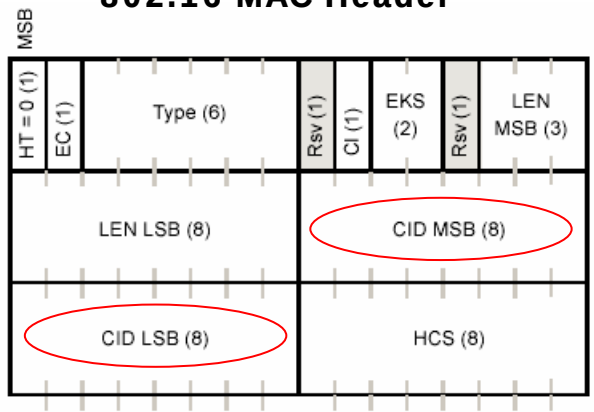



**From the viewpoint of IPv6 ND, BS is just link-level bridge. Unlike IEEE 802.11, however, IEEE 802.16 BS is always acting as the termination point for a communication by using Connection ID instead of MAC address**

**802.11 MAC Header**

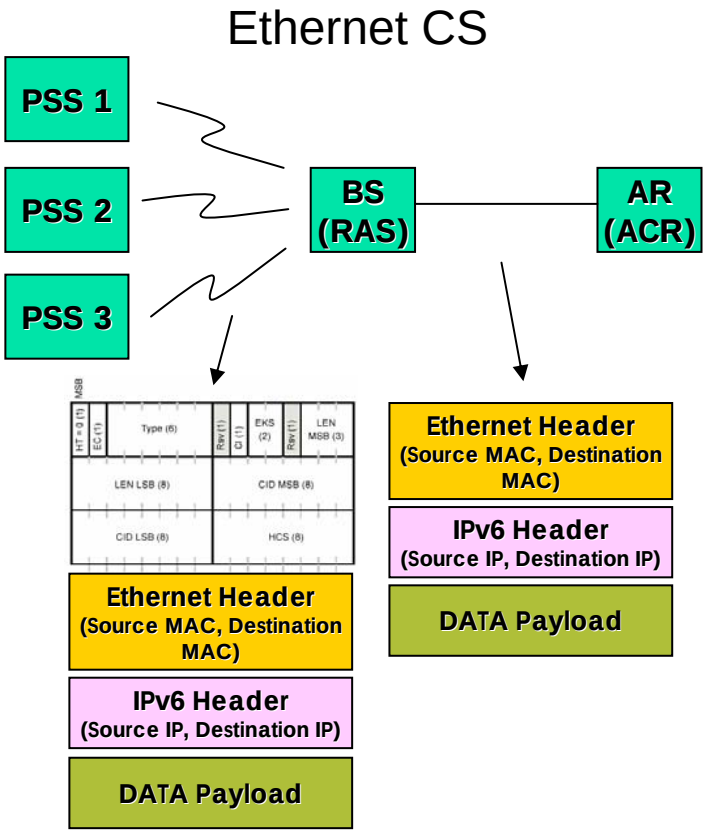



**802.16 MAC Header**

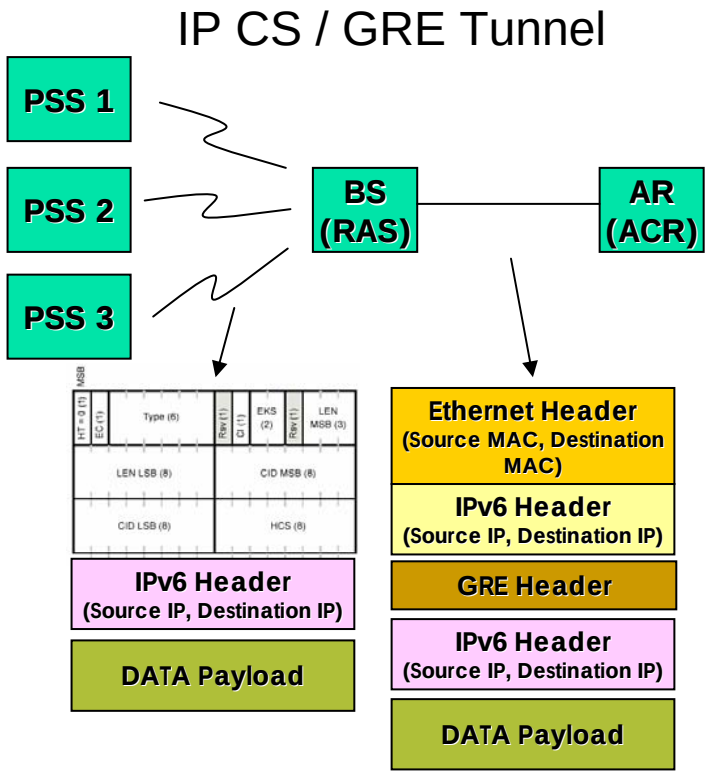


# Link Model Determination

## Emulated broadcast network




## Cellular-like network

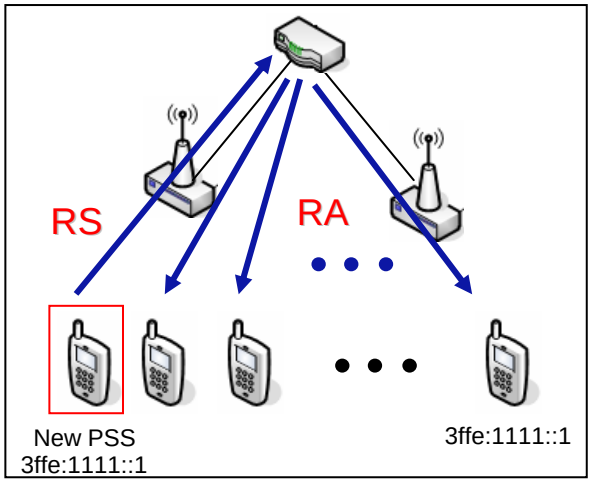


# Link Model Determination

- IPv6 link model depends on how ACR advertises a prefix.
  - A unique prefix to a PSS
    - RFC 3314 recommends that 3GPP terminals generate multiple IPv6 address using the unique prefix per PSS without the concerns of address confliction.
    - Only an ACR and a PSS belong to an IPv6 link.
    - Many IPv6 functionalities can be implemented without difficulty.
  - A single prefix to attached PSSs
    - There will be more issues for adopting IPv6 to IEEE 802.16.
    - This is the approach WiMAX Network Working Group (NWG) currently pursues.

