WiMAX Update

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Information in this document is provided in connection with Intel wireless networking products. Wireless connectivity and some features may require you to purchase additional software, services or external hardware. Network system performance, wireless performance and functionality will vary depending on your specific wireless network plan, environment, operating system, hardware and software configurations. Actual Performance of WiMAX systems are subject to deployment-specific constraints which may impact range, transmission speed and the number of subscribers which may be supported.

All dates, plans and features are preliminary and subject to change without notice.

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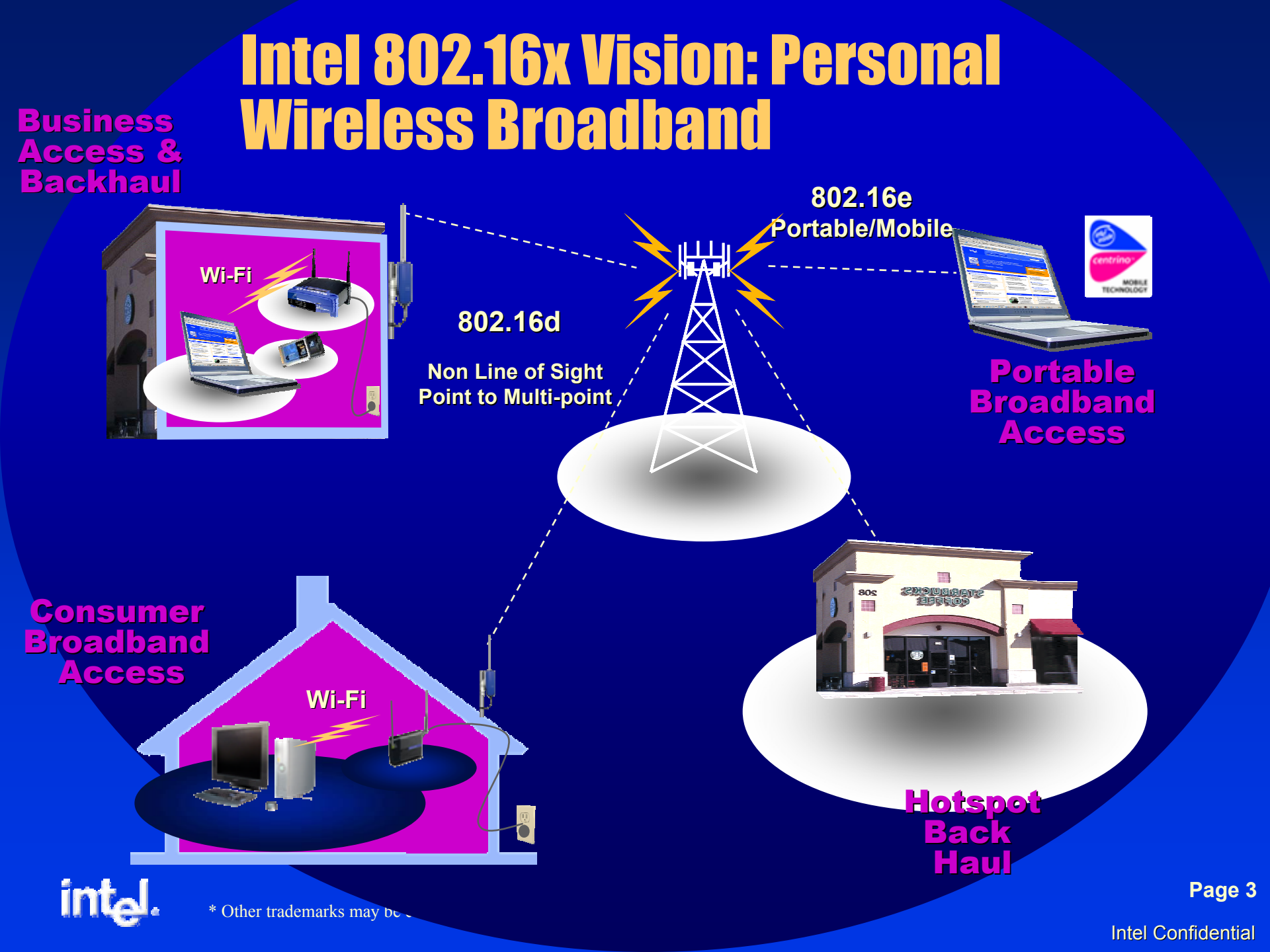
Intel 802.16x Vision: Personal Wireless Broadband



