The FCC and The Future of Spectrum

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Outline

- Overview of Wireless Regulation
- The State of the Wireless Industry
- Emerging Wireless Issues and Trends
- Spectrum Policy Task Force
- Third Generation (3G) Wireless
- Wireless Broadband Technologies

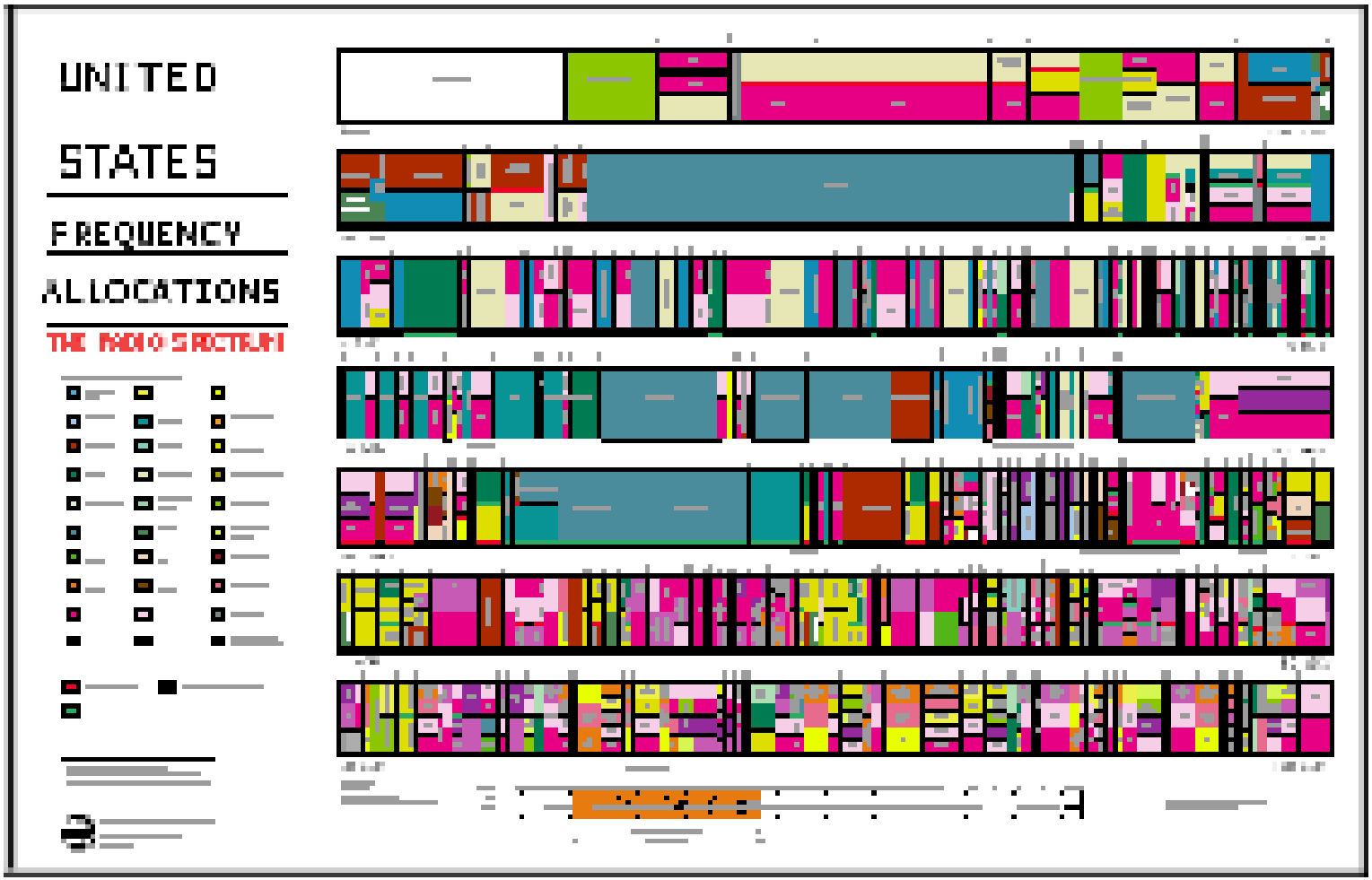
FCC Regulatory Authority

- Communications Act of 1934
  - Purpose: “to make available . . a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges”
- FCC jurisdiction: regulate “interstate and foreign commerce in communication by wire and radio”
  - Authority over wireless, wireline, satellite, broadcast, and cable