# 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

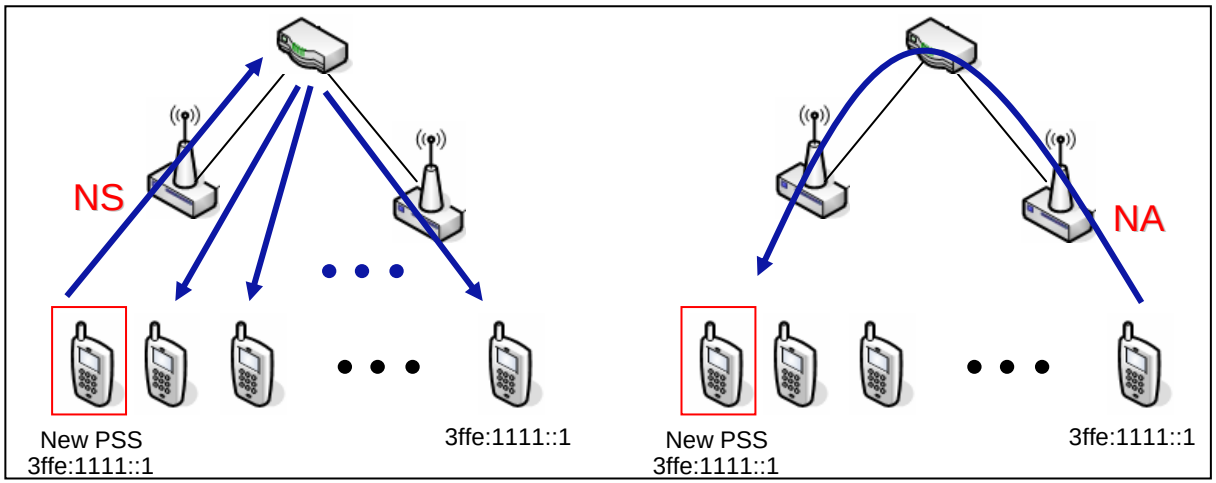
- Whenever needed, unicast it

Option 3: Simulated Multicast using Unicast

- Heavy loads on wireless path

Option 4: New Multicast CID for IP Signaling

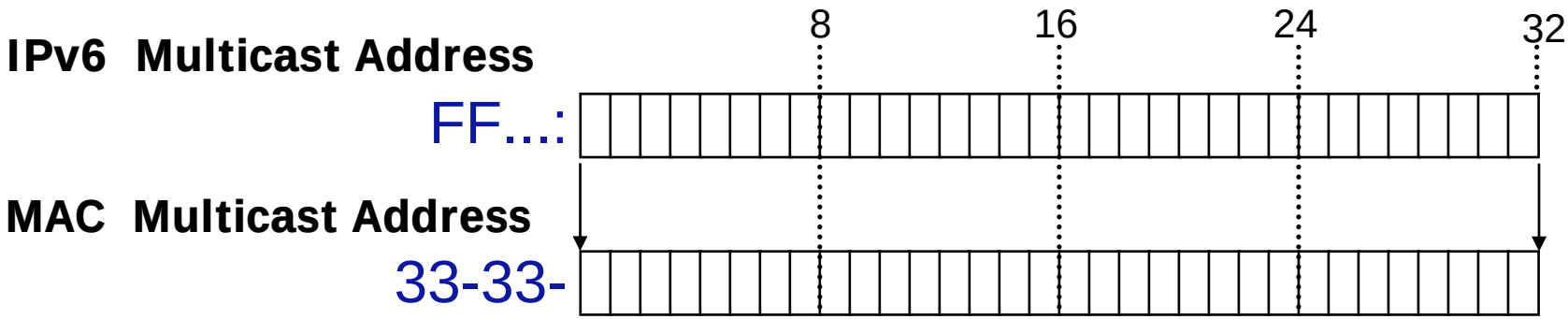
- Efficient, but standard update is needed



# 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 ⇔ Connection ID
  - Case of Ethernet CS
    - IPv6 Multicast Address ↔ Ethernet MAC ⇔ Connection ID
- It seems to be a standardization item in “IETF”
  - If it could be standardized, WiMAX would use the result.
- Etc.
  - MLD (Multicast Listener Discovery)
  - IEEE 802.16 MBS

# IPv6 Neighbor Discovery Service

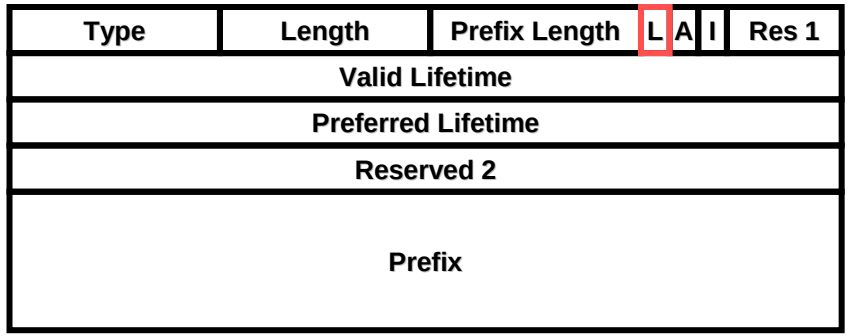
- Why IPv6 ND ?
  - Address Autoconf. and Duplicate Address Detection (DAD)
  - Peer-to-peer communication in a IPv6 link
- Specific Protocols for IPv6 ND Services

