
와이브로상에서의 IPv6 기술 표준화 현황

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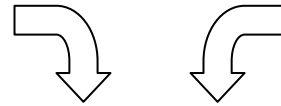
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- **Introduction**
- IPv6 Technical Issues over WiBro
- Standardization Trends & Conclusions

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)

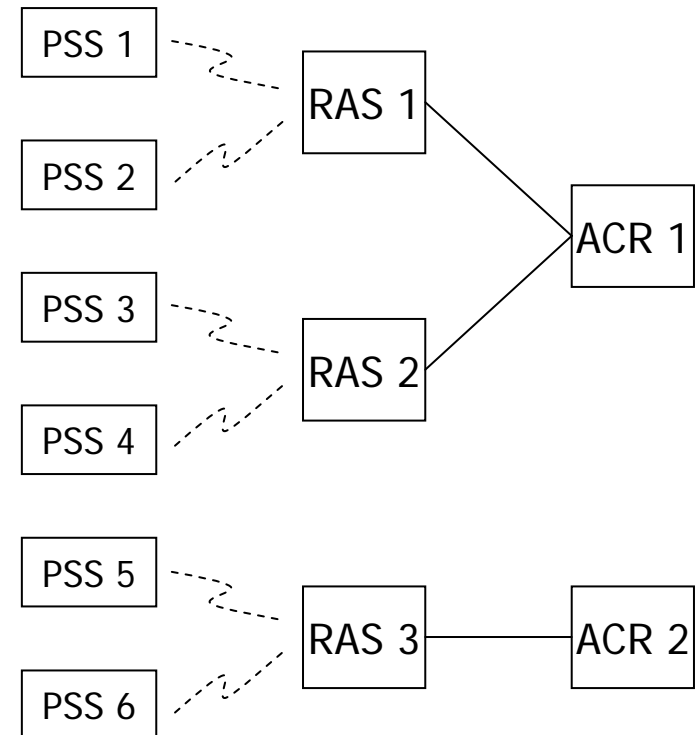
WiBro Network Architecture

■ 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



IP 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.
- A prefix can be shared with multiple PSSs attaching to different RASs under an ACR.
- Even from IP perspective, an PSS cannot communicate with another PSS directly. All traffic go through an AR.
 - It implies that an MS's on-link neighbor is only an AR.

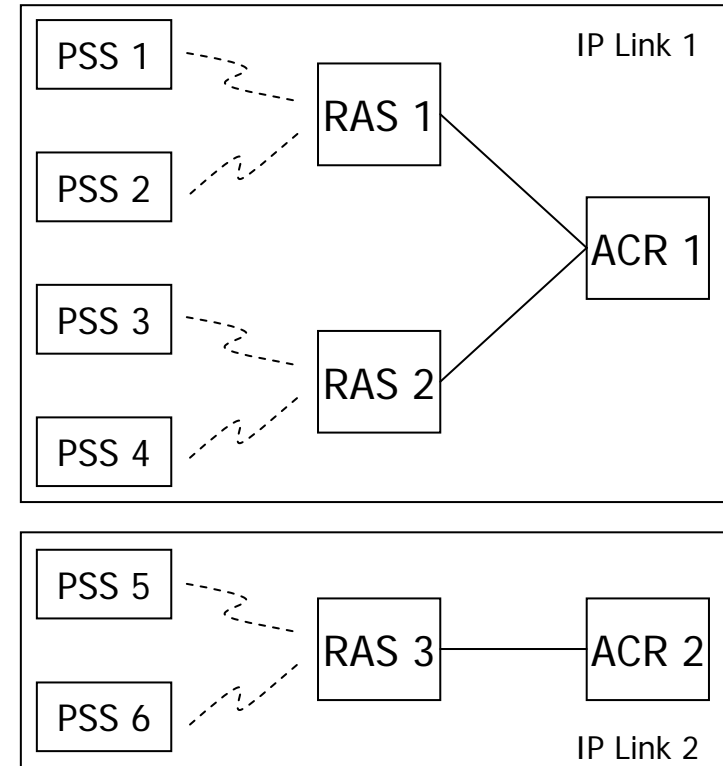
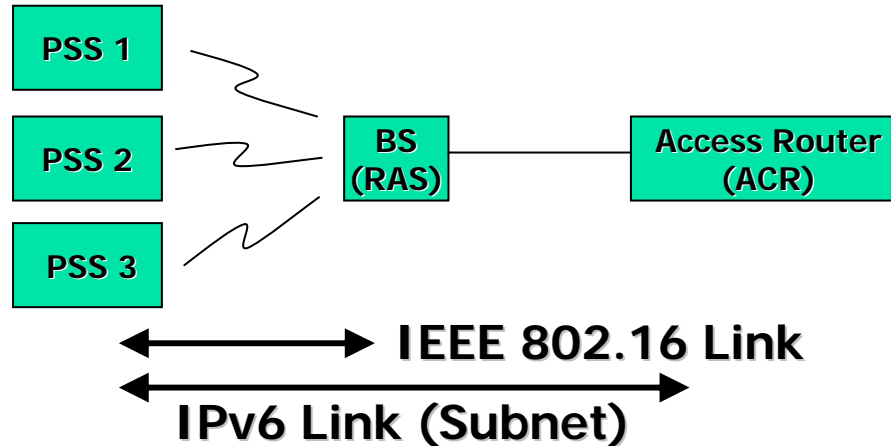


