

# **“Keeping Pace with Moore and Marconi”**

## **2005 International Symposium on Advanced Radio Technologies**

**Michael D. Gallagher**

Assistant Secretary for Communications and Information  
National Telecommunications and Information Administration

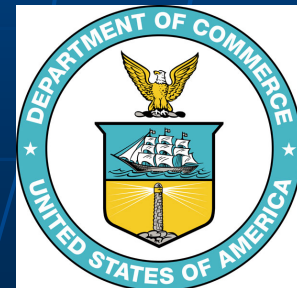
U.S. Department of Commerce

[www.ntia.doc.gov](http://www.ntia.doc.gov)



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# The Spectrum Challenge

A Presidential Policy Board examining spectrum management summed up the urgent issues in stating:

*"The development of so valuable a resource as the radio spectrum is a matter of paramount importance. Despite technical and operational improvements the demand for frequencies has steadily crowded the supply within the usable spectrum. The use of this resource should have the most careful planning and administration within the United States and in cooperation with other countries. Unfortunately, guidance and administration have often been inadequate."*

# New & Emerging Technology and Policy Challenges

- Spectrum Management in the 21<sup>st</sup> Century
- Technology Highlights
  - Smart antennas and MIMO
  - Software-Defined Radio and Cognitive Radio
  - Ultrawideband
  - Wi-Fi, WiMax, Mesh Networks

# Smart Antennas and MIMO

## ■ Smart Antenna Technology

- Benefits:
  - Reduce multipath fading
  - Increase system capacity
  - Extend battery life of terminals
  - Extend range of base stations
  - Reduce interference
- Advanced antenna designs

## ■ MIMO

- Increased system capacity
- ITS research

# Software Defined Radio (SDR) and Cognitive Radio (CR)

## ■ SDR

- SDR-enabled devices can be dynamically programmed
- Alleviate interoperability problems

## ■ CR

- Employs model-based reasoning based on its assessment of radio environment

## ■ Regulation of SDR and CR

# Ultrawideband (UWB)

- FCC legalized UWB emissions in 2002.
- Competing proposals for primary standard: high data rate Wireless Personal Area Network (WPAN) or IEEE 802.15.3.
- NTIA/ITS performing research to help with decision.
- Freescale Inc. (Motorola) plans to deliver three UWB product families over the next year.
- Wide range of perspectives on future market size and growth potential.

# Broadband Technologies Helping to Achieve the President's Goal...

## ■ Wi-Fi

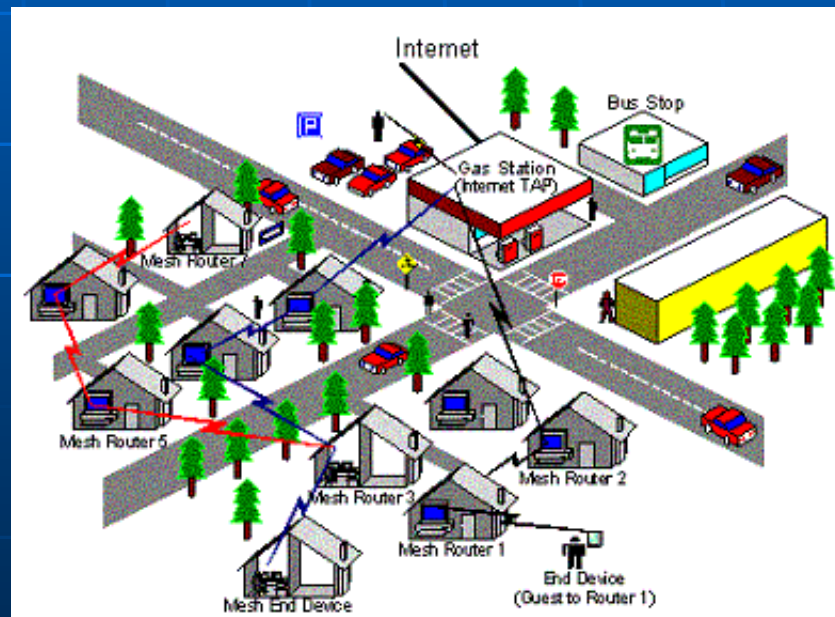
- As of Feb. 23, 2005, JiWire.com has calculated 59,811 Wi-Fi hotspots in 96 countries, with 24,027 hotspots in the U.S.
- Wi-Fi NICs are readily available for less than \$50, and InStat/MDR predicts that 95% of laptops will have Wi-Fi as a standard feature by 2005.

