

Emerging areas, trends and business analysis of WiMAX Technology

S.BAMA

Project Manager,
Networks Business Unit,

Sasken Communication
Technologies Limited,

bama.s@sasken.com

Outline

- Overview of WiMAX technology
- Emerging technology/research areas in WiMAX
 - End-2-End QoS
 - WiMAX Security
 - WiMAX Performance
 - Network and Sub-system Design
 - Fixed to Mobile WiMAX Migration
- WiMAX trend analysis
- Business analysis in India
- Future Potential

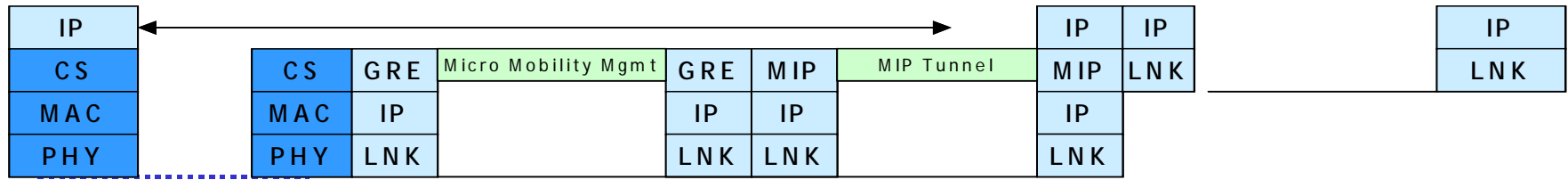
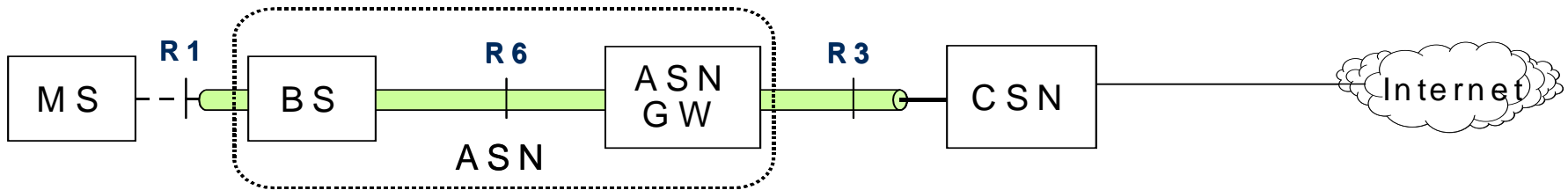
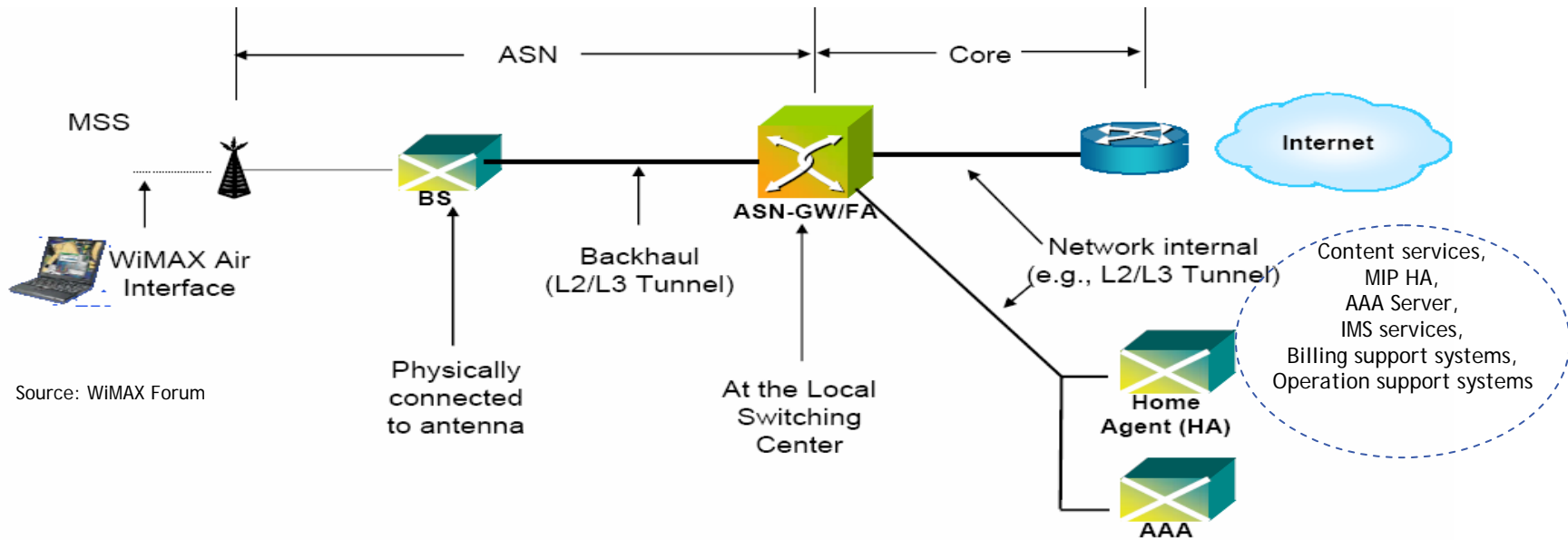
WiMAX (Worldwide Interoperability for Microwave Access)