| | RS | RA | NS | NA | Redirect | Notes |
|---|---|---|---|---|---|---|
| Router Discovery | ✓ | ✓ | | | | **Adaptation to WiBro** |
| Prefix Discovery | ✓ | ✓ | | | | **Adaptation to WiBro** |
| Parameter Discovery | ✓ | ✓ | | | | **Adaptation to WiBro** |
| Address Autoconfiguration | | | | | | **What Policy? (Whether or not stateless address aucoconf in WiBro)** |
| Address Resolution | | | ✓ | ✓ | | **Ethernet CS, IP CS (Adaptation to WiBro)** |
| Next-hop determination | | | | | | **Adaptation to WiBro** |
| Neighbor Unreachability Detection | | | ✓ | ✓ | | **Adaptation to WiBro** |
| Duplicate Address Detection | | | ✓ | ✓ | | **Whether or not stateless address aucoconf in WiBro** |
| Redirect | | | | | ✓ | **Adaptation to WiBro** |

# IPv6 Neighbor Discovery Service

- Router (ACR)/Prefix/Parameters Discovery
  - How to deliver Router (ACR) information, On-link Preifx, 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).**



# 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
    - Proxy DAD
      - Omniscient ACR knows about all PSSs’ addresses attached to itself
      - ACR may immediately confirm the uniqueness of the address, maybe, by sending a modified NA message.

# 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

# Mobile IPv6 over WiBro

- Mobile IPv6: RFC 3775 (June 2004)
  - Movement Detection
  - Address Configuration and Confirmation (DAD)
  - Return Routability
  - Location Registration

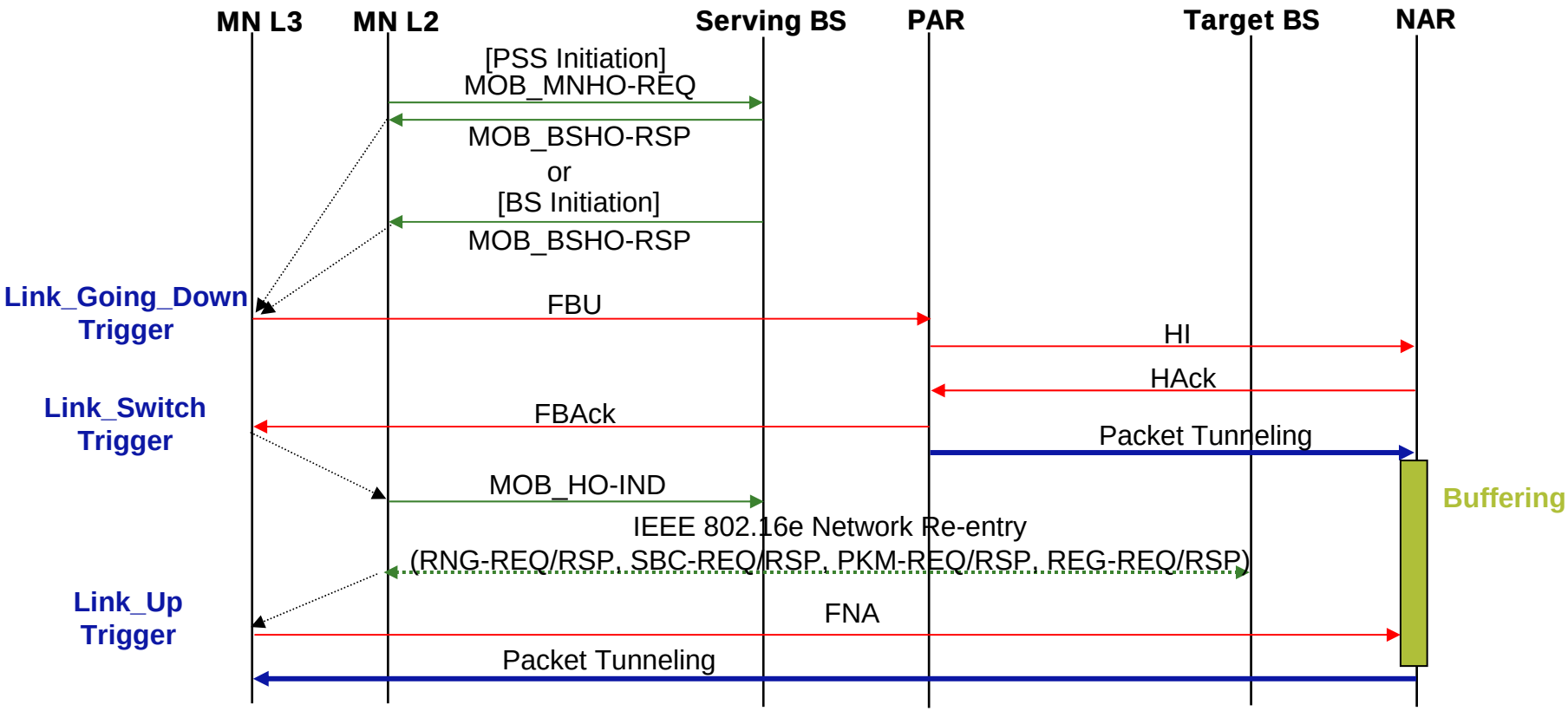
- MIPv6 over WiBro
  - Easy Deployment
  - No More Issues will remain if “IPv6 over WiBro” technical issues are resolved.

