2 0 1 3

Challenges of IPV6 for a WiMAX Operator: A Motivation for Migration to LTE

G.Reza Mahmoudi

r.mahmoudi@mobinet.net

IP MPLS Manager

Mobinnet Telecommunication Company (MTC), **Iran**

MENOG12
5-14 March 2013
Dubai, United Arab Emirates

MOBINNET TELECOMMUNICATION CO.

Agenda

- ✓ **Wimax Networks in Middle East**
- ✓ **Are Wimax Operators out of IPV6 Game?**
- ✓ **How Can Carrier Grade NAT Pave the Way For IPV6 Transition?**
- ✓ **LTE Can be the Destination!**
- ✓ **Conclusion**

- WiMAX (IEEE 802.16) provides a cost effective IP-Based last mile to build broadband networks.
- Based on Wimax Forum Industry Research Report, March 2011, it is estimated more than 800 million subscribers are using Wimax. The stats by the end of 2010 is:

Total Deployments	582
Total Countries with WiMAX Deployments	150
Total Countries with Wimax in Middle East	10
Total Deployments in Middle East	29
POPs Covered (Worlwide)	823,401,252
POPs Covered (Middle East)	33,509,544

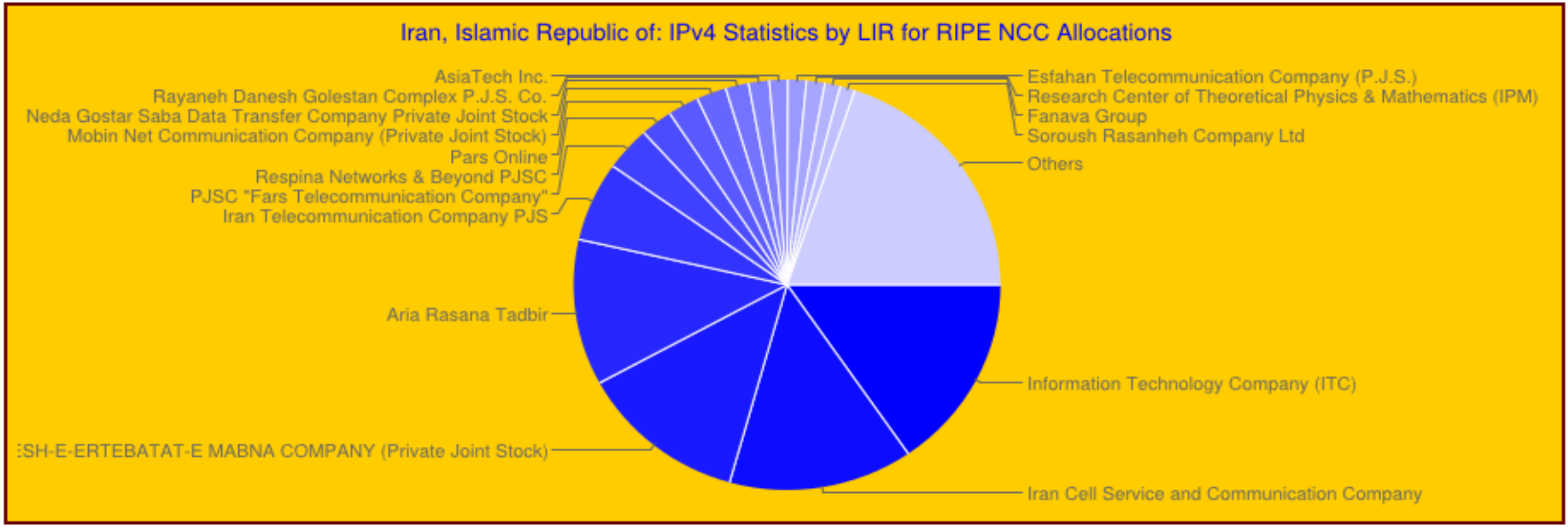
- WiMAX was a rapid & efficient answer for the demanding market of broadband in Iran during 2008-2012.
- MobinNet as the only nationwide WiMAX operator, has covered more than 150 cities in Iran with broadband services.

