Scope of MBWA

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Base Document:

Purpose:
   To provide background information on mobile broadband wireless access

Mobile Broadband Wireless Access Systems

Scope of MBWA

May 20, 2002

Scope of MBWA

- **Growth in devices and users**

- **Leverage the existing Internet**

- **Mobile applications**

- **MBWA design requirements**

- **What MBWA is not…**

- **Standardization**

Addressable Device Market

- 80 million installed laptops and PDAs in the U.S. represent a huge market ready for wireless Internet access
- Sales of potential data devices, such as handheld games, MP3 players, digital cameras, automobile devices, etc., expected to explode worldwide
  - 140 million data devices expected to ship worldwide in 2003 (The Shosteck Group)

U.S. Installed Base of Laptops and PDAs

17% CAGR

36% CAGR

Legend:
- Laptops
- PDAs

Y-axis (Millions): 0.0, 20.0, 40.0, 60.0, 80.0, 100.0, 120.0, 140.0, 160.0

X-axis: 2000, 2001E, 2002E, 2003E, 2004E
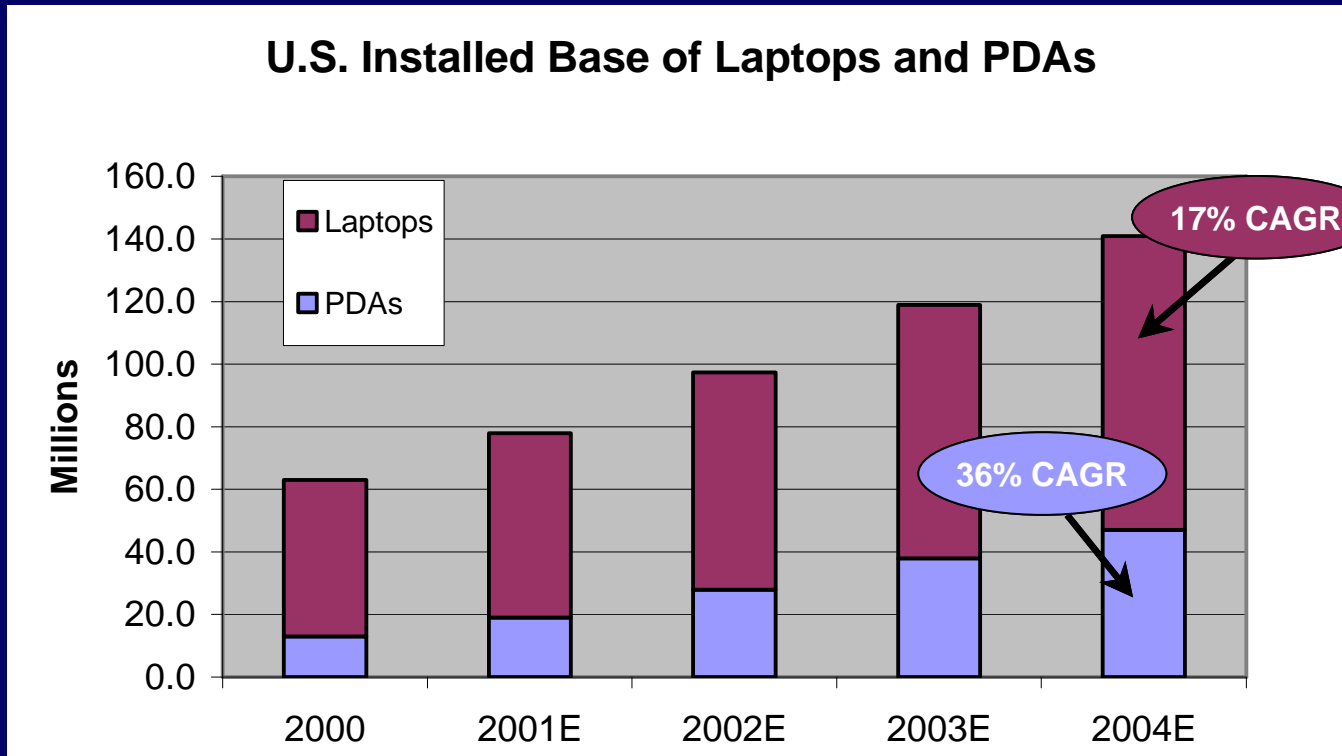
Source: Gartner Group, Yankee Group.