Outdoor Subscriber Station (802.16d)

Business Backhaul & Premium Residential

- Directional antenna
  - When installed, it's aligned with base station
  - It's fixed – never moves location
  - Always higher throughput than omni-directional antenna (all other things equal)
- Applications
  - Rural / Macro-cell deployments
  - Wi-Fi hot spot backhaul
  - Premium residential, MDU connectivity
  - Challenging environments

Indoor Subscriber Station (802.16d)

Integrated 802.16 / 802.11 Access Point

- Omni-directional antenna
  - Designed to not require alignment with base station
    - May work better near a window
    - Optional window-mount antenna
  - Portable but fixed when in use
    - Can be moved to a different room in the house or a different location within the service area
  - Lower throughput than directional
- Applications
  - Consumer DSL-like broadband
  - Carriers who want to avoid truck rolls
    - Customer self installation
  - Precursor for portable/mobile

Portable Client (802.16e)

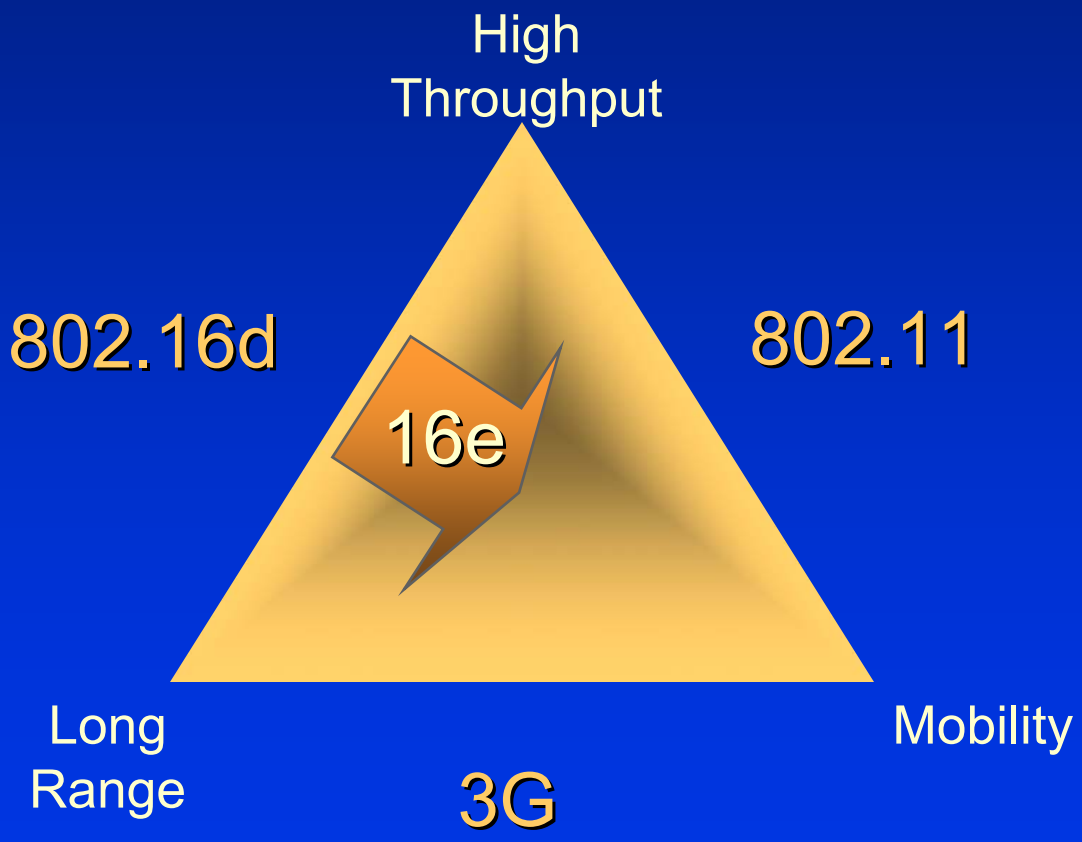
PCI Express* Form Factor or Mini PCI*

Laptop Seeks Best Connection:
802.11 if in vicinity of Hot Spot
802.16 if outside Hot Spot range

