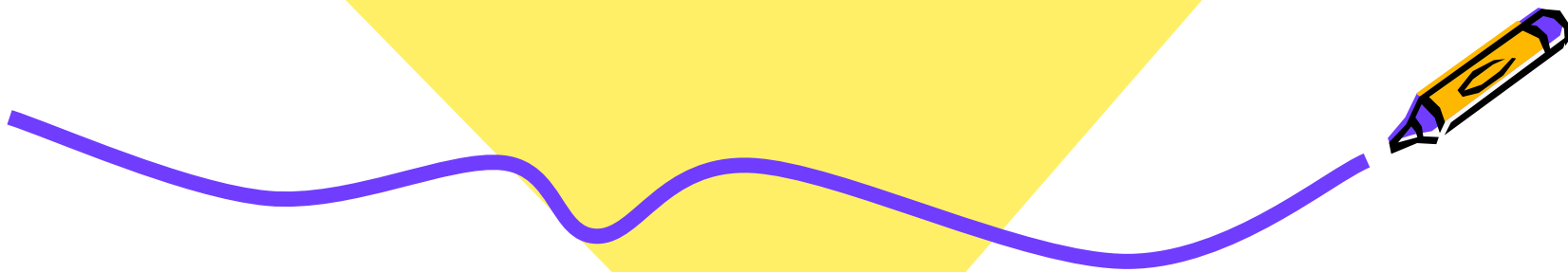
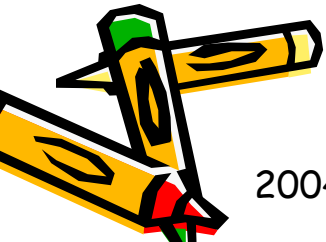


WiMAX(802.16)



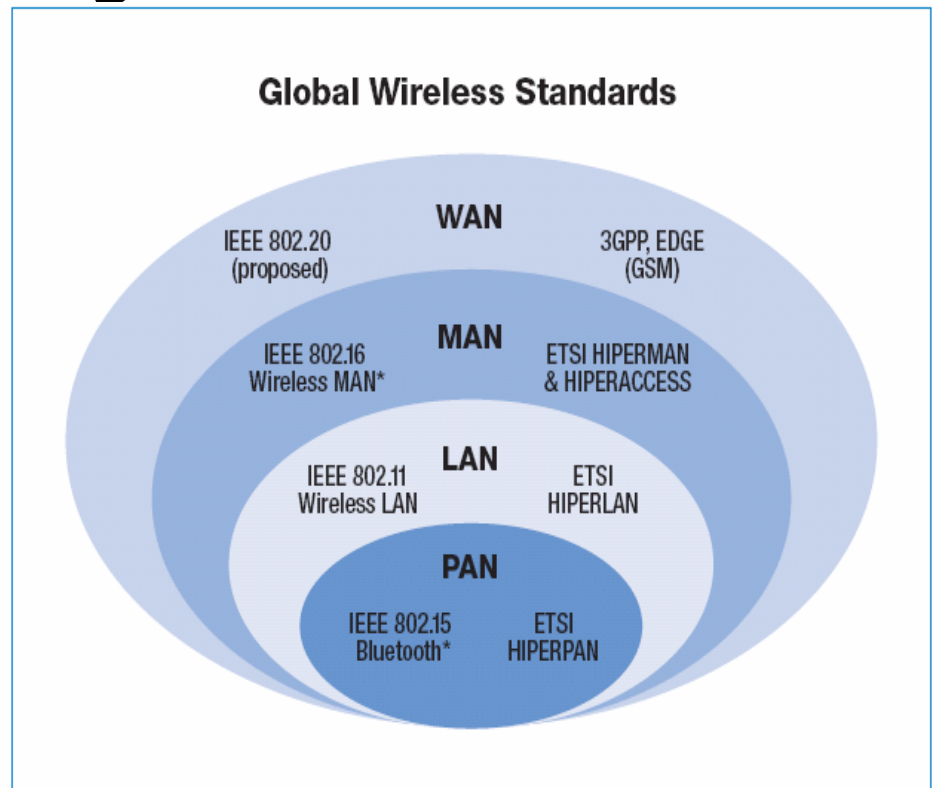
Outline

- Introduction
- WiMAX's Features
- WiMAX's Competitors
- Conclusion
- References



Introduction

- Wireless Technologies
 - UWB (PAN)
 - Wi-Fi (LAN)
 - WiMAX (MAN)
 - 3G (WAN)