FCC's Spectrum Management Role

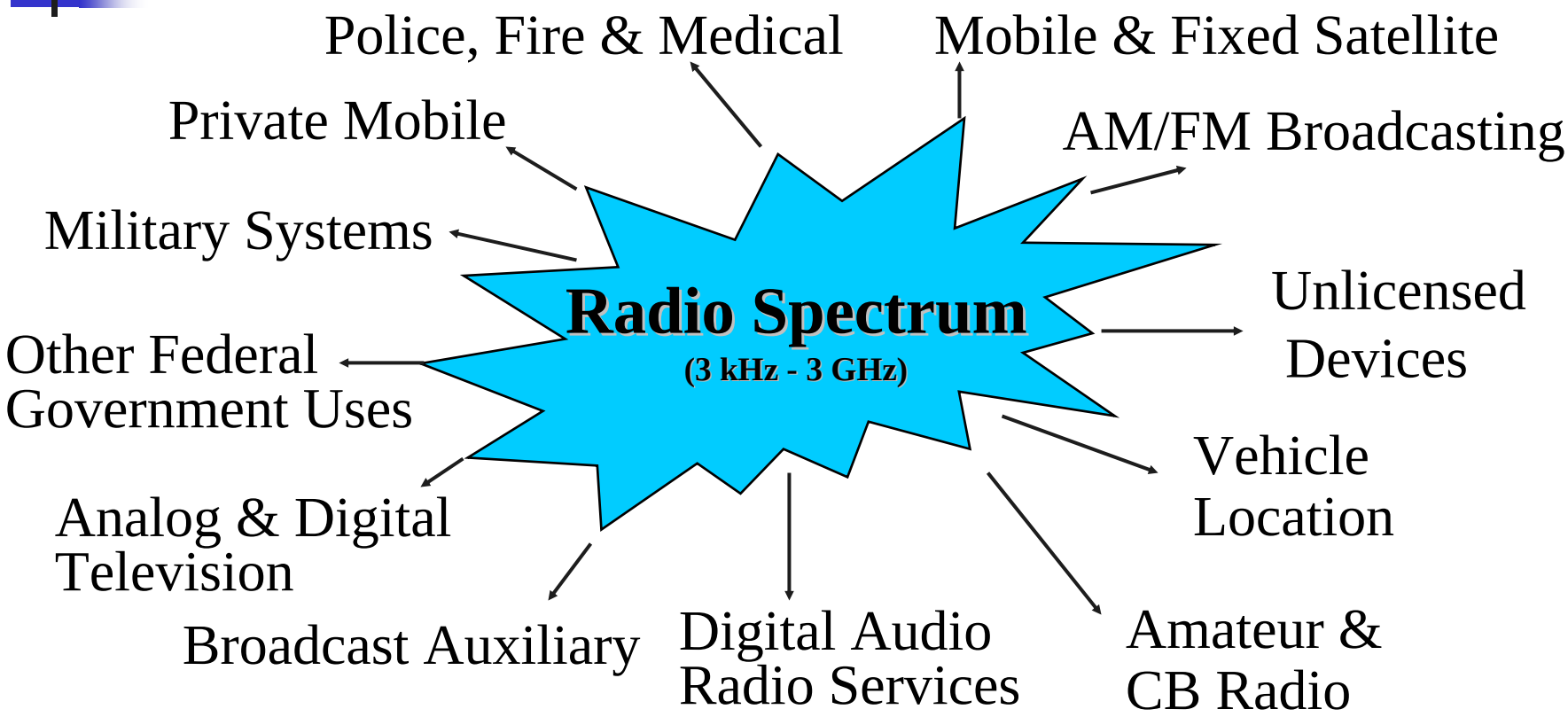
- Radio Spectrum -- Range of frequencies from 3 kHz to 400 GHz
- Title III -- Exclusive FCC regulation of radio spectrum and technology (except for Federal government spectrum use)
  - Allocations – What types of services (fixed, mobile, broadcast, satellite) go in what bands
  - Service Rules -- Technical and operational requirements for each band (e.g., to prevent interference)
  - Licensing – Who is authorized to operate in each band
  - Enforcement -- Compliance with FCC regulations

