

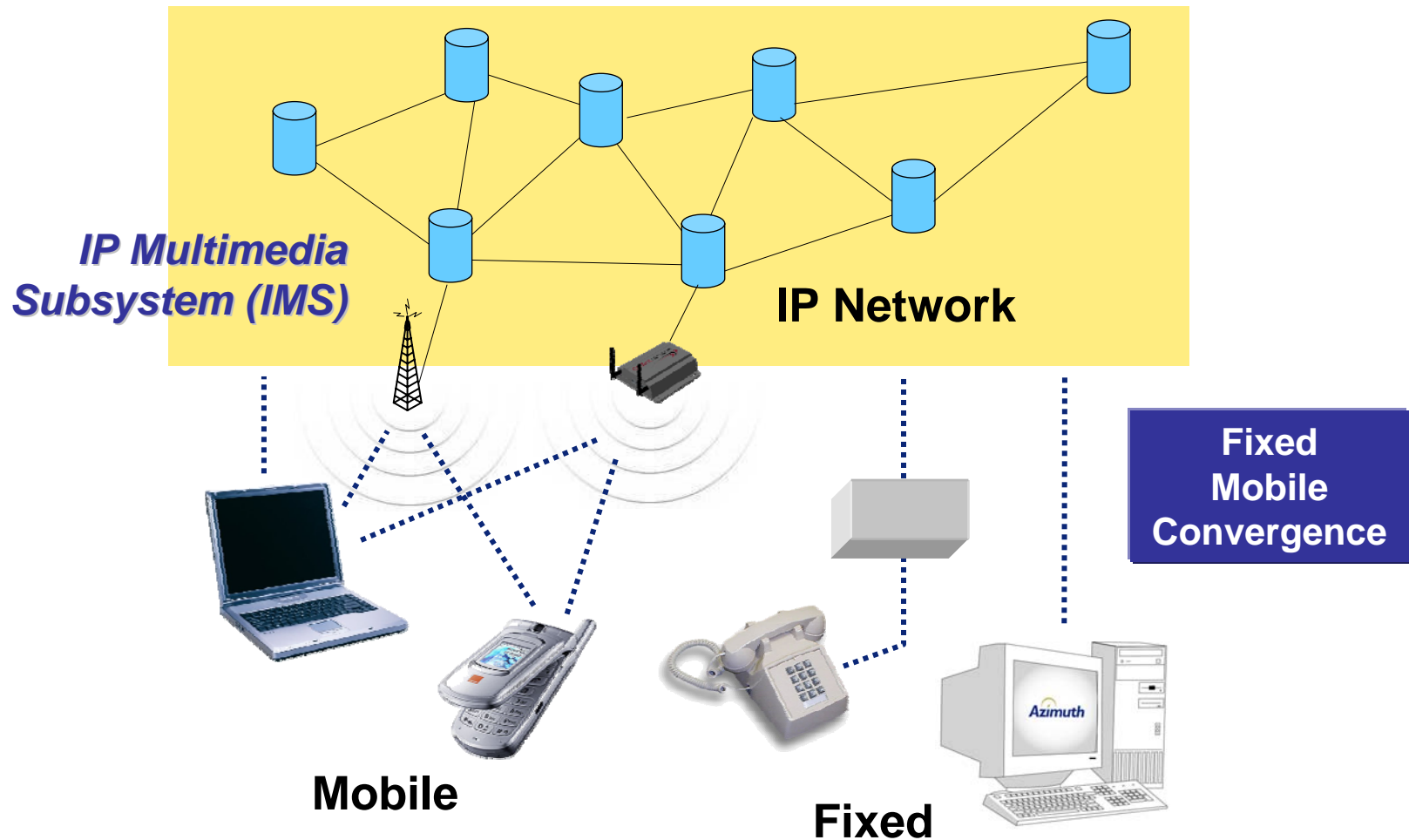


A Glimpse at the Wireless Data Communications Standards

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8 August 2007

IMS Infrastructure for FMC

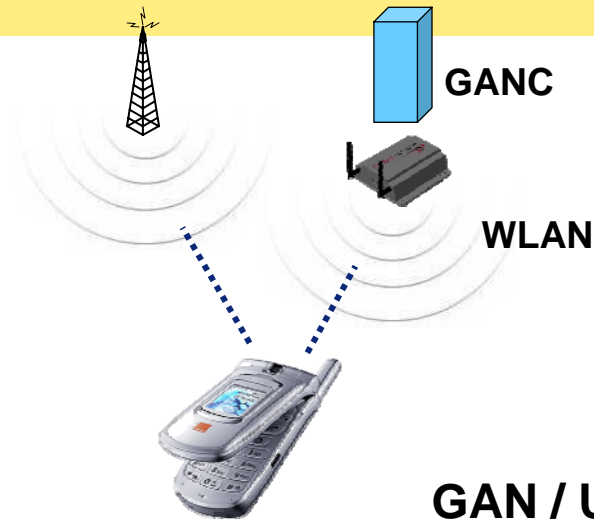


Standards for FMC



- **3GPP- IMS**
 - **GAN/UMA 2G**
 - **VCC 3G/4G**
 - **I-WLAN (no handoff)**