Introduction

	UWB	Bluetooth	Wi-Fi	Wi-Fi	Wi-Fi	WiMAX	WiMAX	Edge	CDMA2000/1 x EV-DO	WCDMA/UMTS
Standard	802.15.3a	802.15.1	802.11a	802.11b	802.11g	802.16d	802.16e	2.5G	3G	3G
Usage	WPAN	WPAN	WLAN	WLAN	WLAN	WMAN Fixed	WMAN Portable	WWAN	WWAN	WWAN
Throughput	110-480Mbps	Up to 720Kpbs	Up to 54Mbps	Up to 11Mbps	Up to 54Mbps	Up to 75Mbps (20MHz BW)	Up to 30Mbps (10MHz BW)	Up to 384Kbps	Up to 2.4 Mbps (typical 300-600Kbps)	Up to 2Mbps (Up to 10Mbps with HSDPA technology)
Range	Up to 30 feet	Up to 30 feet	Up to 300 feet	Up to 300 feet	Up to 300 feet	Typical 4-6 miles	Typical 1-3 miles	Typical 1-5 miles	Typical 1-5 miles	Typical 1-5 miles
Frequency	7.5GHz	2.4GHz	5GHz	2.4GHz	2.4GHz	Sub 11GHz	2-6GHz	1900MHz	400, 800, 900, 1700, 1800, 1900, 2100MHz	1800, 1900, 2100MHz

2004-12-29

Ting-Kai Huang, MNET Lab

Introduction

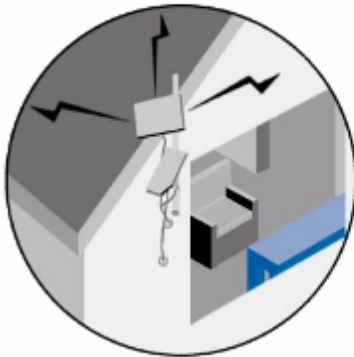
- Why is WiMAX?



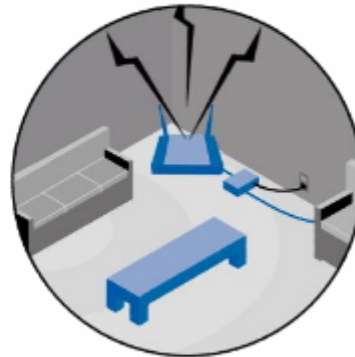
Introduction

• WiMAX's Roadmap

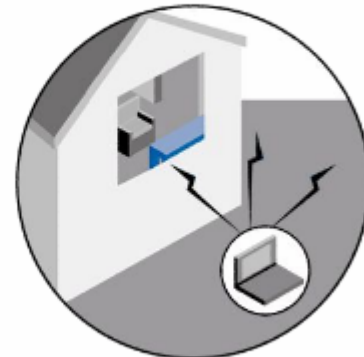
WiMAX Deployment Stages:



First half of 2005



second half of 2005



2006

Introduction

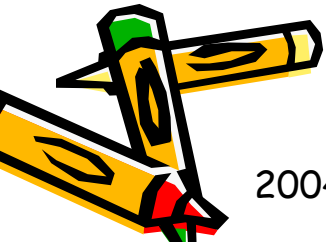
How to Popularize WiMAX?

- Standardize

(<http://grouper.ieee.org/groups/802/16/>)

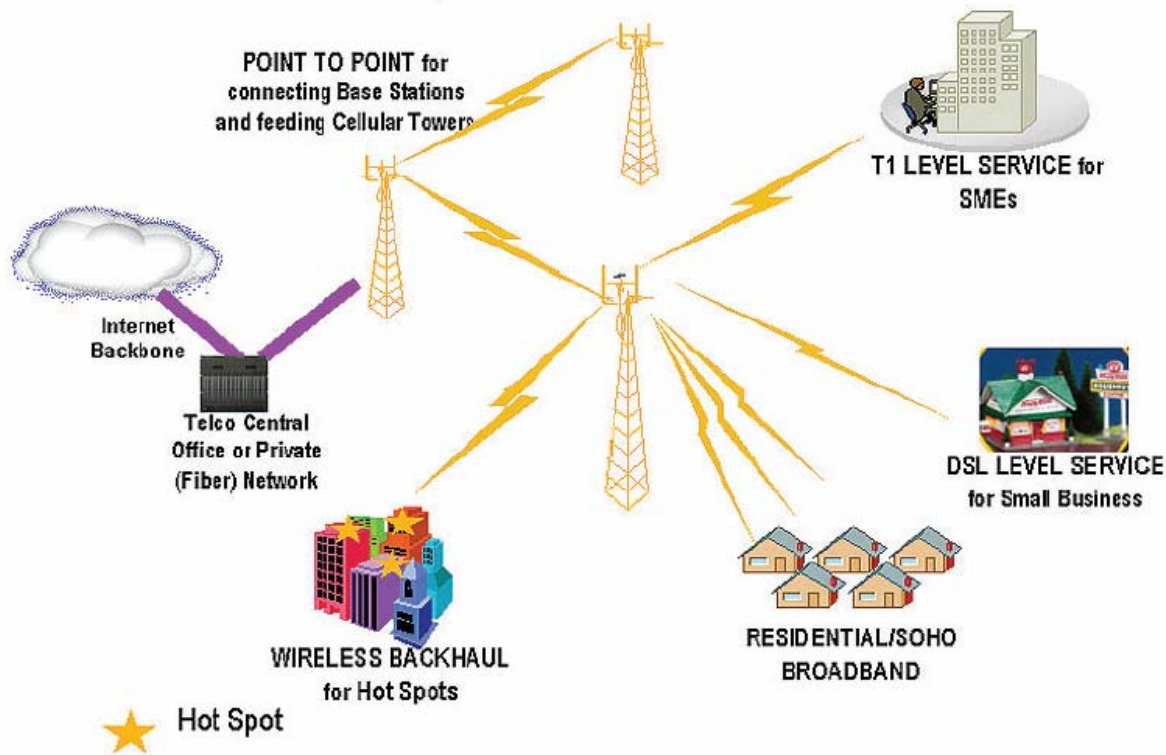
- Interoperability

(<http://www.wimaxforum.org/home>)