U.S. Table of Frequency Allocations



Available at: http://www.ntia.doc.gov/osmhome/allochrt.html

Many Uses Compete For the Same Spectrum



Subscriber growth, system capacity constraints, new technology requirements create demand for more bandwidth, but vacant spectrum below 3 GHz ("beachfront property" for mobile) is very scarce in US

A Simplified Spectrum Chart

Fixed Microwave/Satellite

PCS

Cellular Phones

UHF-TV

Land Mobile

Coast Guard/Harbor

VHF-TV Chs 7-13

Police

VHF Marine

Civil Air Patrol

Aviation

FM Broadcast

VHF-TV Chs 2-6

Citizens Band

Amateur (Ham)

Search & Rescue (SAR)

AM Broadcast

Marine

15 GHz -

2 GHz -

1 GHz -

800 MHz -

700 MHz -

400 MHz -

150 MHz -

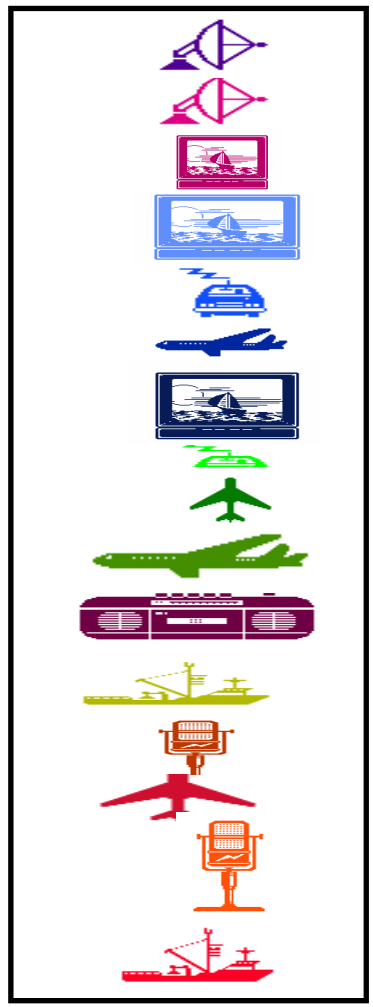
108 MHz -

54 MHz -

27 MHz -

1600 KHz -

70 KHz -



FCC Wireless Competition Policy

- Make spectrum available to multiple providers under flexible, market-oriented rules
  - Most commercial spectrum assigned by auction
  - Flexible secondary market policies
- Rely primarily on competition to provide improved service and lower prices to wireless consumers
  - Wireless rates/services essentially deregulated
  - Focused regulation to promote competition (e.g., Local Number Portability)
  - FCC monitors wireless competition and must approve all wireless mergers & acquisitions

State/Local Regulation of Wireless

- States cannot regulate wireless rates or entry, but can regulate “other terms and conditions” of wireless service
  - Increased interest in regulation by some states (e.g., CPUC “Bill of Rights”)
- State consumer, contract, and tort laws generally apply to wireless
- Tower siting – Primarily regulated at state/local level
  - Federal role – Historic preservation/NEPA