Iran, Islamic Republic of (IR) - IPv4 Stats - Sorted by number of addresses

Data from RIPE NCC website as of: Sun Feb 24 2013

Total number of addresses: 9 414 656

http://www-public.int-evry.fr

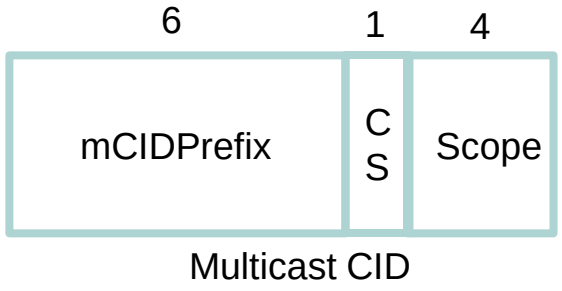


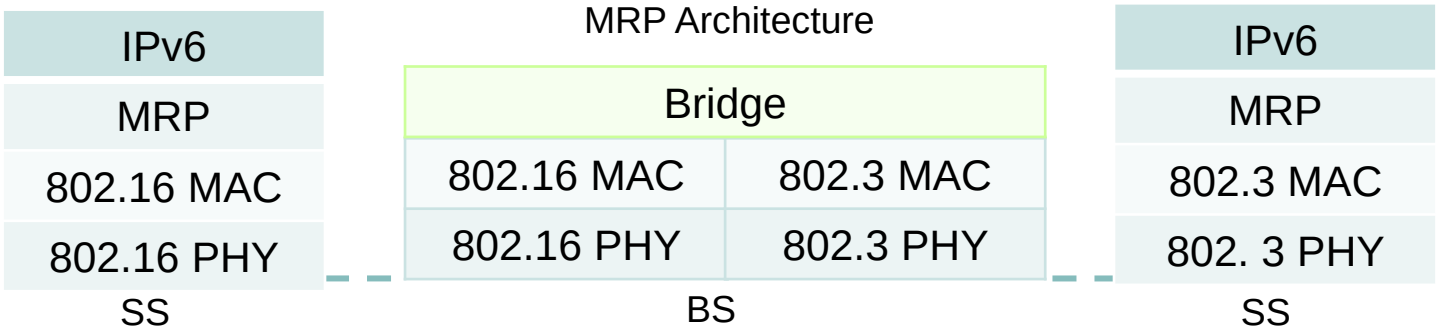
Are Wimax Operators out of IPV6 Game?

Efforts for IPV6 in Wimax

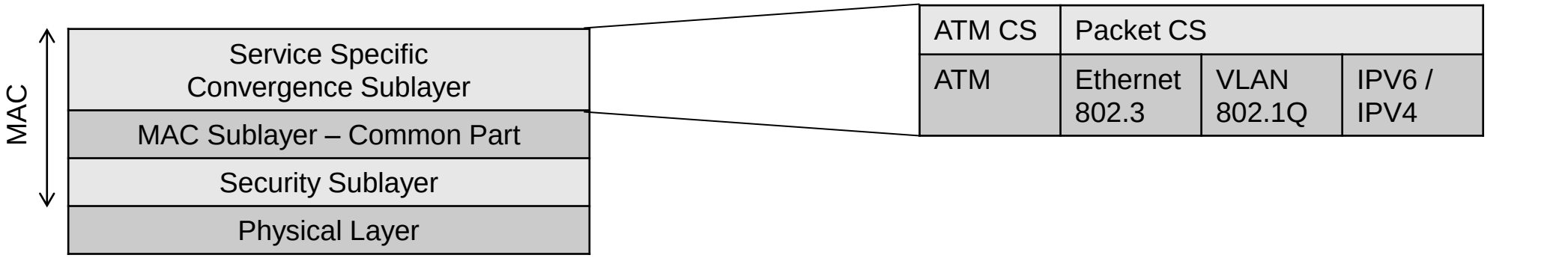
- Special group namely 16ng was formed to tackle IPv6 support over WiMAX in IETF
- Wimax Forum (as a consortium of industrials) has worked on different scenarios
- A few RFC's and Drafts were worked out:
  - draft-ietf-16ng-ipv6-over-ipv6cs-00
  - RFC 4968: Analysis of IPv6 Link Models for IEEE 802.16 Based Networks
  - RFC 5121: Transmission of IPv6 via the IPv6 Convergence Sublayer over IEEE 802.16 Networks
  - RFC 5154: IP over IEEE 802.16 Problem Statement and Goals