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- **IPv6 Technical Issues over WiBro**
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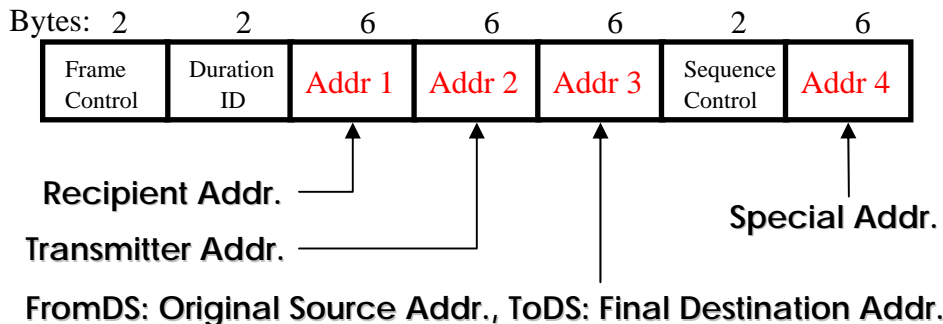
Link Model Determination

- IEEE 802.16 Link vs. IPv6 Link (Subnet)

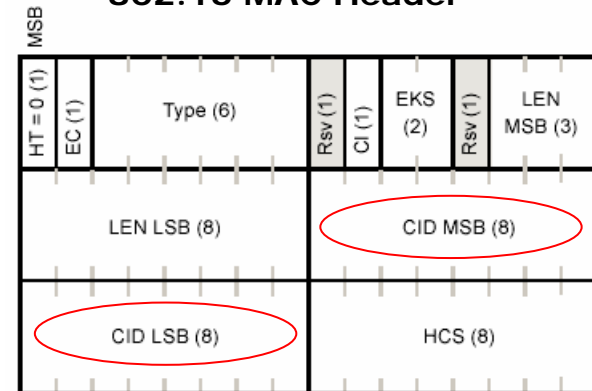


From the viewpoint of IPv6 ND, BS is just link-level bridge. Unlike IEEE 802.11, however, IEEE 802.16 RAS is always acting as the termination point for a communication by using **Connection ID** instead of MAC address