Addressable Business User Segment

- **Enterprise is an attractive early market segment**
- **Business users average 10 hours per week on the wireline Internet**
- **70+% of business users subscribe to wireless voice services**
- **Highly mobile – 80% of business mobile phone users also travel**

U.S. Workforce Population

2.1% CAGR

8.9% CAGR

■	Workforce Population
◆	Mobile and Remote Population

Millions

140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0

1999   2000   2001E   2002E   2003E   2004E
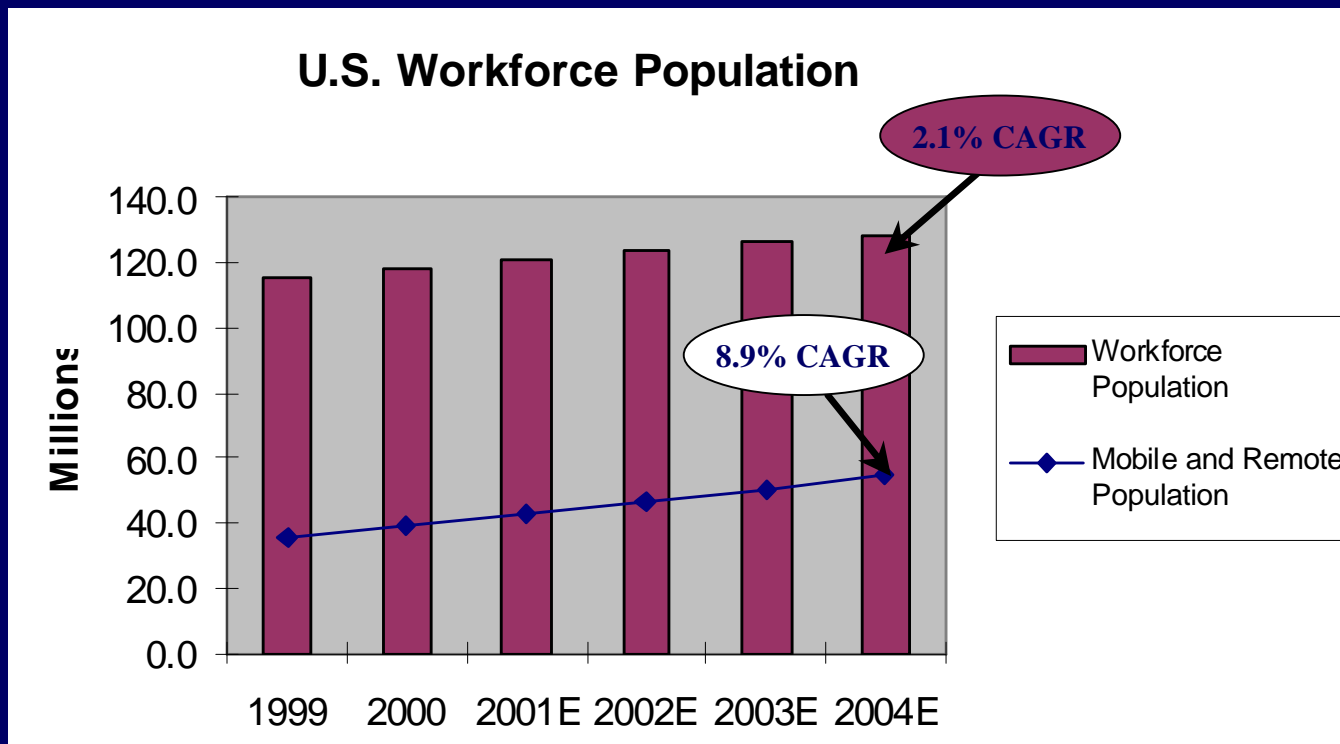
Source: IDC.