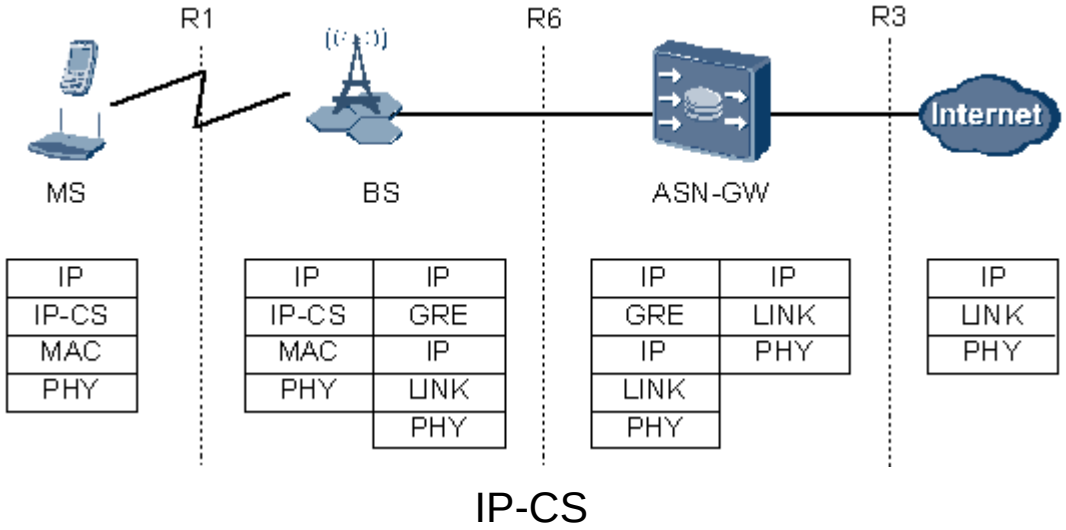
- A new functionality of IPv6 is its stateless autoconfiguration mechanism: Neighbor Discovery Protocol (NDP)
- IEEE 802.16 works on a point-to-multipoint architecture basis, thus multicast communication is not supported which makes the deployment of IPv6 harder
- IEEE 802.16 can't map directly the IP multicast addresses into layer 2 multicast addresses
  - Solution1: 16ng has proposed CID dedicated to multicast, namely mCID
  - Solution 2: intermediate layer between IP layer (or Ethernet) and the 802.16 Convergence Sublayer (CS) named Multicast Relaying Part (MRP).
  - Propose to concentrate at the BS all procedures related to handling and managing multicast packets (centralized fashion).



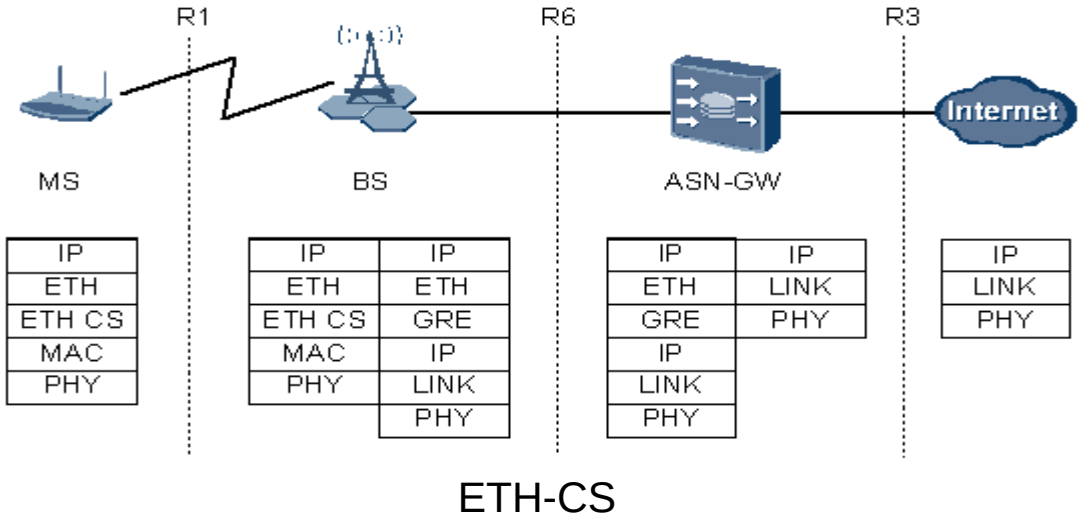


- 2 Sublayers of MAC: the convergence sublayer and the common part sublayer
- IP CS and ETH CS are most commonly used