- Omni-directional antenna
  - Not aligned with base station
    - Location can be highly variable
  - Portable and can support both fixed and mobile use
    - Can be moving while in use
  - Lower throughput than directional antenna
- Applications
  - Consumer DSL-like connectivity in the wider area network

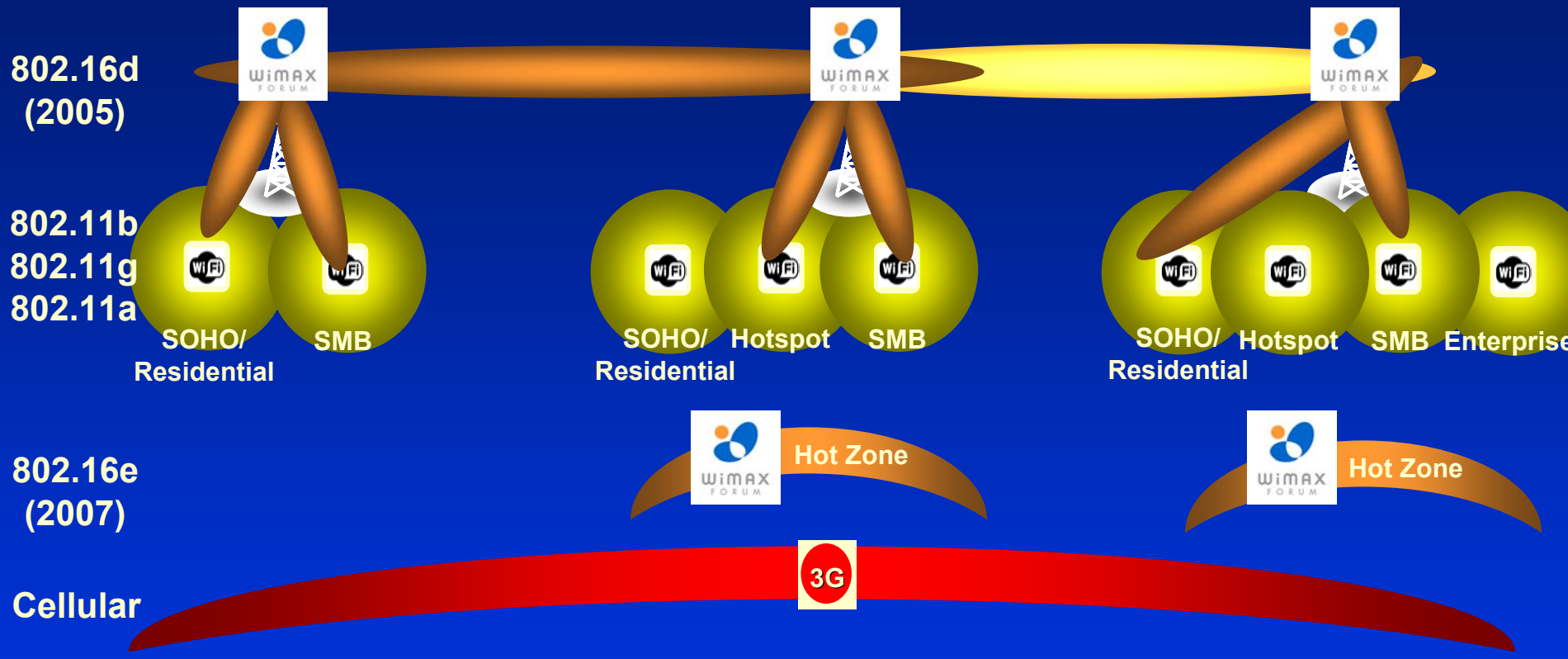
Wireless Physics Tradeoff

High throughput, long range, mobility

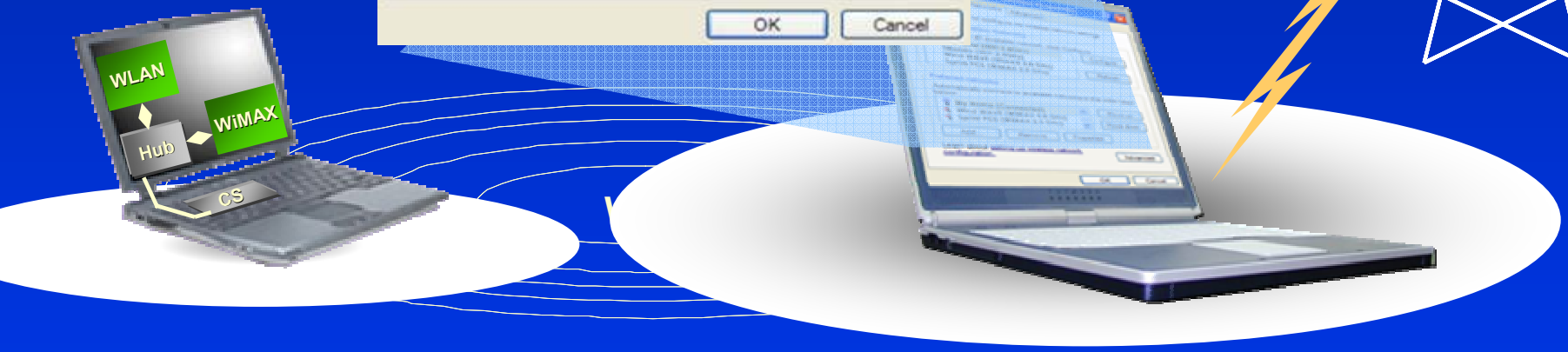


An Unwired Broadband World

At Work, at Home, On the Road



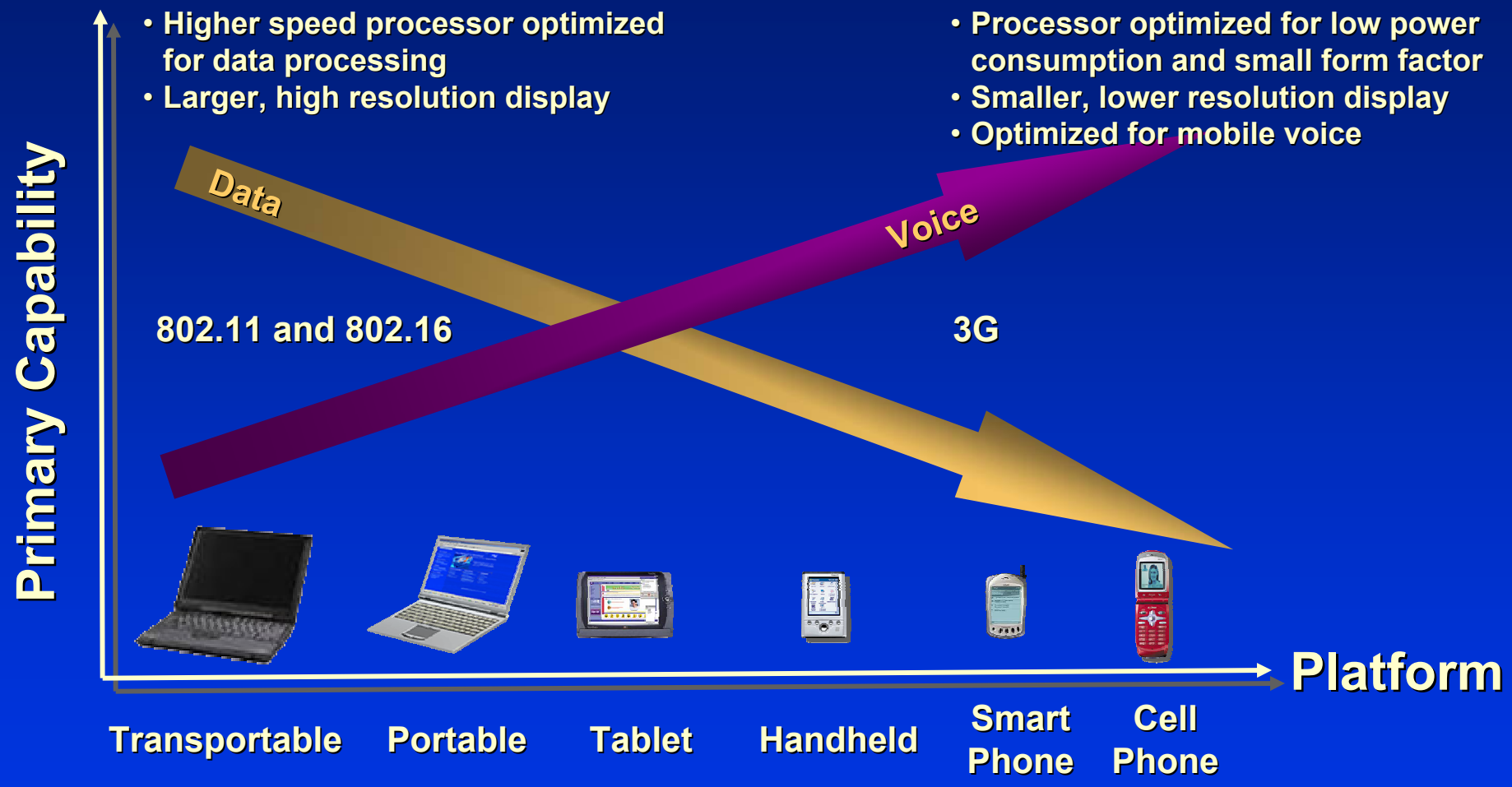
Wi-Fi and WiMAX: Combination delivers "Always Best Connected"