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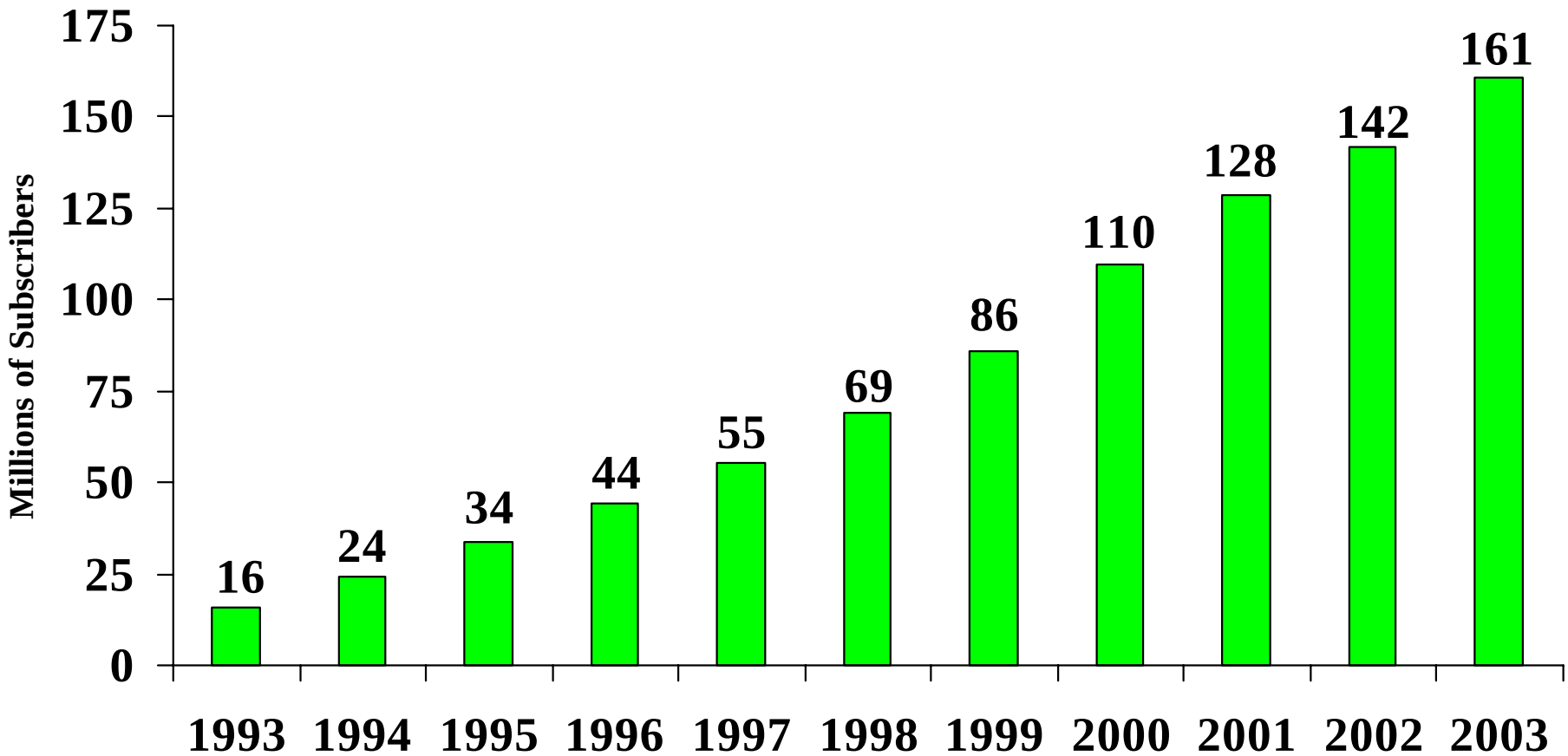