802.11 MAC Header

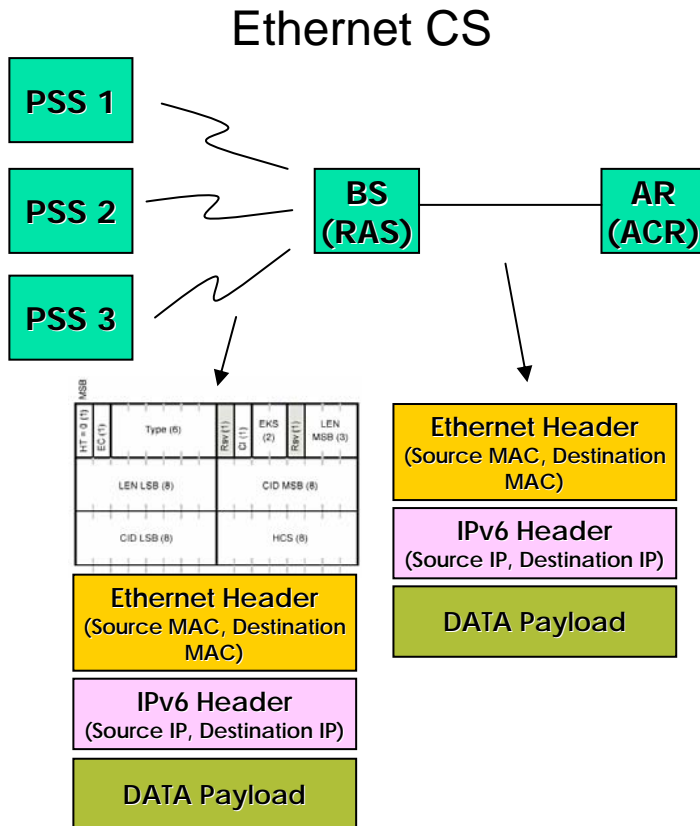


802.16 MAC Header

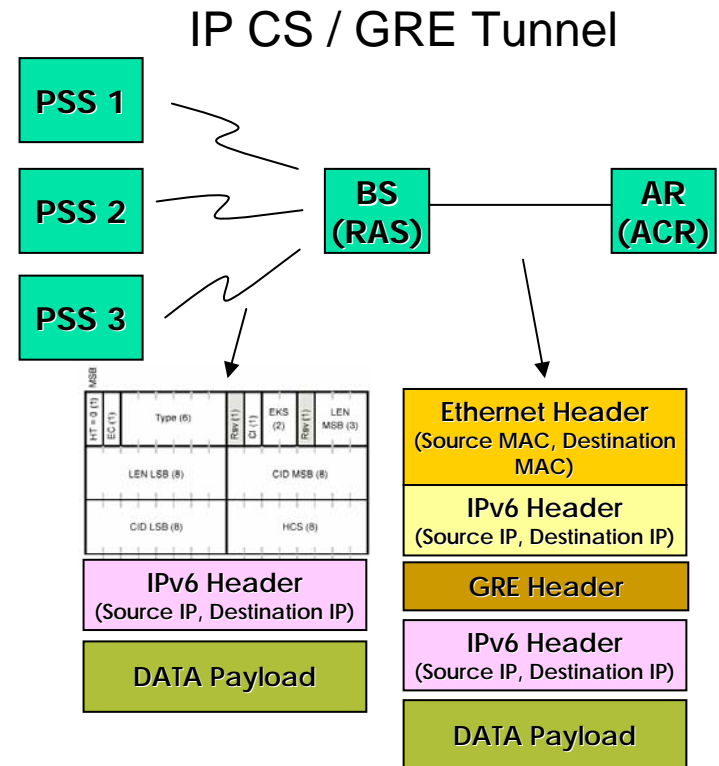


Link Model Determination

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

[접근방법]

Option 1: RS/RA를 내보내지 않음

- MAC Singling Message 내에 RS 및 RA를 Embed 함

Option 2: RS/RA를 Unicast로 보냄

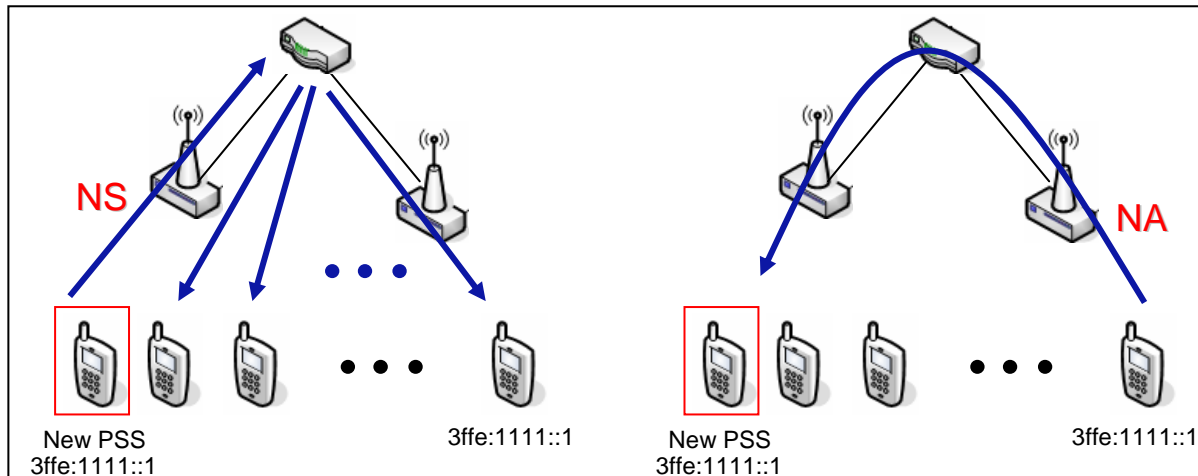
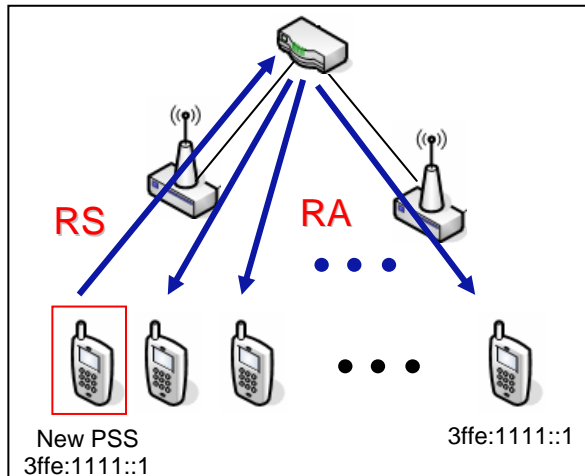
- Router의 주소를 미리 단말에게 알려주어야 함