Mobility Add-In Card Target Features:

- **PCI Express* Form Factor w/ Simplified Network Connection Software**
- **Integrated Lid Antenna**

Wireless Platform Continuum



There's no "best" technology -> the solution must be optimized for the Platform and the Usage Model.

WiMAX and 3G

- It's an OFDM vs. CDMA debate
  - OFDM provides benefits for scalable, high speed data connections
- Voice traffic growing, competing w/data for limited spectrum resources
  - Carriers must maintain voice quality, revenue
- As data volumes grow, there is increasing need to offload to a more data efficient network technology
  - Mobile Carriers who are successful with data today agree
- WiMAX provides efficient, data-centric overlay network
  - It is the only standard OFDM-based technology for this application
- Wireless carriers should work with equipment providers to make sure that WiMAX overlay is available

IEEE 802.16* Standards

	802.16 Line of sight	802.16REVd 802.16-2004	802.16e Mobile Enhancements
Status of Standard	Dec 2001	802.16a: Jan 2003 802.16REVd: July 2004	Estimate Jan 2005
Spectrum	10 - 66 GHz	< 11 GHz: 2.5, 3.5 GHz licensed 5.8 GHz license-exempt	< 6 GHz
Aggregate Bit Rate	32–134 Mb/s in 28 MHz of spectrum	Up to 75 Mbps in 20 MHz of spectrum	Up to 15 Mbps in 5 MHz of spectrum
Mobility	Fixed	Fixed outdoor & indoor	Portable/Mobile
Channel Bandwidth	20, 25 and 28 MHz	Flexible channel bandwidths between 1.25 and 20 MHz	Same as 802.16d w/ more “sub-channels” for low power
Typical Cell Radius	1-3 miles; up to 5 miles	3 to 5 miles	1-3 miles

Standards Mapping

	1H 2005	2H 2005	'06 – '07
Standard	**802.16REVd**	**802.16REVd / 802.16e**	**802.16e**
Usage Model	• Outdoor install • Fixed wireless broadband data service • Circuit-switched (TDM) voice for wireless local loop as well as E1/T1 level service for enterprise	• Indoor install • Consumer wireless broadband data service • Portability for roaming within a service area	• Portability • Higher speed data support • Roaming across SPs • VoIP
Devices	• Outdoor CPE • Indoor CPE	• Outdoor CPE • Indoor CPE • Residential Gateways • Notebook computers	• Outdoor CPE • Indoor CPE • Residential Gateways • Notebook computers • Handhelds (data+voice)
Mfrs & Carriers	• WiMAX Forum Mfrs • WISPs in low pop density (rural) markets • Major carriers in urban centers in emerging markets	• WiMAX Forum Mfrs including Network Infrastructure Mfrs • Broadband Data Service Providers in developed markets	• WiMAX Forum Mfrs • Laptop/HH Mfrs • Mobile Data & Voice Service Providers