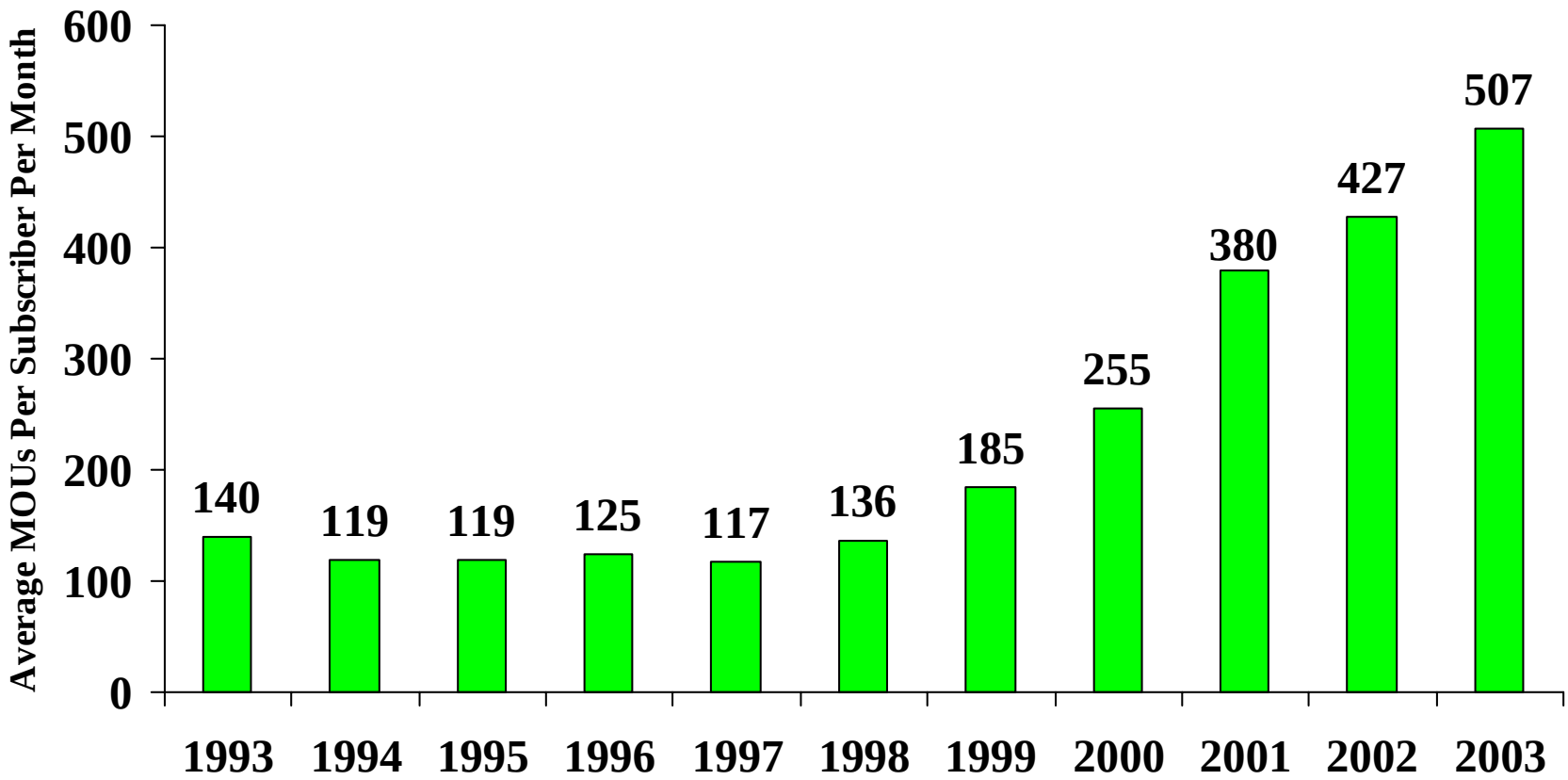
Total U.S. Mobile Wireless Subscribers