- IEEE802.16 standard for “Wireless Metropolitan access networks”
- BWA(Broadband Wireless Access) Solution
- Can go places where no wired infrastructure can reach
- Operates on both licensed and unlicensed frequency bands
- Higher data rates over longer distances
- Complement the existing last mile wired networks (DSL , cable etc.)
- Fast deployment, cost saving
- High speed data, voice and video
- Fixed and mobile BWA



Source: WiMAX Forum

WiMAX network components - WiMAX NWG Group



802.16e

WiMAX strengths

- Technical advantages – OFDMA, high speed, high throughput, larger distances.
- WiMAX uses IEEE802.16e which is an open mobile standard - Leads to greater innovation and hence a better performance when moving forward and also potentially lower intellectual property licensing fees and provide for a quicker rate of change compared to that of existing mobile technologies.
- WiMAX is also the first major mobile standard to offer all IP as a standard feature set - Doing so offers cost advantages, the ability to offer multiple services over a single platform, reductions in operating and capital expenditures, rapid application development and often a competitive edge.
- The low cost of WiMAX spectrum is a clear driver for service providers to enter the field of wireless services with WiMAX
- WiMAX is new, so carriers don't have a legacy of older technology to protect until it can be written off

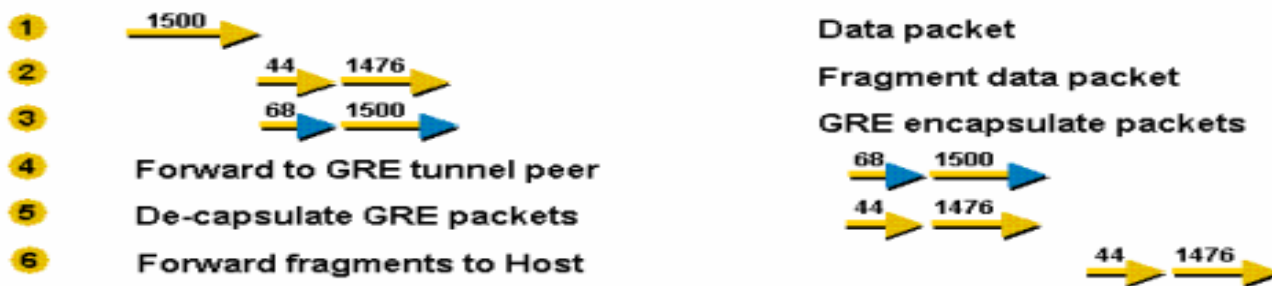
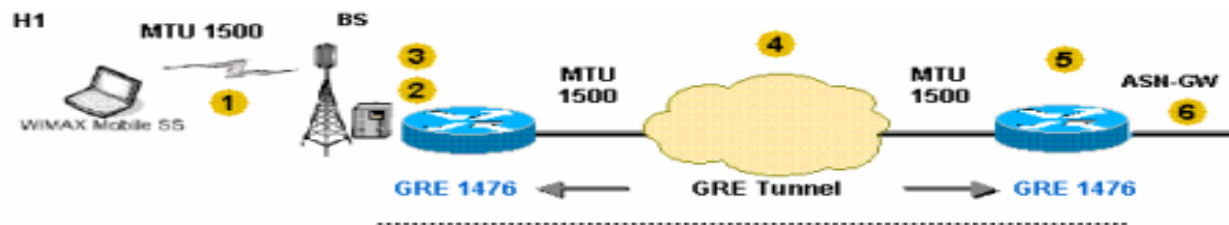
Emerging technology areas in WiMAX