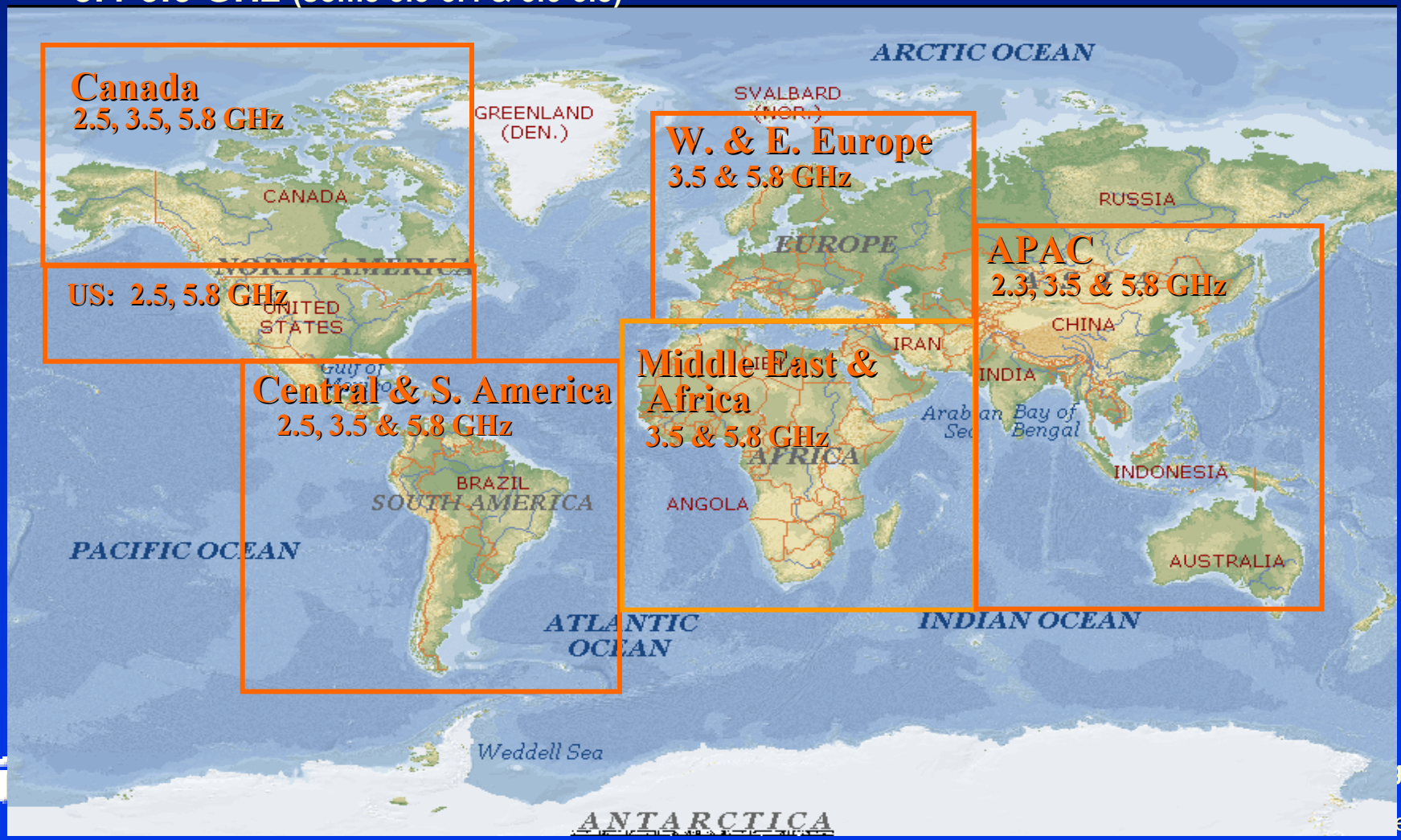
Tri-mode Radio to Enable a Worldwide WiMAX Client (Subscriber)

Licensed Bands

- 2.3-2.4 GHz, 2.5-2.7 GHz
- 3.4-3.6 GHz (some 3.3-3.4 & 3.6-3.8)

Unlicensed Bands

- 5.725- 5.85 GHz (also 5.25-5.35; 5.4-5.725)