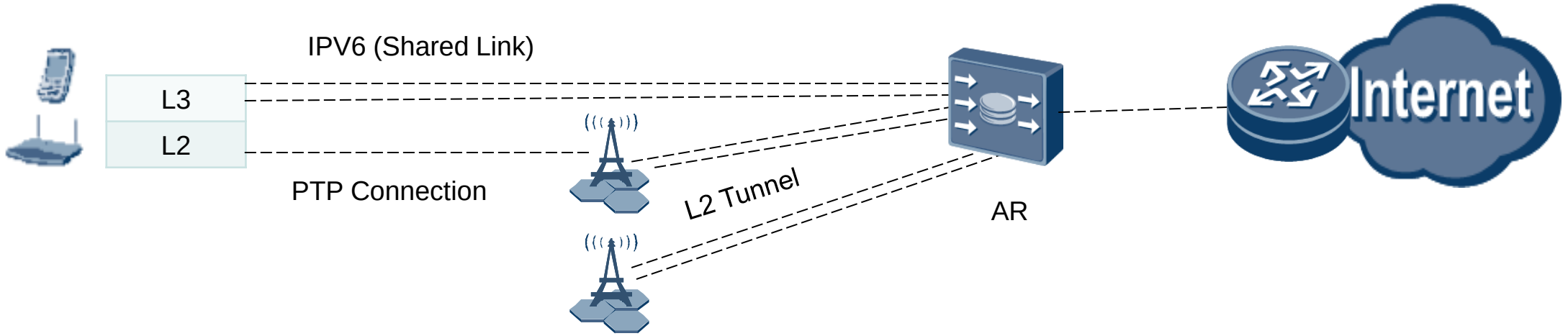


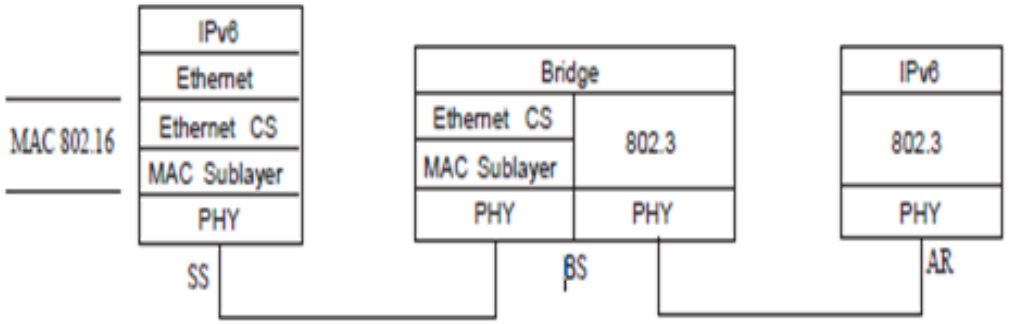
IP-CS



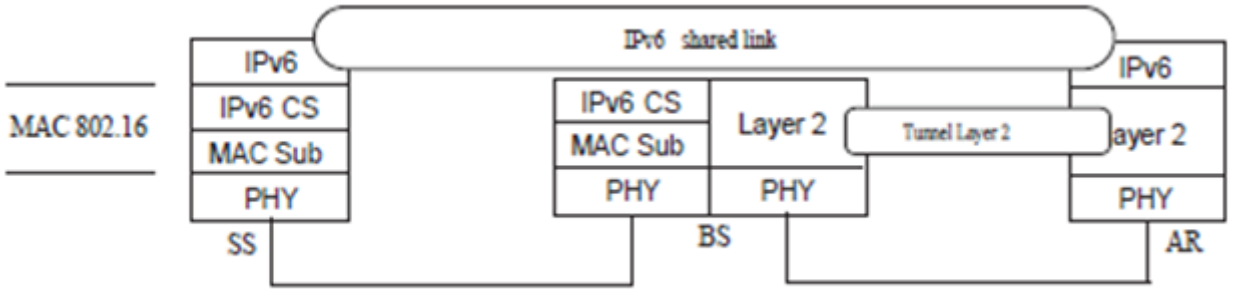
ETH-CS

Shared IPv6 Prefix Link Model





Shared IPV6 Prefix (ETH-CS)

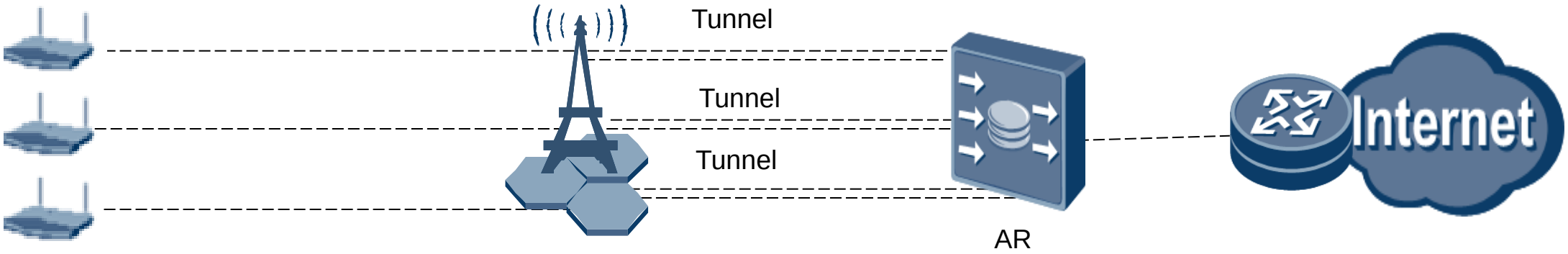


Shared IPV6 Prefix (IP-CS)