QoS considerations in WiMAX architecture

- Edge of Diffserv domain (Base Station) - should address transferring packets queued in the present BS's air interface (pertaining to moving MS) to the new BS without service degradation
- Core of Diffserv domain (ASN-GW) - The Guaranteed Bandwidth/Minimum Reserved rate at the core of the Diffserv domain should be configured sufficiently high enough to accommodate any new MS traffic (due to mobility) without violating the individual MS traffic limit
- End-2-End security - If the the entire IP packet is encrypted, creates problem to classify the packet as being a high priority packet like VoIP because the payload of IP is not in clear
- Micro flows per MN - The WiMAX forum advocates the use of Per-MS flow to mark/identify the QoS class rather than per-micro flow per MS. Hence increasing number of micro flows will result in service degradation, since different flows per MS are part of an aggregate traffic.

Performance considerations in WiMAX architecture

- Mobile IP registration process - *Solution* - User pre and post registration methods
- Tunnel between FA & HA - Avoid MS-HA-CN, by using binding updates and create tunnel and use Care of address.
- Link MTU - lots of overhead bytes introduced by various protocols at various stages of the WiMAX Network architecture and would result in fragmentation of the packet.
solution - Change the default MTU to avoid fragmentation.



MS/BS/ASN-GW Challenges

- **Design based on scalability requirements** - Max no. of MS sessions, GRE tunnels, SA, QoS - would determine how many MS can be supported by a ASN-GW
- **Network Processor** - GRE Tunneling, Packet classification, Routing & traffic bi-casting to be implemented in NP to handle data rates of the order of few hundreds of Gbps.
- **Interoperability** - R6 data path establishment designed in such way that they are inter-operable with other vendor product
- **Antenna Diversity & MIMO**
- **Scalable PHY** to ensure different levels of feature addition based on uptake
- **Terminal Device Architecture** needs to account for varying demands of IP Multimedia Application integration

Security considerations in WiMAX

- Physical Layer threats - jamming , scrambling
- MAC layer threats -
 - Both management & data connection to be secured
 - Weakness in authentication
 - Eavesdropping of management messages