## ■ WiMax

- Intel plans to build WiMax into its Centrino chip platforms, which power 80% of all PCs, by 2006. Motorola plans to commercially offer integrated radio access networks that can handle 3G, Wi-Fi, WiMax and other future wireless innovations. AT&T, Siemens, and Alcatel are also backing WiMax technology.
- InStat/MDR estimates that a company could reach 97.2% of the US population with a \$3.7 billion investment in Wi-Fi. (Source: *Why Cheaper and Faster WiMAX will Force Convergence*, Wireless Business Forecast, Dec. 16, 2004)

# Unlicensed Mesh Networking

- By linking nodes on an ad hoc basis, mesh technology promises to deliver high bandwidth at an order of magnitude lower cost than existing licensed wireless technologies.
- Mesh architecture permits the extension of wireless coverage to areas that do not have wire infrastructure, and can link diverse devices or networks.
- Mesh access points integrate with existing WLAN access points to extend wireless coverage to areas not readily accessible by cables.



Self-Organizing Neighborhood Wireless Mesh Networks  
(Source: Microsoft Research)



# New Communications Forces

## ■ Multiple Ubiquitous Digital Networks

- 1's and 0's
- Single digital connection
- No more user classes – industry, private, government
- Multiple users share a big digital pipe

## ■ Sharply increased intelligence at the edge

- Software-defined Radio
- Cognitive Radio
- Smart radios: the bit-sources and bit-sinks that terminate the universal bit-pipes

# Public Policy Focus: Public Safety

- NTIA/ITS Public Safety Program supports:
  - PUBLIC SAFETY PRACTITIONERS
  - On behalf of the National Institute of Standards and Technology's Office of Law Enforcement Standards (OLES)
    - Dept of Homeland Security's SAFECOM Program
    - National Institute of Justice's CommTech Program (formerly known as the AGILE Program)
    - Dept of Justice's Community Oriented Policing Services (COPS) Program
    - Dept of Justice's "GLOBAL" Justice Information Sharing Initiative
  - Dept of Homeland Security's CIO's Office and Wireless Management Office

# NTIA/ITS Public Safety Program

*Standardized interoperability work for wireless communications and information sharing --*

Includes for the Long-Term Solution:

- Requirements Definition
- Architecture Framework Development
- Interface Specifications (Standards) Development
- Test and Evaluation
- R&D based on Gap Analysis (VoIP, security, MANET, etc.)

Includes for the Short-Term Solution:

- Assessment of Interim Interoperability Products

# Rethinking Spectrum Management Approaches

## Old Way

- Command and control
  - Specific rules ensure acceptable performance for specific service
  - The way it has always been done...

## Evolution

- Alternatives
  - Low power non-licensed underlays
  - Secondary markets
  - Smart sharing algorithms to avoid interference – like DFS
  - Wireless mesh networks to grow capacity as fast as consumption
  - Flexible Use Spectrum Rights (ISART Tutorial)
  - Initially deployed in targeted responsible manner

# President's Spectrum Policy Initiative

*“The existing legal and policy framework for spectrum management has not kept pace with the dramatic changes in technology and spectrum use.”*

- President George W. Bush, Presidential Memorandum,  
May 29, 2003

- Committed the Administration to develop a comprehensive U.S. spectrum policy for the 21<sup>st</sup> century.
- The Secretary of Commerce was charged to lead this initiative.

# Responding to the President's Directive

- A Federal Government Spectrum Task Force proposed recommendations for improving the federal agencies' use of the spectrum.
- A separate report, with input from a wide range of stakeholders, recommended improvements to overall spectrum management (including use by federal, state, local, and private sector entities).
- The recommendations included proposals to develop:
  - A test bed for sharing spectrum between federal government and non-government users.
  - Long range spectrum strategic plans.
  - A process for reviewing cost effectiveness and efficiency in federal agencies' selection of systems.
  - Proposals for greater use of incentives in the management of government as well as non-government spectrum.
  - A review of international spectrum policy and framework.
- In November, 2004 President Bush issued an Executive Memorandum that established the recommendations as national policy and called for their implementation.

# What's Next: Implementation Plan Deliverables

- High-level federal government PPSG was created and provided advice on drafting of the implementation plan.
- Highlights for 2005:
  - Establish a private sector FACA advisory committee
  - Establish a spectrum test-bed for 20 MHz of spectrum from FCC and NTIA
  - Catalog current/future spectrum engineering and analysis models to determine impact of technologies on spectrum environments
  - Create an incentives plan to increase efficient and effective spectrum use
- Highlights for 2006:
  - Federal and national strategic plan
  - Recommend improvements to international spectrum management process
  - Updated federal government frequency assignment process
  - Outreach program to promote new engineering/analysis tools to federal and non-federal spectrum users

# Conclusion

- The most viral forces moving the digital economy are beyond the reach of state and federal regulators.
- Change in the communications and information technology market continues to occur at a phenomenal rate.
- U.S innovation leadership depends on the U.S creating President Bush's environment for new technologies and entrepreneurship.
- Are we creating an innovation culture open to dramatic acceleration in the market?