- **IEEE**
 - **802.11n, k, u, v, y, s**
 - **802.16e, m**
 - **802.21**

GAN / UMA GSM Infrastructure

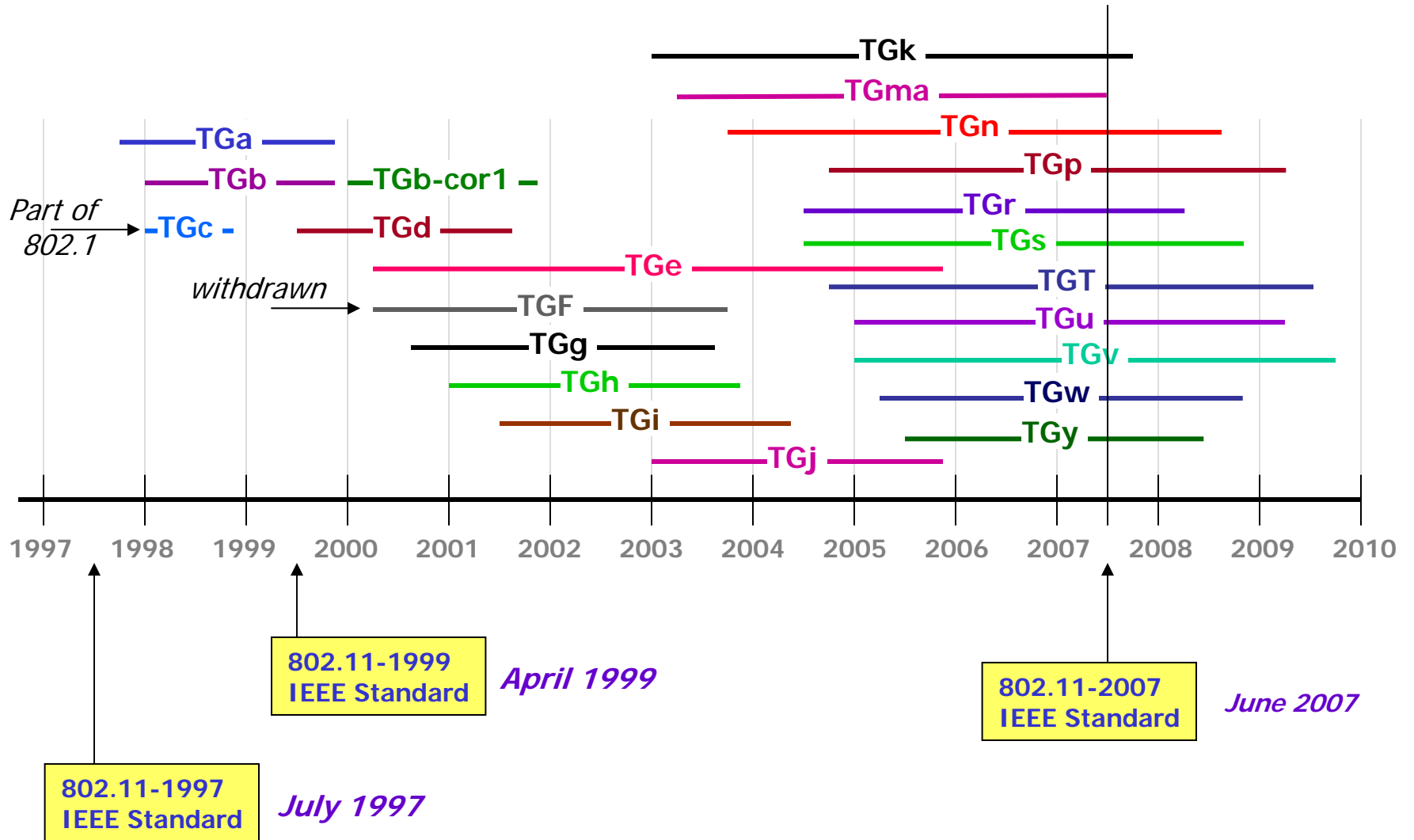


GAN / UMA GSM/WiFi phones



GAN = generic access network
UMA = unlicensed mobile access
VCC = Voice Call Continuity
I-WLAN = Interworking-WLAN
IMS = internet multimedia subsystem