Mobile IP Security - Optional SA issue

- Security of the data that left BS

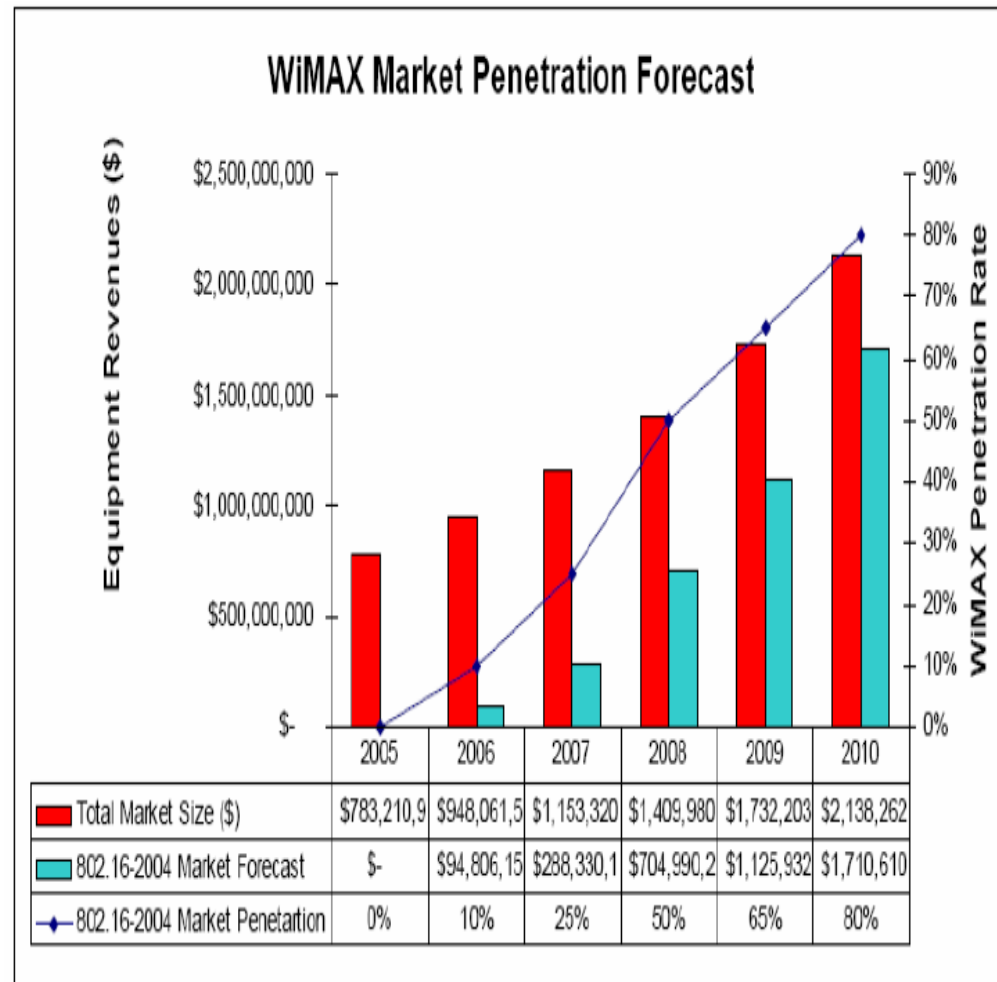
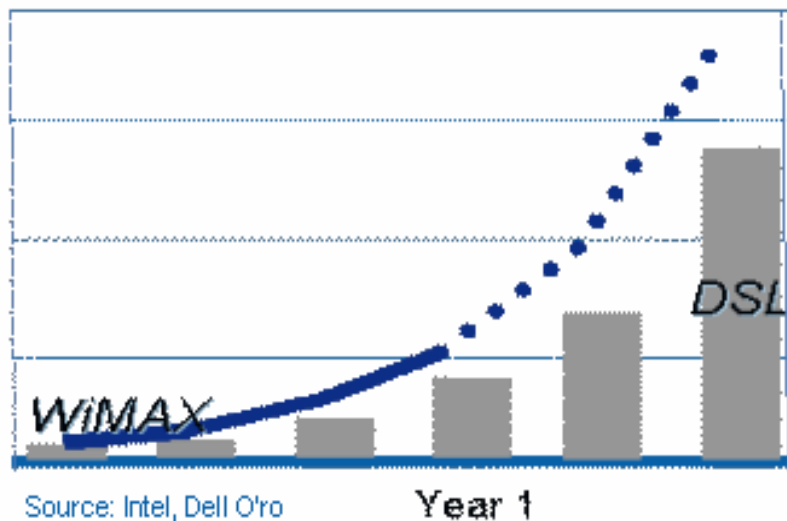
802.16e enhancements over 802.16d

- Distributed Network Architecture, BS and ASN-GW functionality is segregated
- PHY change from OFDM to OFDMA adding complex subchannelisation schemes
- QoS E-RTPS, 2-D/3-D scheduler (slot/subchannel or slot/subchannel/space) working in “802.16d” or 802.16e mode
- CDMA based Ranging
- Paging
- Handover implementation for Mobile Deployments
- Sleep Mode Management (Application Power Class Management)
- Idle Mode Management
- Improved Security

WiMAX trend analysis

WiMAX penetration

- Currently there are around 350 trials and deployments which includes both fixed and mobile.