Intel's Broadband Wireless Strategy

1. Enable standards and interoperability
2. Deliver building blocks and enable platforms
3. Optimize for data and end state of worldwide client SKU
4. Drive both licensed and license exempt market development

Intel Product Focus: Silicon for Platform Solutions

Carrier Class Base Station

Pico Base Station

802.16d/e Baseband Chipset

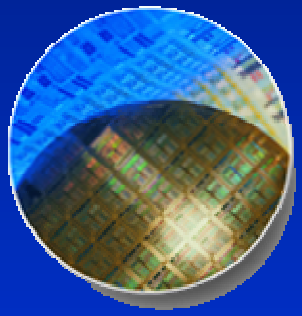
Licenced & Licensed Exempt Radio

Outdoor Install CPE

obile Client Platforms

Portable/ Indoor Install CPE

Solution Roadmap Summary

2004	2005	2006
		
1st Intel Si	**Mainstream WIMAX Deployments**	**WiMAX Notebook Integration**
Trials	**Fixed Outdoor CPE/BS: 1H'05** **Indoor/ Mobile CPE/BS: 2H'05**	

Equipment Mfrs & Carriers Supporting Intel WiMAX* Vision

Airspan Networks*

Alcatel*

Alvarion*

Aperto Networks*

Proxim*

Redline*

Siemens Mobile*

UK Broadband* (United Kingdom)

PCCW* (Hong Kong)

Iberbanda* (Spain)

Reliance Infocomm* (India)

BT* (United Kingdom)

Telmex* (Mexico)

Neotec* (Brazil)

MVS Net* (Mexico)

WiMAX Forum*

- A non-profit organization comprised
  - broadband wireless access system manufacturers
  - component (silicon, RF, antenna) suppliers
  - software developers
  - carriers
- Promote WiMAX brand identity & WiMAX-Certified* equipment to drive interoperability
  - Based upon IEEE 802.16* and ETSI HiperMAN* standards
- The WiMAX Forum was founded in April ’01
  - Over 116 members and growing