Addressable Mass User Market

- **U.S. adoption of wireline Internet reveals a huge market waiting to be unwired**
  - Over 104 million active Internet users in the U.S.
- **Wireless Internet access with the similar functionality and price points as a wireline connection (with the added benefit of ubiquity) will lead to significant adoption/replacement**
  - For example, cellular voice subscriptions = 2/3 the level of wireline voice lines in U.S.

U.S. Internet Users
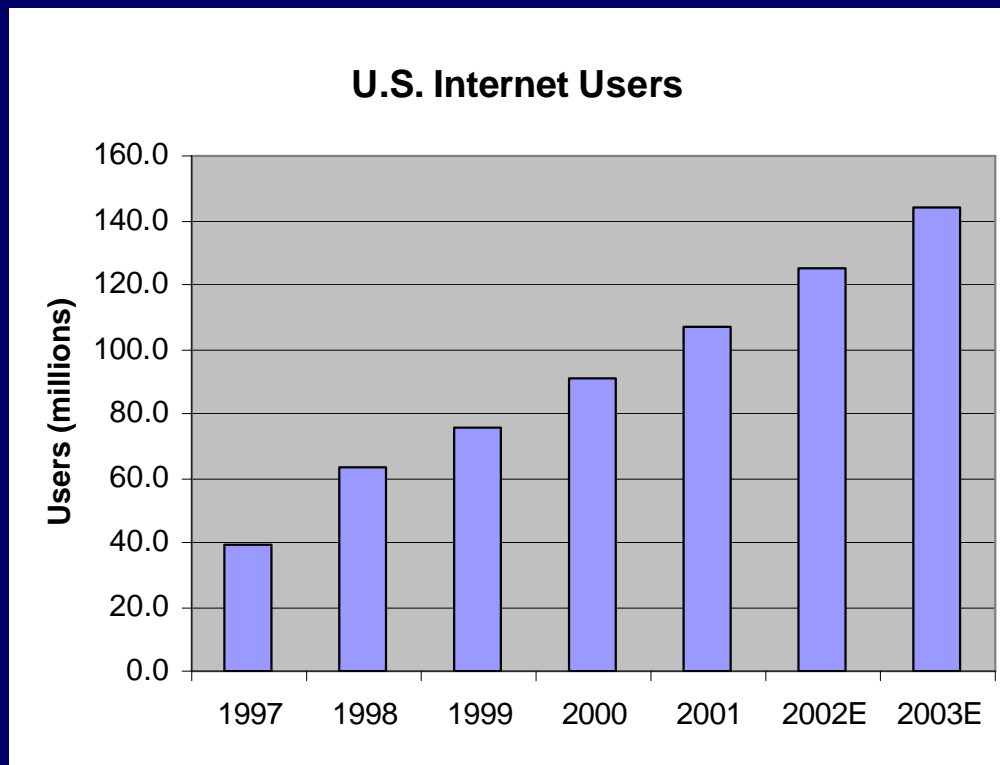
Source: Morgan Stanley, U.S. Department of Commerce.

Leverage the existing Internet

Large existing base of internet content and IP-based applications

	Internet (HTML, IP, etc)	Cellular (WAP, imode, etc)
Content (#web pages)	2 billion	<100,000
Devices	550 million	150 million

- *Cellular did not reinvent dial tone, it simply mobilized it*
- *MBWA should not reinvent the internet, it should mobilize it*

Sources: Cellmania.com, NTT DoCoMo, ResearchPortal.com, Strategy Analytics, USA Today, Wit Soundview.