WiMAX challenges

Technical challenges :

- Plethora of options in the standard
- Lack of uniform spectrum around the world

Business challenges :

- Handset and equipment availability
- Infrastructure and handset costs
- Entrenched and enhanced wire line data services
- Competing cellular technologies

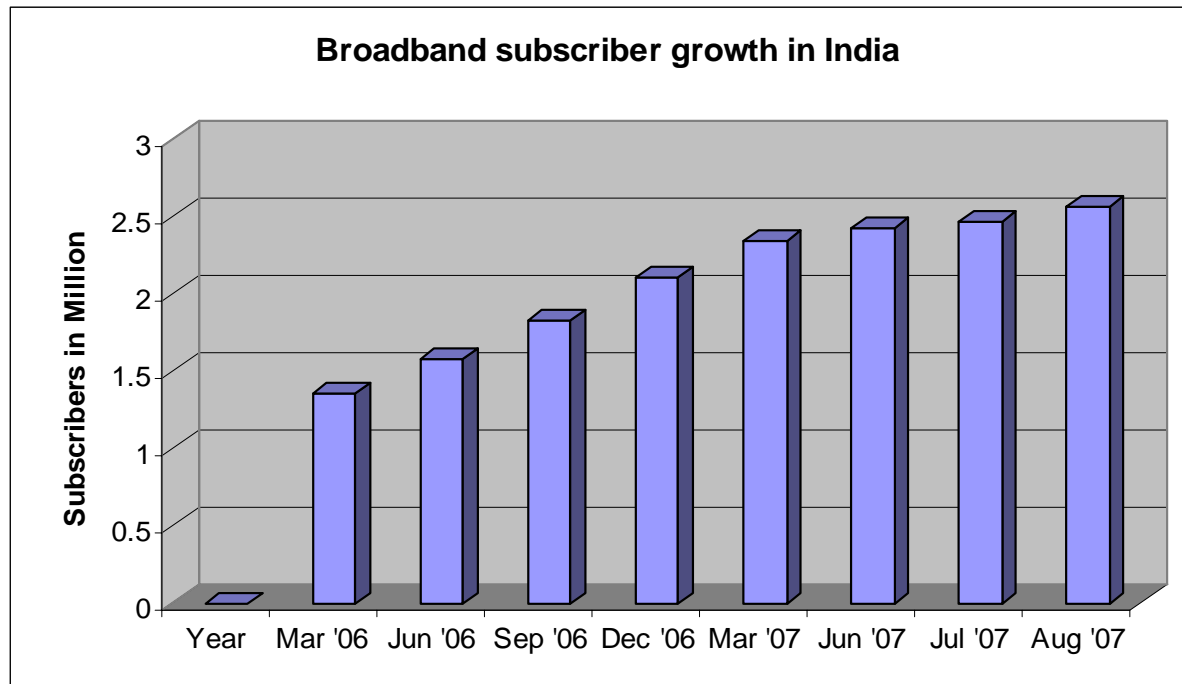
Practical limitations

- A commonly held misconception is that WiMAX will deliver 70 [Mbit/s](#), over 70 miles (112.6 kilometers) when the recipient is moving or mobile. Each of these is true individually, given ideal circumstances, but they are not simultaneously true.
- In practice this means that in line-of-sight environments you could deliver symmetrical speeds of 10Mbps at 10km but in urban environments it is more likely that 30% of installations may be non-line-of-sight and therefore users may only receive 10Mbps over 2km and if the recipient is on the move the bps rates drop significantly.
- WiMAX has some similarities to [DSL](#) in this respect, where one can either have high [bandwidth](#) or long reach, but not both simultaneously.
- The other feature to consider with WiMAX is that available bandwidth is shared between users in a given radio sector, so if there are many active users in a single sector, each will get reduced bandwidth.