IEEE 802.11 Timeline



IEEE 802.11 Active Task Groups



- ❑ TGk – Radio Resource Measurements
- ❑ TGn – High Throughput
- ❑ TGp – Wireless Access Vehicular Environment (WAVE/DSRC)
- ❑ TGr – Fast Roaming
- ❑ TGs – ESS Mesh Networking
- ❑ TGT – IEEE 802 Performance
- ❑ TGu – InterWorking with External Networks
- ❑ TGv – Wireless Network Management
- ❑ TGw – Protected Management Frames
- ❑ TGy – 3650-3700 MHz Operation in USA
- ❑ DLS – Direct Link Setup Study Group

<http://grouper.ieee.org/groups/802/11>



802.11n Summary

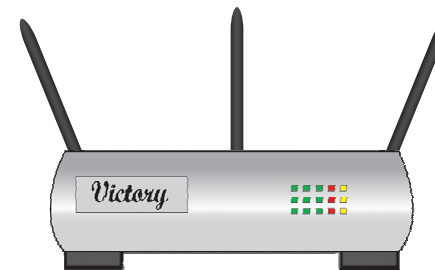


- ❑ Minimum of 100 Mbps throughput at the MAC SAP interface – with no 802.11 overhead;
 - data rate reaches 600 Mbps with 4 spatial streams in 40 MHz channels
- ❑ PHY improvements
 - Spatial Multiplexing, Beamforming, up to 4x4 MIMO, 40 MHz channels
- ❑ MAC improvements
 - Frame aggregation, block acknowledgements
- ❑ Battery life improvements for handsets
 - Sleep mode with scheduled packet delivery

Real implementations use up to 2 spatial streams and the following configurations:

2x2, 2x3, 3x3

Extra transmitters or receivers implement diversity

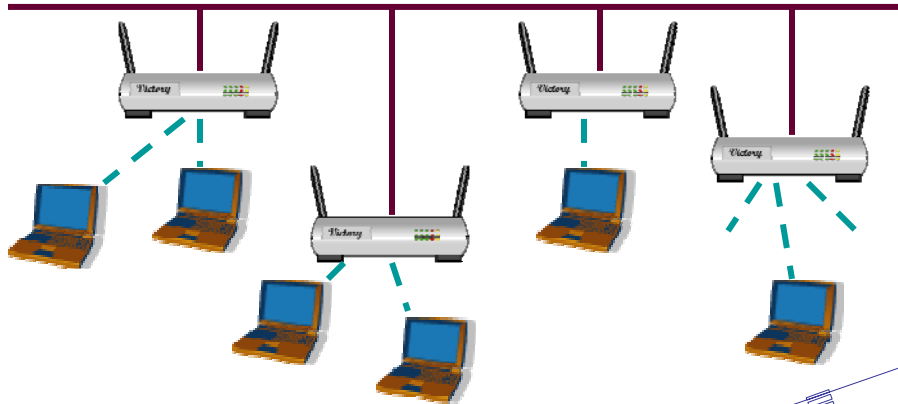


802.11s Mesh for Municipal Outdoor Networks



Wired connection to each AP

**Traditional
WLAN**

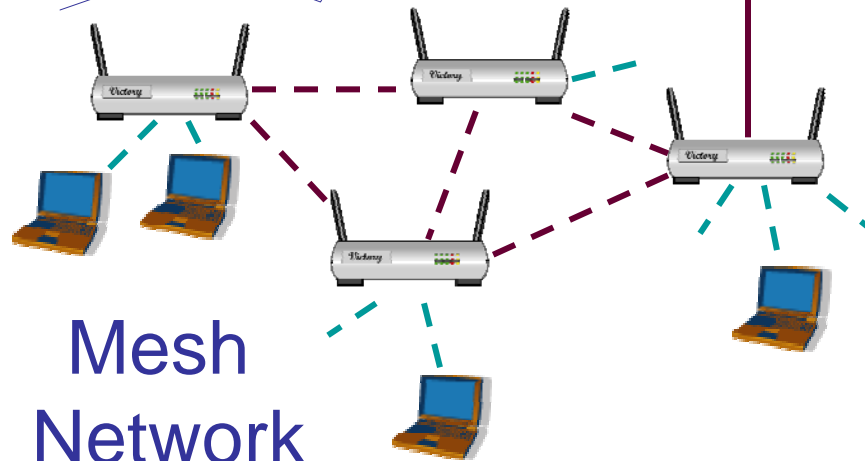


Mesh Portal

Wired links

Mesh links

Client links



**Mesh
Network**

Lightly Regulated Band for Contention-based Networks



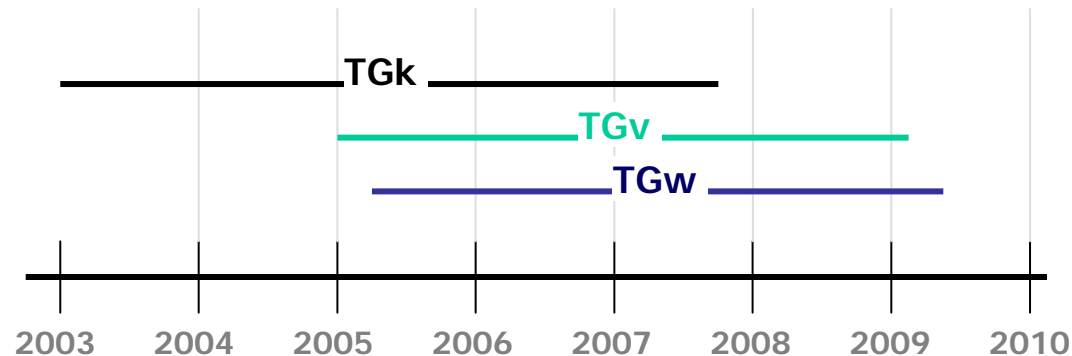
- ❑ March 2005 FCC offered 50 MHz at 3650 to 3700 MHz for *contention-based protocol*
- ❑ 802.11y meets FCC requirement; 802.16h is working to comply
- ❑ 21st century regulation geared for digital communications
 - multiple services to share the band in an orderly way

- ❖ 300 Million licenses one for every person or company
- ❖ \$300 per license for 10 years
- ❖ Registered stations (base stations): 1 W/MHz, ~15 km
- ❖ Unregistered stations (handsets, laptops): 40 mW/MHz, 1-1.5 km

802.11k,v,w for Enterprise-grade Performance and Management



- ❑ 802.11k – Radio Resource Measurements
 - Protocol to map the network, measure signal levels and traffic levels at every device
 - Assist with fast handoff for voice handsets
 - Determine whether network segments have sufficient QoS performance for mission-critical services such as VoIP
 - Monitor Enterprise WLAN from a central point
- ❑ 802.11v – Wireless Network Management
 - Protocols for location protocol, load sharing, fast handoff management, power conservation for handsets, device location
- ❑ 802.11w – Protected Management Frames
 - Encrypt 802.11 k,v management frames to protect from attackers



802.11u and 802.21



- 802.11u - InterWorking with External Networks
 - Goal: Interworking with external networks, including other 802 based networks such as 802.16 and 802.3 and 3GPP based IMS networks
 - Network discovery, emergency call support (e911), roaming, location and availability
 - Network discovery capabilities include information on service provider, QoS capabilities
 - SSP (service subscription provider) – carrier or operator; SSPN is their network

- 802.21 is developing MIH (media independent handover)
 - GAS (generic advertising service) defines a way for a station to access the Advertising Server that has information about 802.11 and 802.16 networks
 - Information on SSPN, its corresponding SSID, radio, available services, etc.
 - 802.11u provides a means for a station to access the 802.21 information server to find all the information in one place.

IEEE 802.16 Overview



- Network Management Task Group
 - P802.16g, Management Plane Procedures & Services
 - P802.16i, Mobile Management Information Base
 - P802.16k, 802.16 Bridging (for 802.1d)
- 802.16h, License-Exempt Task Group
 - Developing PAR (project authorization request)
 - A joint meeting next week with 802.11 TGy and 802.19
- 802.16j, Mobile Multihop Relay
 - developing PAR
- 802.16m, AMT Advanced Air Interface
 - developing PAR

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



ITU-T Framework



ITU-T – United Nations telecommunications standards organization

Accepts detailed standards contributions from 3GPP, IEEE and other groups



IEEE 802.11 – WLAN (wireless local area network)

IEEE 802.16 – WMAN (wireless metropolitan area network)

3GPP – WWAN (wireless wide area network, cellular)

ITU International Mobile Telecommunications



□ **IMT-2000**

- Global standard for third generation (3G) wireless communications
- Provides a framework for worldwide wireless access by linking the diverse systems of terrestrial and satellite based networks.
- Data rate limit is approximately 30 Mbps
- Detailed specifications contributed by 3GPP, 3GPP2, ETSI and others