http://www.wimaxforum.org

Industry Leadership

Standards

WiMAX FORUM

IEEE

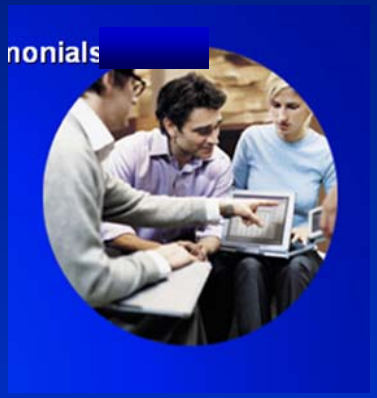
Wi Fi

Rich Ecosystem & Solutions Enabling

Intel® Communications Alliance

A community of communications and embedded developers and solution providers

Enterprise IT Relationships



Broad Marketing

centrino

$300M Intel® Centrino™ Mobile Technology launch 2003

Intel Capital & Industry Investments

Fuel Innovation

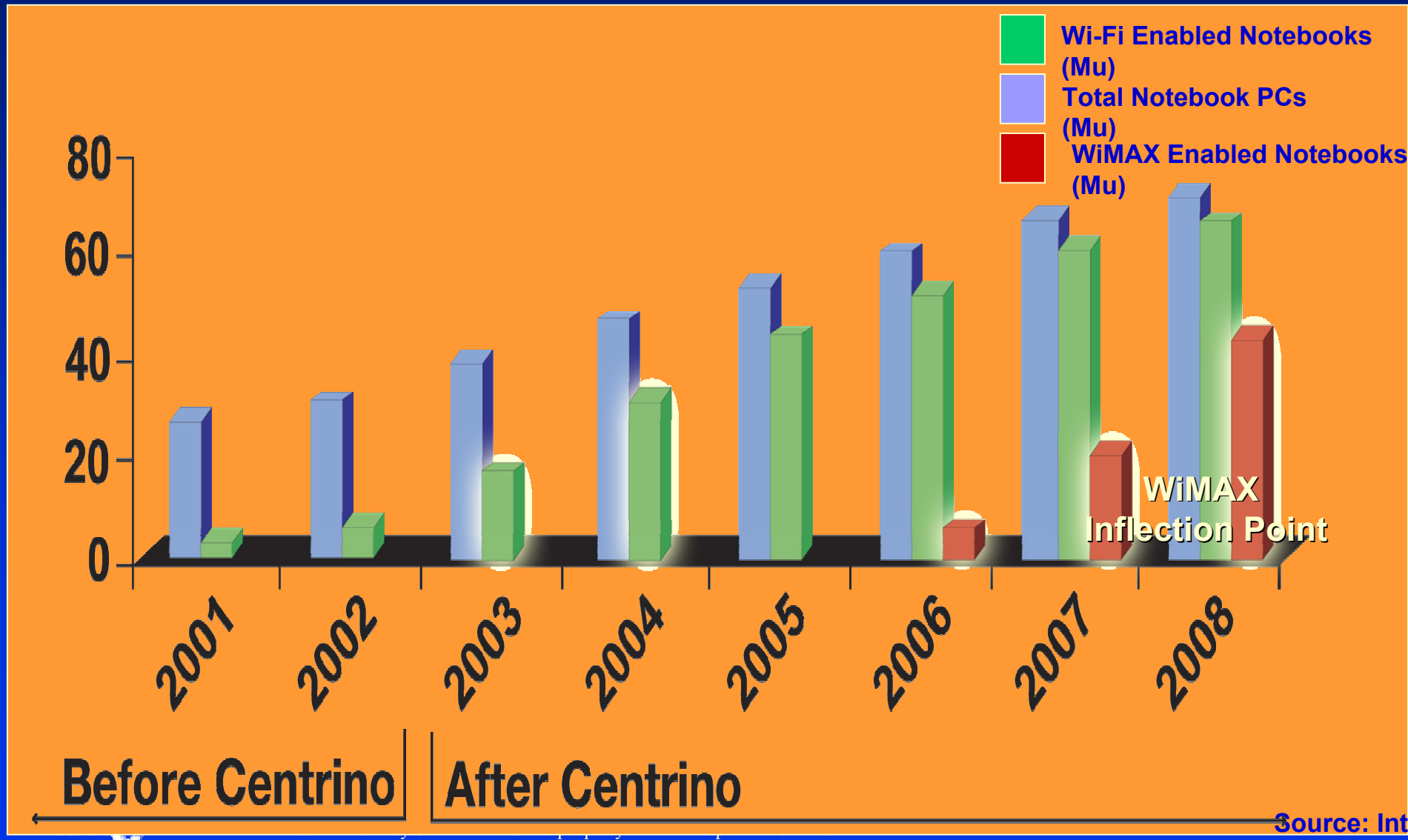
$150M fund for investments in companies developing wireless networking products

Regulation

intel

Integration Will Drive Adoption

Requires Low Cost & Worldwide SKU



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BACK UP

802.16 and 802.11 Standards

	802.11	802.16d	Technical
Range	• Optimized for 100 meters • Add access points or high gain antenna for greater coverage	• Optimized for typical cell size of 3-5 km • Up to 50 km range in fixed, line-of-sight conditions	• 802.16 PHY tolerates the longer multi-path delay spreads caused by distance (10x more)
Coverage	• Optimized for indoor environments and users within 100m of each other	• Optimized for outdoor environments (trees, buildings, users spread out over distance) • Standard support for advanced antenna techniques & mesh	• 802.16: 256 OFDM (vs. 64 OFDM)
Scalability	• Channel bandwidth is wide (20 MHz) and fixed -> OK for LANs (small cell sizes)	• Channel b/w is flexible from 1.5 MHz to 20 MHz for Metropolitan Area cell planning • Accommodates both licensed and license exempt bands	• Macro cell planning (MAN) has different requirements than micro-cell (LAN) planning
Bit rate	• 2.7 bps/Hz peak data rate; Up to 54 Mbps in 20 MHz channel	• 3.8 bps/Hz peak data rate; Up to 75 Mbps in 20 MHz of spectrum	• Slightly higher modulation scheme yields slightly higher data throughput
QoS	• No QoS support today -> 802.11e working to standardize	• QoS designed in for voice/ video, differentiated services	• 802.11: contention-based MAC (CSMA) • 802.16: grant request MAC