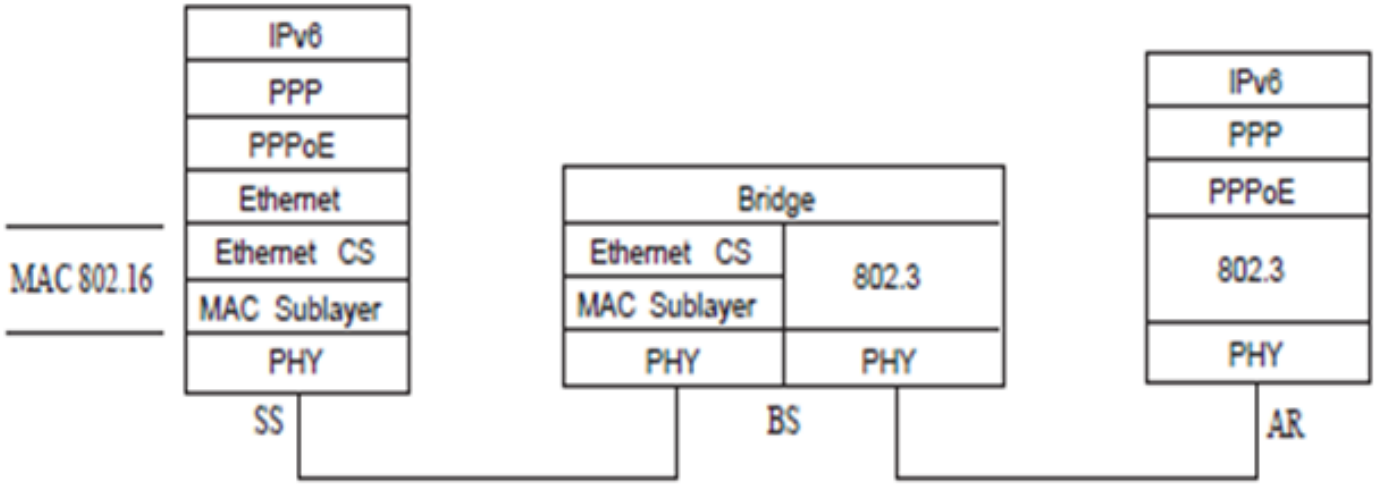
IPV6 Deployment Scenarios in Wimax: Shared IPV6 Link Model

- Definition: All SS under an AR use the same IP Subnet even if attached to different BS.
- Shared IPv6 prefix based on IPv6 CS:
  - The connection between SS and AR is seen as a shared link.
  - Link between SS and BS is a P2P link.
  - This P2P link is extended to the AR on a per station basis.
- Shared IPv6 prefix based on Ethernet CS:
  - Underlying link layer works like Ethernet specially in terms of broadcast and multicast.
  - BS implements Bridge functionality.
  - Frequent IPv6 multicast signaling within the IPv6 subnet like Ethernet wakes up SS in sleep mode.

Point-to-Point Link Model: Per station IPv6 prefix



- For IP CS with IPv6 classifiers, a point-to-point link model have advantage due to the simplicity for performing the DAD or defining any new protocol.