Wide range of mobile applications

Productivity

Mobile Office
Voice/Data PDA

Mobile Office PC

Insurance
& Real Estate

Vehicle fleets

Lifestyle

Mobile Video
& Digital
Cameras

Entertainment &
Telematics

Mobile MP3
Players

Online
Interactive
Gaming

Mobile Application: Digital cameras

- *Ricoh RDC -i700 Internet-ready digital camera provides Internet Protocol (IP) video and high-resolution still images over mobile broadband network.*

Real Estate

Rescue   **Insurance**

*Insurance: 2.3M industry workers, 550,000 mobile, concentrated in relatively few firms

Source: *Conning and Company, Bureau of Labor, Statistics*

Mobile Application: Gaming

– "Mobile gaming over the Internet will grow to an $8.8 Billion industry by 2006" – Bear Stearns

- **The Challenge: Interactive applications need low latency**
  - Delays of less than 50 milliseconds are desirable for highly interactive applications such as gaming
  - Interactive applications can not sustain delays in excess of 150 milliseconds…

Mobile Application: Vehicular

- **Vehicle fleets**
  - **Delivery services: FedEx, UPS**
  - **Trucking industry**
  - **Corporate fleets**
- **Telematics (diagnostics, entertainment, etc.)**
- **Passengers in cars, buses and trains**
- *Full mobility: MBWA should work anytime, anywhere*

Fixed ⇒	Portable ⇒	Mobile
Landline phones	Cordless phones	Mobile Phones
Wired internet / Fixed wireless	Wireless PAN/LAN	MBWA

Key issue: Low latency

Rate

3 Mbps

It's not just about data rate…

Multimedia

144 kbps

Enterprise/ VPN , etc.

14 kbps

Email, File Transfer

Rate

WAP, Cellular- Specific Apps

Video- conferencing

Delay

1 second

Web Browsing, mCommerce

250 msec

Multi-user Games, VoIP, TCP, etc.

…it's about packet delay

20 msec

Delay
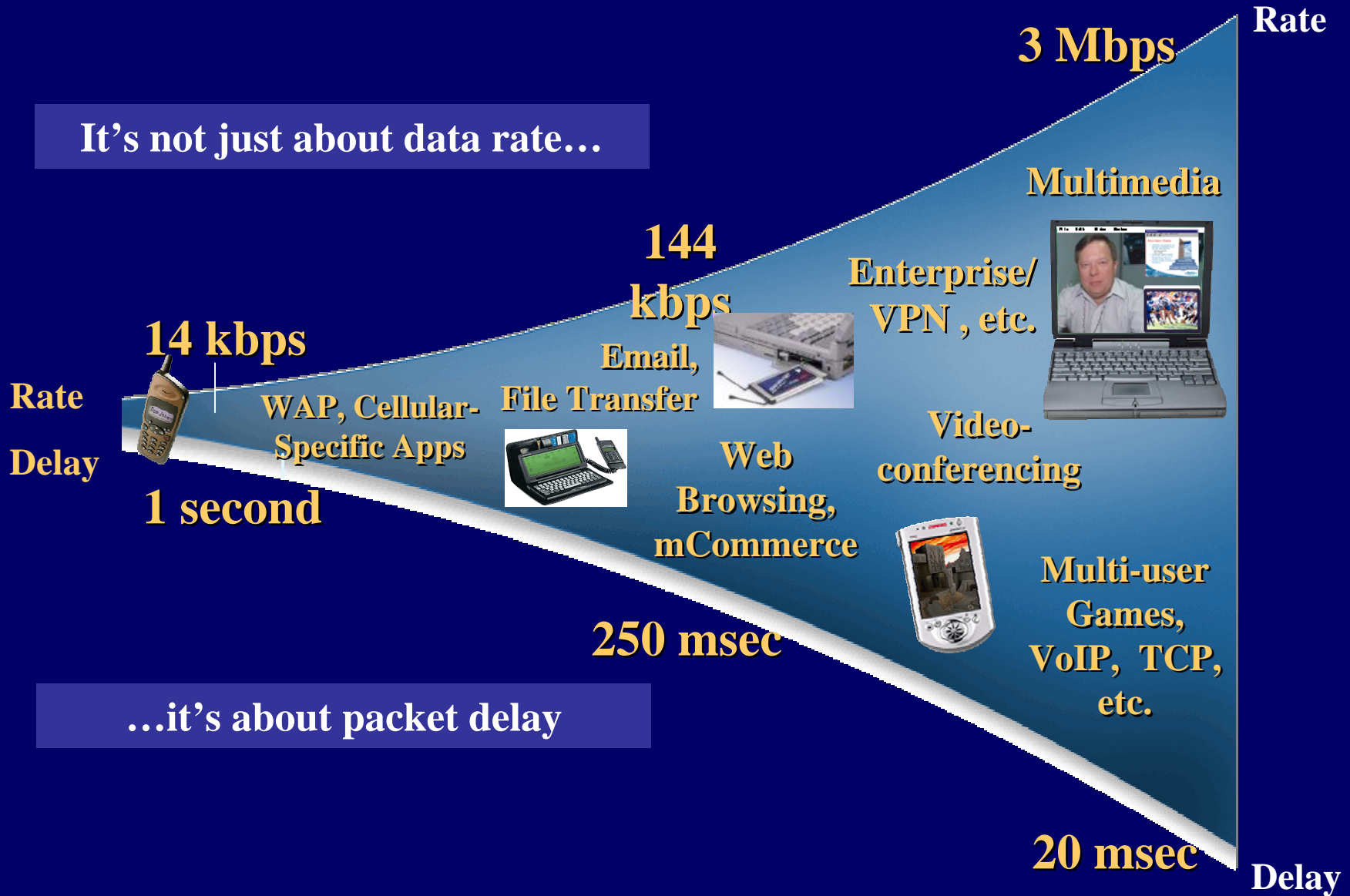
MBWA requirements for mobile applications