Option 3: Simulated Multicast using Unicast

- 무선구간에 부하가 심함

Option 4: IP Signaling 위한 New Multicast

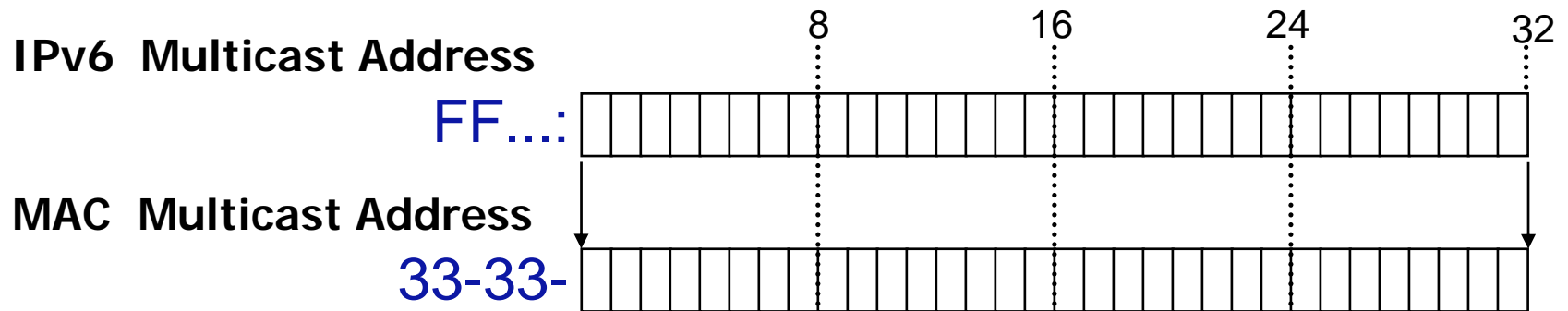
- CID 할당 및 효율적 Multicast 방법 구현



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.

- Etc.
 - MLD (Multicast Listener Discovery)
 - IEEE 802.16 MBS

IPv6 Neighbor Discovery Service

- Why IPv6 ND ?
 - Address Autoconf. and Duplicate Address Detection
 - 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? & Adaptation to WiBro (Whether or not stateless address autoconf in WiBro)
Address Resolution			✓	✓		No Use
Next-hop determination						No Use
Neighbor Unreachability Detection			✓	✓		Adaptation to WiBro or No Use
Duplicate Address Detection			✓	✓		What Policy? & Adaptation to WiBro Whether or not stateless address autoconf in WiBro
Redirect					✓	No Use

IPv6 Neighbor Discovery Service

■ Router (ACR)/Prefix/Parameters Discovery

□ Router (ACR), On-link Prefix, Link MTU 정보들을 어떻게 단말기에 알려주는가?

□ 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.

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

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

IPv6 Neighbor Discovery Service

■ Stateless Address Auto-configuration & DAD

- Stateless Auto-conf를 지원해야 하나?
- 만약 지원한다면...
 - 어떻게 DAD (Uniqueness Test)를 할 수 있나?
 - 어떻게 제어국쪽의 CS Layer에게 생성된 IPv6 주소를 통보하는가?
- Original
 - 단말이 On-link Prefix와 자기 자신의 ID를 Combine 하여 구성
 - 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
 - 단말 입장에서 Neighbor 는 오로지 ACR
 - No Use

IPv6 Neighbor Discovery Service

■ Neighbor Unreachability Detection

- 어떻게 Neighbor Node가 Reachable 한지 아닌지 알 수 있나?
- Original
 - NS/NA exchange in unicast manner
- WiMAX/WiBro Approach
 - 단말 입장에서 Neighbor 는 오로지 ACR
 - We may do this from link-layer event notification without NS/NA exchange.