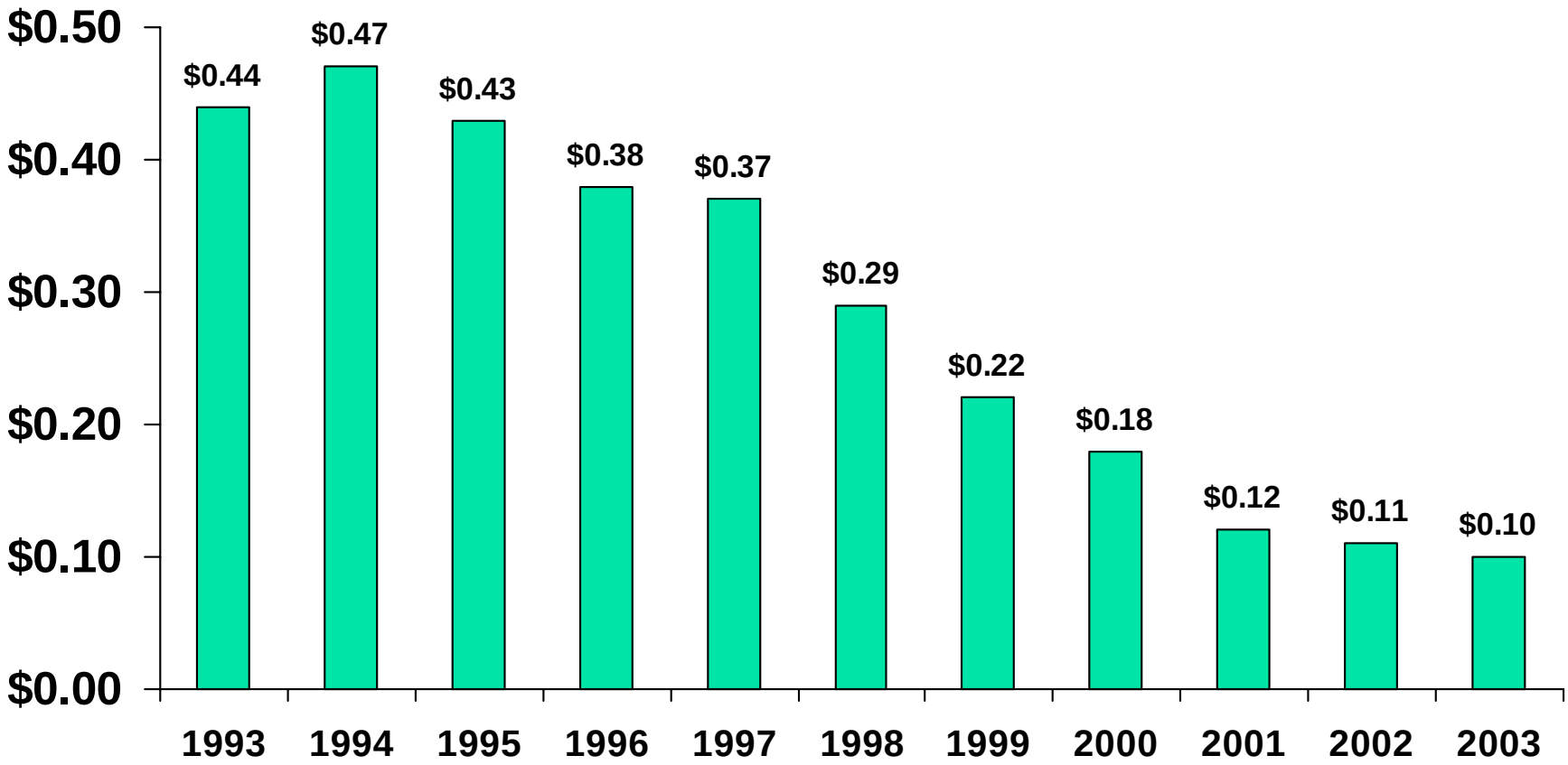
Source: Cellular Telecommunications & Internet Association (1992-2000); FCC (2001-2003).