- Mobile IPv6 is not handover management protocol but location & path update protocol.

# FMIPv6 (Fast Mobile IPv6) over WiBro

- Fast Handover over Mobile IPv6: RFC 4068 (July 2005)
  - It is a mature protocol
    - It takes about 5 year to update it
  - It can be the next step IP-handover solution for WiBro
  - IETF Official Standardization Item
    - FMIPv6 over IEEE 802.16e
      - SAIT, KUT, Samsung DM, ETRI Collaboration
      - http://www.ietf.org/internet-drafts/draft-ietf-mipshop-fh80216e-00.txt
  - Some optimization technique needed for WiBro

# FMIPv6 (Fast Mobile IPv6) over WiBro



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# IPv6 Deployment Scenario in IEEE 802.16 Networks

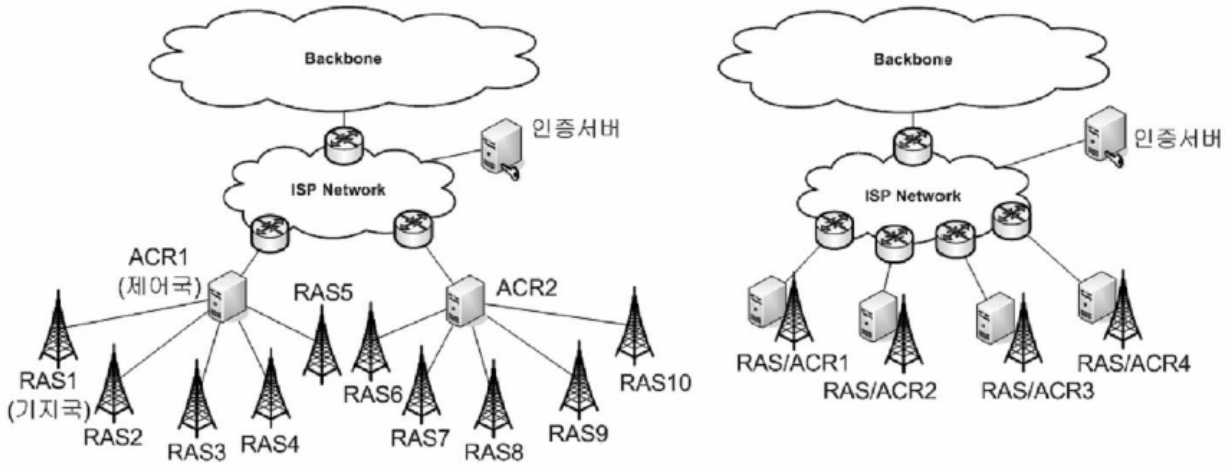
- How to provide the service?
  - Cellular-like
  - Hot-zone
- How to define system architecture?
  - Router separation from BS
  - BS and Router in one Box
- How to allocate prefix?
  - A unique prefix to a SS
  - A single prefix to attached SSs
- How to make convergence sub-layer?
  - IP CS
  - Etehrent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