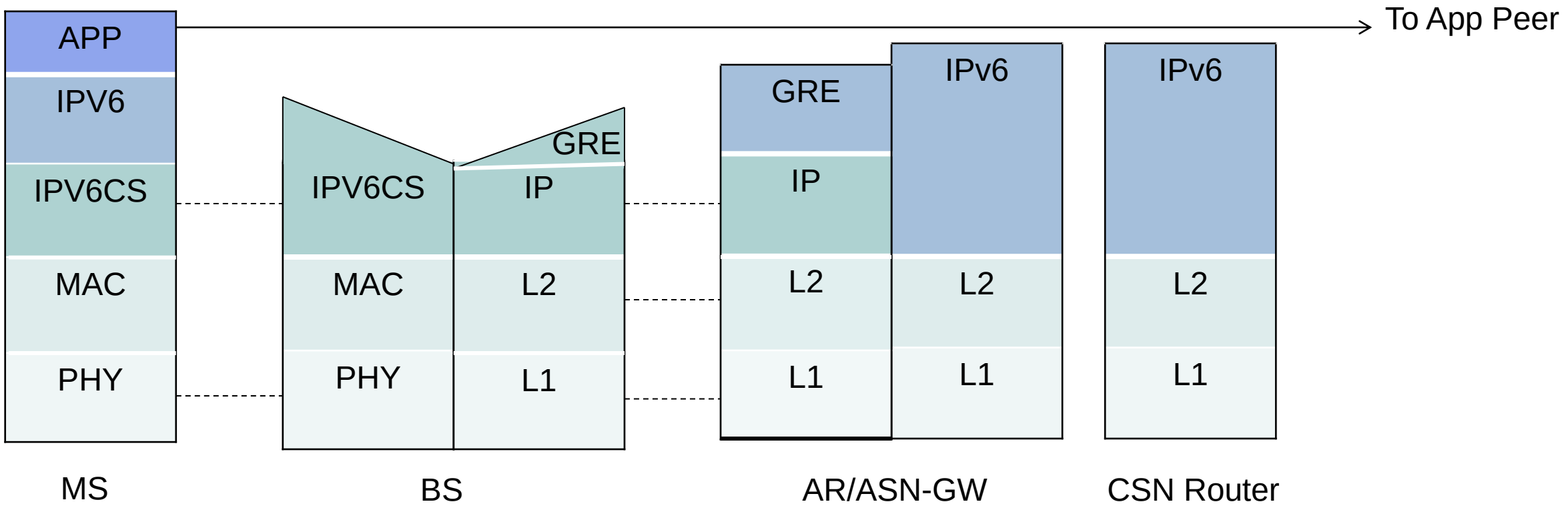


P2P Link Model Based on ETH-CS

IPV6 Deployment Scenarios in Wimax: P2P IPV6 Link Model

- Each SS under a BS have different subnets. (SS and AR use the a specific IPV6 subnet) so DAD become meaningless
- IPv6 packets with destination address of link local scope are delivered only within the point-to-point link between a SS and an AR
- Normal solution is using PPP (Point-To-Point Protocol) but 802.16 doesn’t have the mechanism for encapsulation and decapsulation of PPP frames !
- PPP over Ethernet by Ethernet CS is deployed.

Wimax Protocol Stack for IPV6 (RFC 5121)



The IPv6 end- points are constituted in the MS and the AR.

Results for IPV6 Support After Initial Tests in Mobinnet Network

Row	Product Domain	Product	IPV6 Support	Roadmap/Comment
1	BSS	Convergent Billing System	No	Operating system and software needs to be upgraded to support basic functions
2	BSS	AAA	No	Operating system and software needs to be upgraded to support basic functions
3	Core	ASN Gateways	No	Vendors won't develop IPV6 on Wimax ASNA vendor mentioned it may happen in Q3-2013 nut just to support basics.
4	IMS	IMS	Partial	In the new version it can support completely but requires tests.
5	IP MPLS	Routers	Yes	
6	IP MPLS	Switches	Partial	
7	IP MPLS	Firewall	Partial	
8	IP MPLS	Traffic Management Equipment	No	
9	OSS	NMS	No	
10	RAN	BS	No	Almost all vendors don't have plan to develop IPV6 on Wimax BS.
11	Terminal	CPE	Partial	2 vendors mentioned it is possible with firmware upgrade.
12	Transmission	SDH	No	
13	Transmission	Microwave	No	

Remained Obstacles

- Implementation of IPV6 in ASN Gateways
- IPV6 CIDR & Billing System
- IPV6 Mobility although solutions like Fast handover procedure (FMIPv6) proposed
- CPE and Handset support for IPV6 although A few vendors have proposed firmware upgrade to support
- Default MTU size specially for IPV6 CS