- **Mobile office – leverage the existing Internet**

- **Digital images, multimedia – high data rate**

- **Interactive and streaming applications (gaming, VoIP, TCP) – low latency**

- **Anytime, anywhere – support for full mobility**

Design Principles for MBWA

- **Support IP-based applications**

- **Provide high DL/UL data rate**

- **Low latency MAC control channels**

- **Full support for vehicular mobility**

- In order to leverage existing applications, it is necessary to have low latency in order to support TCP/IP as well as interactivity

- To reduce the latency, dedicated control channels in the PHY can be used for the MAC messages.

- The system needs to be robust in the high Doppler conditions and rapid changing environments associated with mobility.

Additional MBWA requirements for wide-area cellular systems

- **Guarantees on throughput –** operates in licensed spectrum

- **Deployment –** compatible parameters with existing cellular systems

- **Frequency planning –** universal spectral reuse

- **Quality of Service –** MAC support for QoS

- **Handoffs –** MAC support for fast handoffs

What MBWA is not...

- **Wireless LAN modified for coverage.**
- **Cellular voice modified for data.**
- **Fixed wireless modified for mobility.**

data

MBWA

coverage

mobility
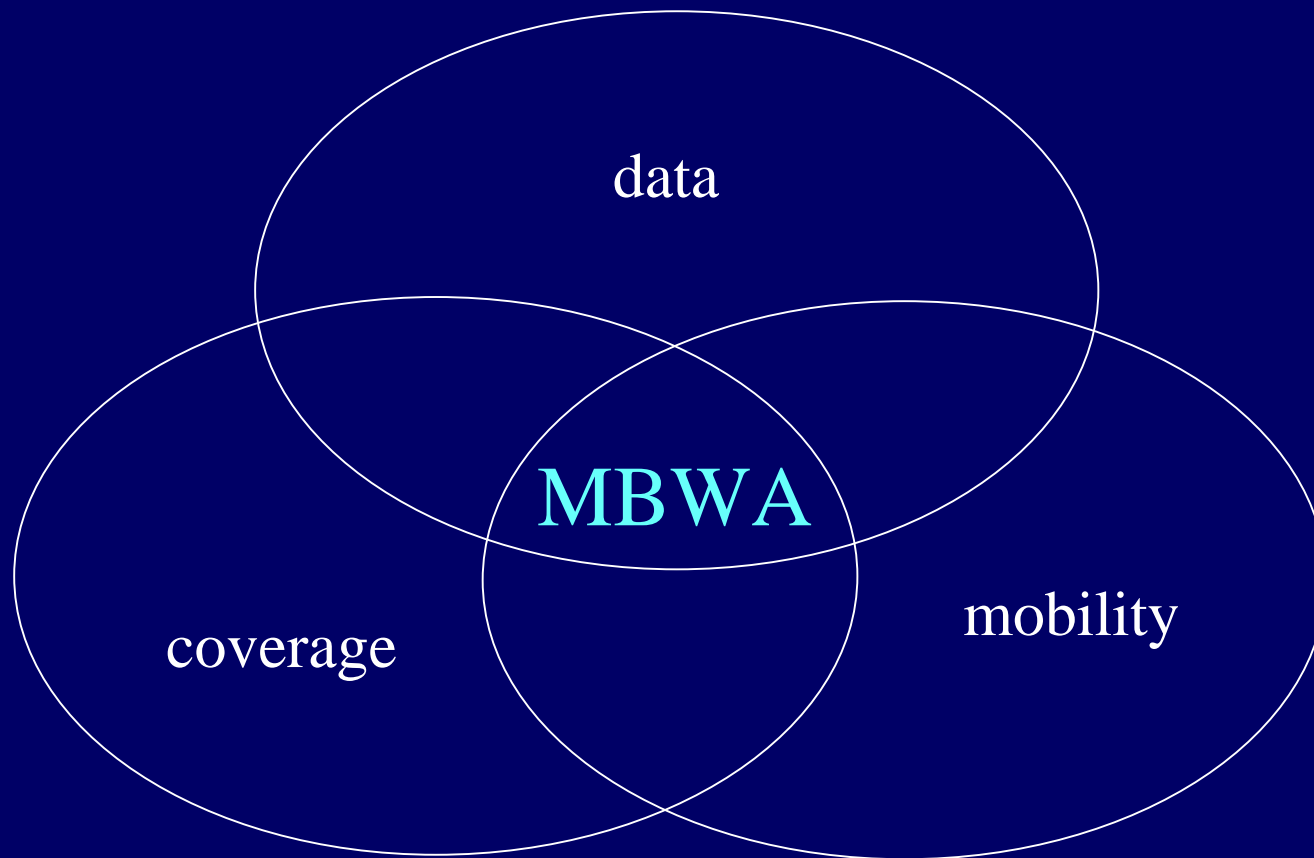
MBWA needs new approach

- **Wireless LAN does not scale economically to cellular deployments**
  - Microcell architecture results in high infrastructure costs
  - Contention-based access causes delays as users increase