# How to provide the service?

- Cellular-like [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 [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
  - RFC 3314 recommends that 3GPP terminals generate multiple IPv6 address using the unique prefix per terminal without the concerns of address confliction.
  - Many IPv6 functionalities can be implemented without difficulty.

- A single prefix to attached SSs [WiBro]
  - 'Hot zone' scenario would not allow RFC 3314 recommendation
  - There will be more issues for adopting IPv6 to IEEE 802.16.

# How to make convergence sub-layer?

- IP CS (e.g. WiBro)
- Ethernet CS

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# Standardization Trends

- **IETF**
  - **16ng (BoF) – IPv6 over IEEE 802.16**
    - **2005년 11월에 새롭게 신설 - 2005.11, 2006.03 2번의 BoF, 각각 100여명 참석, WG화 호응도 좋음**
    - 한국 연구자들이 주도적으로 참여
  - **MIPSHOP WG**
    - **FMIPv6 over WiBro 제안건(삼성, ETRI, 한국기술교대) WG Item 채택 유망**
  - **v6ops WG**
    - **IPv6 Deployment Scenario over IEEE 802.16e Link (ETRI, 한국기술교대) WG Item 채택됨**
      - **http://www.ietf.org/internet-drafts/draft-shin-v6ops-802-16-deployment-scenarios-00.txt**
- **WiMAX**
  - **NWG**
    - **Release 2에는 IPv6 및 Mobile IPv6 관련 기술을 넣는 계획 수립**
      - 최근 **IPv6 Subteam** 구성
    - **IETF 16ng 의 결과를 WiMAX에서 활용하려고 함**
- **IEEE**
  - **IEEE 802.16g - 네트워크 측면에서의 관리 및 제어 평면 규격 정의**
- **TTA**
  - **IPv6 over WiBro WG** (IPv6 PG – PG210)
    - **2005년 10월경 신설 - 2006년 국내 고유 표준 제정 목표, 국내 WiBro 망 관점에서 접근**
- **IPv6 Forum Korea**
  - **Mobility WG**
    - **IPv6 over IEEE802.16 연구, WiBro 망에만 한정된 연구가 아님**

# The 64th IETF 16ng BoF Agenda (2005.11)

- **IETF 16ng Agenda – Co-chairs: Daniel-Samsung DM, Gabriel-Microsoft**
  - **An Introduction to IEEE 802.16(e) (15 minutes)**
    - **presenter: Hannes Tschofenig <hannes.tschofenig@siemens.com>**
  - **WiMAX Forum Network Working Group Overview, (15 minutes)**
    - **presenter: Parviz Yegani <pyegani@cisco.com>**
  - **IEEE 802.16 and NETLMM Overview, (5 minutes)**
    - **presenter: James Kempf <kempf@docomolabs-usa.com>**
  - **IPv6 Deployment over IEEE 802.16, (5 minutes)**
    - **presenter: Yu-Seon Kim <yseonkim@kt.co.kr>**
  - **Transport of IP over IEEE 802.16, (10 minutes)**
    - **presenter: Jeff Mandin <jeff@streetwaves-networks.com>**
  - **Scenarios and Considerations of IPv6 in IEEE 802.16 Networks, (10 minutes)**
    - **presenter: Myung-Ki Shin <mkshin@pec.etri.re.kr>**
  - **IPv6 NDP Implications in IEEE 802.16, (10 minutes)**
    - **presenter: Syam Madanapalli <syam@samsung.com>**
  - **Fast Mobile IP Handovers over IEEE 802.16e Networks, (10 minutes)**
    - **presenter: Rajeev Koodli <rajeev@iprg.nokia.com>**
  - **16ng Problem Statements, (5 minutes)**
    - **presenter: Junghoon Jee <jhjee@etri.re.kr>**
  - **Overview of proposed charter, (5 minutes)**
    - **presenter: chairs**
  - **Charter discussion, (25 minutes)**
    - **presenter: chairs**