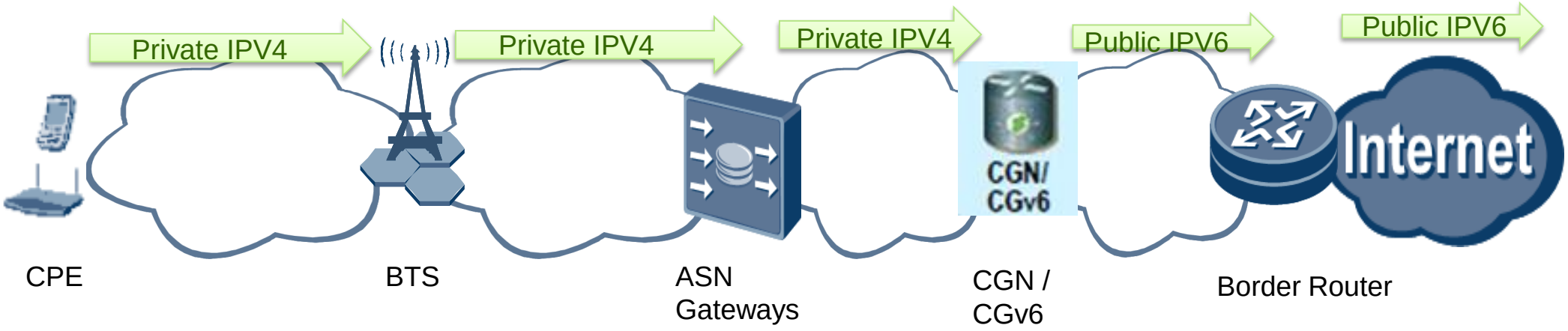
What we can do

- Future of Wimax seems bleak in this field. Most vendors explicitly announced they would stop making new investments in WiMAX equipment specially in terms of R&D however the technical support will be continued.
- IPV6 obstacles are predicted to remain for Wimax operators in functionality, management and security.

How Can Carrier Grade NAT Pave the Way For IPV6 Transition?

- Carrier Grade / Large Scale NAT definition
- Now CG-NAT is more than NA444 for a WiMAX operator. It should address requirements in RFC6264 , Incremental CGN for IPv6 Transition.
- Minimum change imposed to the networks suffer from IPv4 shortage
- Should satisfy requirements of application transparency and paired IP Address Pooling Paired Behavior
- Law compliance for logging should be considered
- When ASN Gateways can’t assign IPV6 to CPE’s, private IPV4 should be used in CPE’s (NAT44 or use port forwarding) while NAT46 being done centrally in SP network to Public IPV6.
- One-to-one NAT can be the starting point.

CG NAT Typical Topology for Wimax



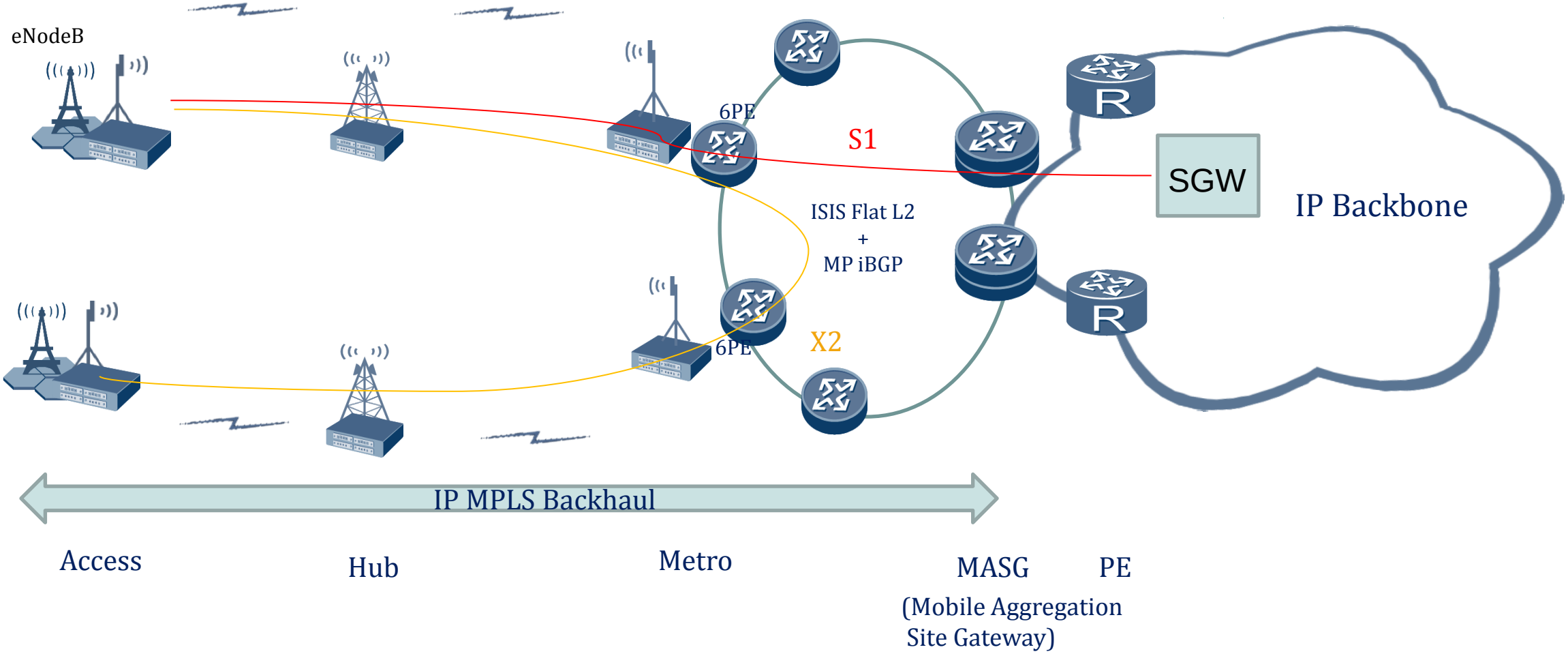
- In WiMAX topology, NAT 64 recommended to be done as the last operation prior to packet goes to Internet or before Border Router