■ Redirect

- ACR이 더 좋은 Next-hop을 단말에게 알려주는 기능.
- Original
 - Redirect message delivery in unicast manner
- WiMAX/WiBro Approach
 - 단말 입장에서 Neighbor 는 오로지 ACR
 - No Use

IPv6 Mobility over WiBro

- RFC 3775 (June 2004) - Mobile IPv6
- No more issues will remain if all “IPv6 over WiBro” technical issues are resolved.
- Mobile IPv6 is not handover management protocol but location & path update protocol.
- RFC 4068 (July 2005) - Fast Handover over Mobile IPv6
 - It takes 5 years to make its RFC version
 - It could be the next step IP-handover solution for WiBro
 - IETF Mipshop WG’s official standardization item
 - FMIPv6 over IEEE 802.16e
 - <http://www.ietf.org/internet-drafts/draft-jang-mipshop-fh80216e-02.txt>

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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

IETF 16ng deliverables (provisional)

- **Problem Statements 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]
- **IP 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

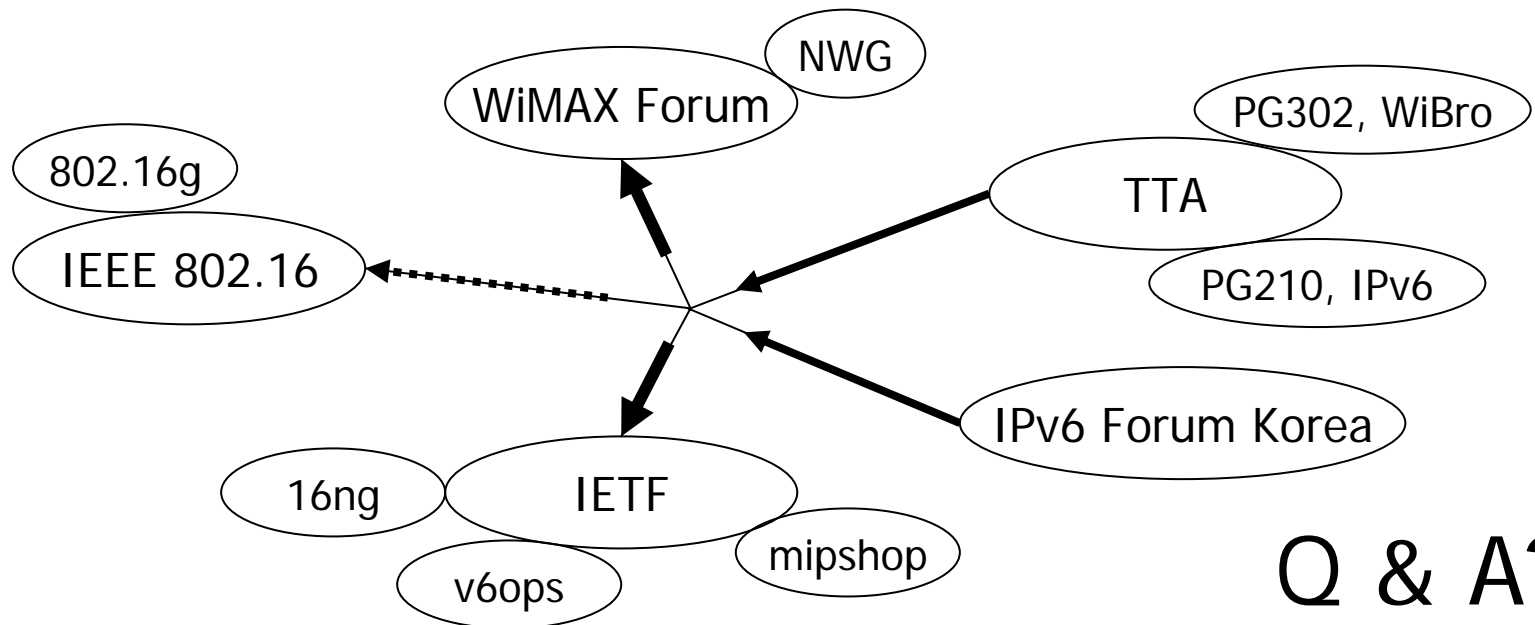
- **1차 회의: 2005년 11월 9일 – 캐나다 벤쿠버**
 - IETF 16ng BoF 창설에 대한 향후 대응 방안 마련
 - 향후 국내 표준 필요성 제기
- **2차 회의: 2005년 12월 14일 – TTA**
 - PG302 서비스 및 네트워크 WG 활동 검토 및 협력 방안 계획 수립
 - WiMAX NWG 활동 검토
 - 2건의 기술 발표
 - 국내 표준 제정에 대한 논의
- **IPv6 PG 210, 12차 정기 회의**
 - 2006년 2월 28일
 - IPv6 over WiBro 국내 표준안 과제 제안
- **3차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