- **Cellular voice cannot support data efficiently**
  - Voice-based systems not optimized for packet data
  - High-speed data not shown to be economically viable

- **Fixed wireless is not optimized for mobile channels**
  - Access and control methods not suited for fast fading
  - Contention-based data/control cannot ensure low latency
  - *Modifying network layer cannot solve fundamental issues necessary for vehicular mobility*

- *MBWA needs a "clean sheet" approach for PHY/MAC*

Standardization

- Mobile broadband wireless data is a promising emerging market
- Design requirements not met by current standards
- Standardization results in better designs and economic benefits
- MBWA group addresses the need for an **air interface optimized for mobile wireless data in cellular systems for licensed bands**
- MBWA fits well into 802, and is complementary to existing 802 WGs

MBWA Air Interface

- Channelization

- Frequency bands

- Modulation

- Pilot tones

- Multiple access

- Control messages

- ARQ

- Forward-Error Correction

- Multiple antennas

- Security

- Support for QoS

- Support for link adaptation

- Handoffs

- Etc…

Conclusions

1. **Motivation** – There is a promising market for mobile broadband wireless access that leverages the existing internet

2. **Design principles** – low latency, high data rate and high mobility require integrated approach to PHY/MAC design

3. **Standards** – develop an air interface optimized for mobile wireless data in cellular systems for licensed bands