□ **IMT-Advanced**

- New generation framework for mobile communication systems beyond IMT-2000 where Deployment around 2010 to 2015
- Data rates to reach around 100 Mbps for high mobility and 1 Gbps for nomadic networks (i.e. WLANs)
- IEEE 802.16m working to define the high mobility interface
- IEEE 802.11 VHT SG (very high throughput study group) working to define the nomadic interface



WiMAX IP-OFDMA



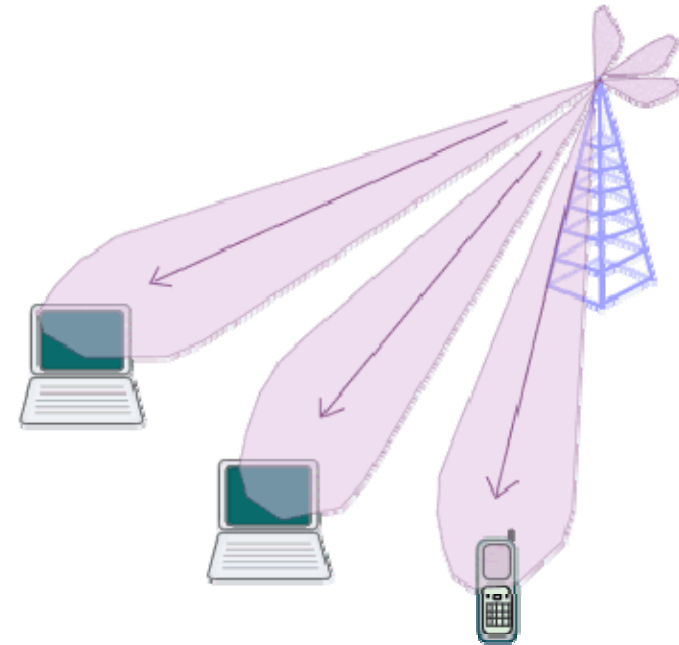
- ❑ The IEEE 802.16e-2005 Wireless MAN standard is based on the concept of scalable OFDMA* (S-OFDMA).
 - A range of bandwidths to accommodate available spectrum
- ❑ WiMAX Forum Release-1
 - Based on 802.16e-2005
 - 1.25, 5, 7, 8.75, 10 and 20 MHz channel bandwidths
 - Initial profiles are 5 and 10 MHz
 - Licensed worldwide spectrum allocations include 2.3, 2.5, 3.3 and 3.5 GHz bands

* Orthogonal Frequency Division Multiple Access

WiMAX Smart Antenna Technologies



- ❑ **Beamforming**
 - Use multiple-antennas to spatially shape the beam to improve coverage and capacity
- ❑ **Spatial Multiplexing (SM)**
 - Multiple streams are transmitted over multiple antennas
 - Multi-antenna receivers separate the streams to achieve higher throughput
 - In uplink single-antenna stations can transmit simultaneously
- ❑ **Space-Time Code (STC)**
 - Transmit diversity such as Alamouti code is supported to reduce fading



2x2 MIMO SM increases the peak data rate two-fold by transmitting two data streams.

IEEE 802.16d vs. 802.16e



	802.16d 2004	802.16e 2005
Cell radius	7 km NLOS 30 km LOS	5 km NLOS 30 km LOS
Bit Rate	Up to 10 Mbps / 3.5 MHz	Up to 15 Mbps / 5 MHz
Bandwidth	3.5, 7 MHz	5, 7, 10 MHz
Band	2.5, 3.5, 5.8 GHz	
Signaling	OFDM, 256 subcarriers	SOFDMA, 2048 subcarriers
Mobility	Fixed, nomadic	High mobility 60 km/h

3GPP Long Term Evolution



- ❑ LTE (Long Term Evolution) being developed as a 4G technology competing with 802.16
 - 100 Mbps uplink; 50 Mbps downlink
 - 5 km cells; 30 km with some degradation
 - Channels 1.25, 1.6, 2.5, 5, 10, 15, 20 MHz
- ❑ MIMO-based; smart antenna
- ❑ No products yet



IEEE 802 Wireless Workshop at Pulvermedia FMC Show



- ❑ <http://www.pulver.com/fmc>
- ❑ Wednesday September 5
 - 9:00 a.m. to 3:20 p.m.
- ❑ Tutorial on the 802.11, 802.16 and 802.21 Wireless standards that enable Fixed Mobile Convergence
- ❑ How these standards are evolving to support voice and video applications
- ❑ Wi-Fi and WiMAX technologies and solutions

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