WiMAX India Business Analysis

Broadband Indian Market

- India, fastest growing wireless market; 7.3 mn added in June
- Total broadband connections in the country reached nearly 2.52 million in June, compared to 2.46 million in May, a growth of 2.44 per cent. (source domain-b.com)



Drivers for penetration of broadband in India

- Decreasing cost per line - WiMAX the initial cost initially but addition of new subscribers will be less
- Decreasing operating expense - Rural networks will see more infrastructure sharing
- Decreasing cost of PC
- Social attitudes and habits embracing broadband facilities
- More Indian content

Among the above drivers, WiMAX have strengths in top two.

WiMAX vendors in India

Most of the major vendors see great future potential for WiMAX in India

- WiMAX system vendors
 - Alvarion
 - Airspan Networks
 - Aperto
 - Arraycomm Inc
 - Flarion
- Infrastructure Vendors
 - Alcatel-Lucent, Ericsson, Nokia-Siemens, Motorola, Nortel
- Chipset Vendors
 - Intel (CPE domination)
 - Beecem, Sequans, Wavesat etc.

Challenges for WiMAX in India

- Technology - 16d or 16e, slow uptake in Indian Segment because ADSL+ variants already available
- WiFi + DSL is a strong competitor in Indian Segment, costs of DSL are going down QoQ, WiMAX CPE's not proven over time over this solution.
- Migration to 16e will be slower (or may not really happen till 2009)
- Alignment of spectrum, issues already are with TRAI pending for long time!
- FDD or TDD or both, CPE dual-mode will bring in additional cost and more choices means more issues and divergence!
- Three sector or four sector, capacity planning and network topology uncertain
- Full mobility and VoIP still far away and bring in additional issues
- Few operators have some networks deployed, not too good reports of field operation of WiMAX equipment, market is highly polarized with few vendors and few WISP's

WiMAX forecast in India

- *Slow uptake in urban environments*, need to really weigh cost and performance of WiMAX CPE over ADSL+WiFi combination,
 - ADSL rates are already 2 Mbps in Bangalore
 - Less than 5\$ per month subscription, set to go down still
 - Modem is free! Can WiMAX do better than this? Seems tough and extremely uncertain
- *Dual Mode* GSM/CDMA+WiFi handset's availability in India will trigger new areas in parallel to WiMAX (GAN, UMA, Femto Cells), it seems uncertain that WiMAX is needed unless the benefits from WiMAX are huge and proven!
- *WiMAX equipment* is heavily suited for all-IP networks making it cost-effective
- *Possible uptake* in rural environments, P2P backhaul, remote telemetry, weather sensing, security equipments. Cost of WiMAX equipment will provide newer markets and opens greenfield areas
- "Unless WiMAX equipment is proven to the same extent as GSM/CDMA/UMTS uptake will be slow and ISP's/WISP's will be reluctant to embrace, WiMAX opens the stage to address newer communication requirements that Cellular technologies could not handle because of cost issues"

WiMAX Future Potential



BWA Future, No Single Domination

- Wi-Fi has been widely deployed as hot-spot and wide area mesh solution in US and Europe, gaining acceptance in UMA/FMC based approaches but not widely deployed for dual-receiver handset requirements
- 3G services are picking up in different variants like Femto Cell and being introduced slowly
- WiMAX and 3G LTE are competing technologies, 3G LTE deployment time decides market share in shared space; stage set for all-IP networks
- Interim solutions for GSM deployments are relying on Evolved Edge to click for introducing IP Multimedia services in developing markets
- 3G LTE introduction will attempt to throttle WiMAX progress and may possibly succeed too in the long run!

“ WiMAX, Wi-Fi and 3G will coexist and compete each with its strengths and weakness with WiMAX and 3G competing”

Research by InSat in March 2007

Thank You

S.BAMA

Project Manager – Networks BU,
Sasken Communication Technologies
bama.s@sasken.com