# The 65th IETF 16ng BoF Agenda (2006.03)

- **IETF 16ng Agenda – Co-chairs: Daniel-Samsung DM, Gabriel-Microsoft**
  - **16NG Problem Statement, (20 minutes)**
    - **Presenter: Junghoon Jee<jhjee@etri.re.kr>**
  - **WiMAX Forum NWG Stage 3 work for IPv6, (10 minutes)**
    - **presenter: Basavaraj Patil <Basavaraj.Patil@nokia.com>**
  - **IPv6 over IEEE 802.16 Solution Framework, (10 minutes)**
    - **presenter: Syam Madanapalli <syam@samsung.com>**
  - **Charter discussion, (50 minutes)**
  - **IPv6 NDP for Common Prefix Allocation in IEEE 802.16, (5 minutes)**
    - **presenter: Hongseok Jeon**
  - **IPv6 Packet Tramsmission over 802.16 Networks, (5 minutes)**
    - **presenter: Myungki Shin <mkshin@pec.etri.re.kr>**
  - **Real-Time usage of IEEE 802.16: Problem Statement, (5 minutes)**
    - **presenter: Pedro Neves**
  - **QoS Aware Real-Time Support for IPv6 in IEEE 802.16 Backhaul scenarios, (5 minutes)**
    - **presenter: Pedro Neves**

# IETF 16ng deliverables (provisional)

- **Requirements and Goals for IPv6 and IPv4 over IEEE 802.16(e) Networks**
  - **to identify the problems and limitations of IP adoption over IEEE 802.16(e) networks. [Informational RFC]**
- **IPv6 over IEEE 802.16(e) Networks**
  - **to define IPv6 operation including the transmission of IPv6 over IEEE 802.16(e) links, Neighbor Discovery Protocol, Stateful (DHCPv6) and Stateless Address Configuration, Broadcast, Multicast, etc. [Proposed Standard RFC]**
- **IPv4 over IEEE 802.16(e) Networks**
  - **to define IPv4 operation including the transmission of IPv4 over IEEE 802.16(e) links, ARP operation, Stateful Address Configuration (DHCPv4), Broadcast, Multicast, etc. [Proposed Standard RFC]**
- **IPv6 and IPv4 deployment over IEEE 802.16(e) Networks**
  - **to illustrate the IP deployment scenarios and considerations over IEEE 802.16(e) networks. [Informational RFC]**
- **Fast Handover Mobile IPv6 over IEEE 802.16e Networks**
  - **to define fast handover scheme for mobile IPv6 (RFC 4068) over IEEE 802.16e links. [Informational RFC]**
- **Fast Handover Mobile IPv4 over IEEE 802.16e Networks**
  - **to define fast handover scheme for mobile IPv4 over IEEE 802.16e links.**