WiMAX的Feature

- Architecture



★ Hot Spot

WiMAX's Features



IEEE 802.16 Standard			
	802.16	802.16a/REVd	802.16e
Completed	Dec. 2001	802.16a: Jan 2003 802.16 REVd: Q3 2004	Estimate: 2nd half of 2005
Spectrum	10 to 66 GHz	< 11 GHz	< 6 GHz
Channel Conditions	Line-of-sight only	Non line-of-sight	Non line-of-sight
Bit Rate	32 to 134 Mb/s at 28 MHz channelization	Up to 75 Mb/s at 20 MHz channelization	Up to 15 Mb/s at 5 MHz channelization
Modulation	QPSK, 16 QAM and 64 QAM	OFDM 256, OFDMA 64 QAM, 16 QAM, QPSK, BPSK	Same as REVd
Mobility	Fixed	Fixed and Portable	Mobility, Regional Roaming
Channel Bandwidths	20, 25 and 28 MHz	Selectable channel bandwidths between 1.25 and 20 MHz, with up to 16 logical sub-channels	Same as REVd
Typical Cell Radius	1 to 3 miles	3 to 5 miles; Maximum range 30 miles based on tower height, antenna gain and transmit power (among other parameters)	1 to 3 miles

Source: WiMAX Forum



PHY Features

Feature	Benefit
256 point FFT OFDM waveform	•Build in support for addressing multi-path in outdoor LOS and NLOS environments
Adaptive Modulation and variable error correction encoding per RF burst	•Ensures a robust RF link while maximizing the number of bits/second for each subscriber unit
TDD and FDD duplexing support	•Provides the flexibility necessary to operate in many different frequency bands with varying channel requirement around the world

PHY Features

Feature	Benefit
Flexible Channel sizes(1.75MHz~20MHz,)	<ul style="list-style-type: none">•Provides the flexibility necessary to operate in many different frequency bands with varying channel requirements around the world
Designed to support smart antenna systems	<ul style="list-style-type: none">•Smart antennas are fast becoming more affordable, and as these costs come down their ability to suppress interference and increase system gain will become important to BWA deployments

Mac Features

Feature	Benefit
Connection-oriented	<ul style="list-style-type: none">• Per Connection QoS• Faster packet routing and forwarding
Automatic Retransmission request (ARQ)	<ul style="list-style-type: none">• Improves end-to-end performance by hiding RF layer induced errors from upper layer protocol
Support for adaptive modulation	<ul style="list-style-type: none">• Enables highest data rates allowed by channel conditions, improving system capacity

Mac Features

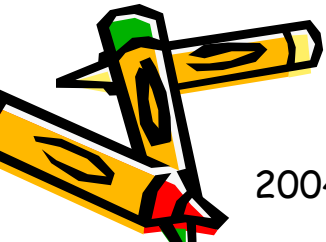
Feature	Benefit
Security and encryption	•Protects user privacy
Automatic Power Control	•Enables cellular deployment by minimum self interference
TDM/TDMA Scheduled Uplink/Downlink frames	•Efficient bandwidth usage
Scalable from 1 to hundreds of subscribers	•Allows cost effective deployments by supporting enough subs to deliver a robust business case

Mac Features

Feature	Benefit
<p>QoS support</p> <ul style="list-style-type: none">•UPS(Unsolicited Grant Service),•rtPS(real time Polling Service),•ntrPS(non real time Polling Service),•BE(Best Effort)	<ul style="list-style-type: none">•Low latency for delay sensitive service(TDM Voice, VoIP)•Optimal transport for VBR traffic(e.g., video) Data prioritization

WiMAX's Cooperators/Competitors?

- Wi-Fi
- 3G
- 802.20



WiMAX vs 3G

	3G	WiMAX
Standard	3GPP, 3GPP2 ITU	802.16 family, IEEE
Spectrum	2GHz(license)	2-11GHz
Bit Rate	2Mbps/384kbps/144kbps	75Mbps/16Mbps
Service	Voice, data, multimedia	Voice, data, multimedia
Coverage	Cellular (4mile)	Cellular (30miles)
Mobility	Low/high	Low
Capacity	>10	>100
QoS	Four class	Four class
User	>90million	2005 year
	IP base	Non-all-IP

Conclusions

- Scheduling for QoS in WiMAX
- How to connect Wi-Fi and WiMAX
 - Handoff
 - Qos Issues



References

- <http://www.wimaxfoum.org/home>
- IEEE 802.16 standard 2004
- <Http://www.digitime.com.tw>