LTE Can be the Destination!

- IETF has considered a mobile IPv6 protocol and RFC6257 for Mobile IPv6
- From 3GPP Release 8, IPv4v6 PDP type is introduced to support dual stack service on the same PDP
- Main concerns of IPV6 deployment in LTE will be:
  - Billing (CDR)
  - Roaming support
  - IPV6 Signaled IP MPLS Support
  - Limited IPV6 support on Air interface in UE
- Transport IPv6-based RAN traffic over an IPv4 MPLS Backhaul that is 6PE
- Wimax operators face 2 big changes simultaneously: LTE migration in mobile world, IPV6 transition in IP world!

- Wimax forum is working on WiMAX 802.16m as a pathway for migration from 802.16e.
- Most WiMAX operator prefer migration to LTE R8 or later.
- Points to consider:
  - FDD-LTE or TD-LTE: Due to the asymmetric nature of broadband service and as wimax is using TDD duplexing mode, TD-LTE is the natural choice for a WiMAX operator.
  - Base station to eNodeB: can happen with software and module upgrade in case both are using OFDMA as access.
  - Terminal: A few CPE manufactures are to develop terminals to work with both technologies.
  - AAA and Billing: There are solutions for serving both technologies simultaneously.
  - Building EPC (Evolved Packet Core): MME (Mobility Management Entity), SGW (Serving Gaetway)
  - **IP Backhaul redesign: Improving Latency & Capacity also embedding synchronization are main concerns**

Mobile IP Backhaul Migration to IPV6



Key Points for Designing LTE ready Backhaul

- **Mobinnet has considered followings key points for backhauling future LTE traffic**

IPV6 Strategy	6PE
Routing Protocols	ISIS, MP-iBGP
High Availability /Fast Convergence	BFD, MPLS TE FRR, VRRP
Access	High capacity Microwave with Adaptove modulation
Backhaul connectivity	10G Dark Fibers
Label Distribution	LDP V4
Synchronization	IEEE 1588v2 specially for phase synch in TD-LTE
Hierarchy	Access, Hub, Metro, Core site
OAM	Ethernet OAM (802.3 a.h) for access, Ethernet CFM (802.1ag) for Metro
QOS	DSCP in Access and Hub Level, MPLS Diffserv at Metro and Core Level
Others	Hub & Spoke MPLS L3VPN for S1 , Partial Mesh VRF for X2 traffic

What makes LTE Backhaul different?

- Capacity: Usually 40Mbps (upgradable to 100Mbps) for each cell site is considered
- eNodeB & X2 Interface: One to many connectivity of eNodeB to Core, direct communication of eNodeB's
- Strict Latency requirements: Below 30ms values are considered now
- QOS support for new LTE QOS concepts: QCI, GBR, MBR, ARP
- **Now LTE has standards and support for IPV6. 3GPP TR 23.975 clarifies IPV6 such as IPV6 capability in PDN gateways , CGN's, and migration scenarios. IP Backhaul should provide coexistence of both IPV4 and IPV6.**

Conclusion

- The efforts for supporting IPV6 on WiMAX 802.16e seems to not be successful at least in the practical deployments.
- Wimax operators should take advantage of transitional solutions such as CG-NAT to tackle IPV4 shortage in short term.
- Migration to LTE can solve IPV6 issue in mobile environment. It should be considered in Access, Core and Backhaul.

T h a n k Y o u

G.Reza Mahmoudi

R.Mahmoudi@mobinet.net

IP MPLS Manager

Mobinnet Telecommunication Company (MTC), Iran