# TTA PG210, IPv6 over WiBro WG

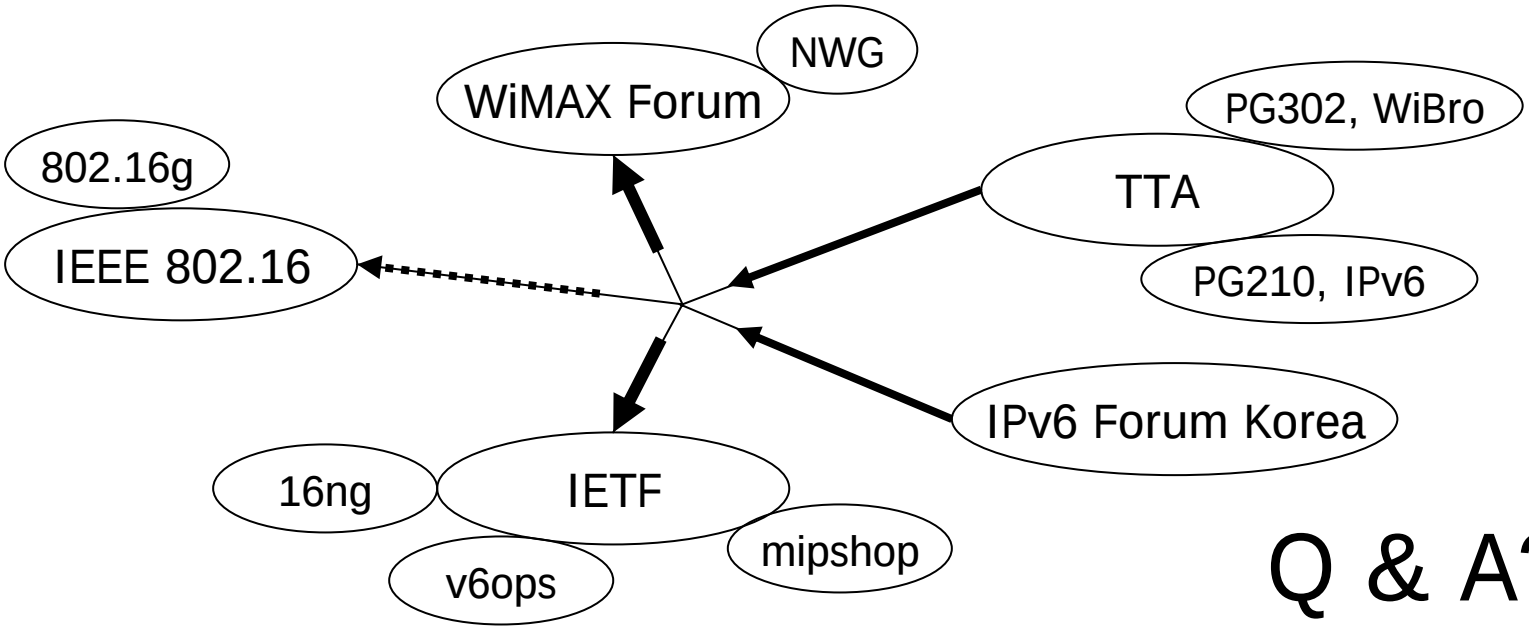
- **1차 회의: 2005년 11월 9일 – 캐나다 벤쿠버**
  - **IETF 16ng BoF** 창설에 대한 향후 대응 방안 마련
  - 향후 국내 표준 필요성 제기
- **2차 회의: 2005년 12월 14일 – TTA**
  - **PG302** 서비스 및 네트워크 **WG** 활동 검토 및 협력 방안 계획 수립
  - **WiMAX NWG** 활동 검토
  - **2**건의 기술 발표
  - 국내 표준 제정에 대한 논의
- **IPv6 PG 210, 12차 정기 회의**
  - **2006년 2월 28일**
  - **IPv6 over WiBro** 국내 표준안 과제 제안
- **3차 회의: 2006년 3월 15일 – TTA**
  - **WiMAX NWG IPv6 Subteam** 활동 검토
  - **4**건의 기술 발표
  - 국내 표준 목차 토의 및 **2006년** 활동 계획 수립

WiBro 상에서의 IPv6 프레임워크 표준 (목차 잠정안)

1) Introduction
2) IPv6 over WiBro: Architecture and Requirement
3) Link/Subnet Model (and Deployment Scenario)
4) WiBro 상에서 IPv6 프로토콜
   4-1) Addressing & Packet Transmission
   4-2) ND over WiBro
   4-3) IPv6 Address Configuration (and DAD)
   4-4) DNS Discovery
   4-5) IPv6 Multicast
   4-6) IPv6 Mobility
5) Security Issues
6) 부록1: IPv6 Operation
7) 부록2: IPR 관련 기술 리스트

# 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, IPv6 over WiBro 표준, IPv6 Forum 표준
- 국내 표준에 대한 국제 표준화
  - IETF 16ng, WiMAX 등




Q & A?