U.S. Average Minutes-of-Use per Month



Source: Cellular Telecommunications & Internet Association , 2004.

U.S. Average Revenue Per Minute for Mobile Wireless Service



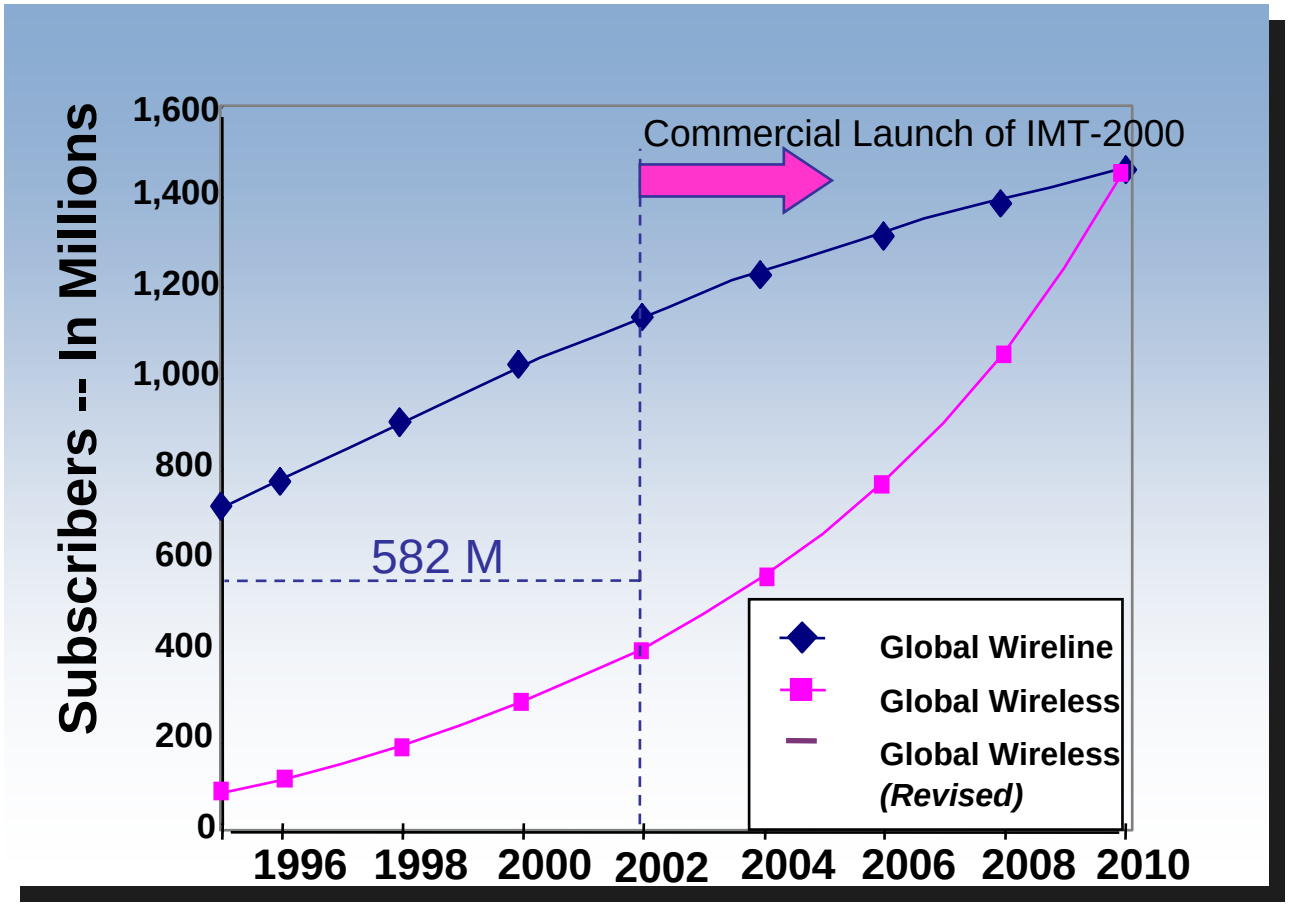
Source: Calculated using Average Local Monthly Bill and Average Minutes of User per Subscriber per Month from Cellular Telecommunications & Internet Association, 2004.

Mobile Data Services in the U.S.

- 25 percent of all mobile telephone subscribers send text messages
- SMS traffic volume -- 2 billion messages per month at the end of 2003
- Popular mobile data applications
  - Picture messaging – Verizon customers share an average of 7 million pictures per month
  - Ring tones
  - Games -- 12.2 million Americans downloaded or subscribed to wireless games through their cell phones in 2003
  - Simple web browsing

Sources: Goldman Sachs (text messaging); CTIA (SMS traffic); Verizon Wireless (picture messaging); Roland Jones, *Cell Phone Gaming Gathers Momentum*, MSNBC, Aug. 17, 2004 (citing market research firm IDC) (mobile gaming figure).

Intermodal Competition



Source: Lucent Technologies

- Worldwide wireless use projected to overtake wireline use by 2010
- Increasing signs of wireless-for-wireline substitution in US

LNP Activity (Through July 2004)

- Wireless-to-Wireless LNP
  - 5.4 million wireless numbers ported to other wireless carriers
  - 806,000 wireless-to-wireless ports in July
- Intermodal LNP
  - 544,000 wireline customers have ported their numbers to wireless carriers
  - 143,000 intermodal ports in July

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Emerging Wireless Issues

- Wireless has become an essential service, not just a convenience, for many consumers
- Consumers expect better coverage and reliability
  - Increased E911 use is a major factor in the service quality issue
- Wireless-for-wireline substitution is increasing even if “cord-cutting” is still relatively uncommon
- Demand for wireless data is an increasingly important driver of new services

Dale Hatfield's 7 Mega-Trends

We're Moving From:

- Analog to Digital
- Voice to Data
- Wired to Wireless
- Circuit Switching to Packet Switching
- Narrowband to Broadband
- High Latency to Low Latency
- Intelligence in the Network Core to Intelligence at the Network Edge

The Network of the Future

- All applications -- voice, data, image, video, multimedia -- conveyed on an all-digital, packet-switched, broadband, low-latency platform
  - A “network of networks” platform that uses common, open, non-proprietary standards and protocols (e.g., Internet Protocol)
- Platform will use wireless technology to allow users to communicate anyplace, anytime, in any mode or combination of modes

Getting There is the Hard Part

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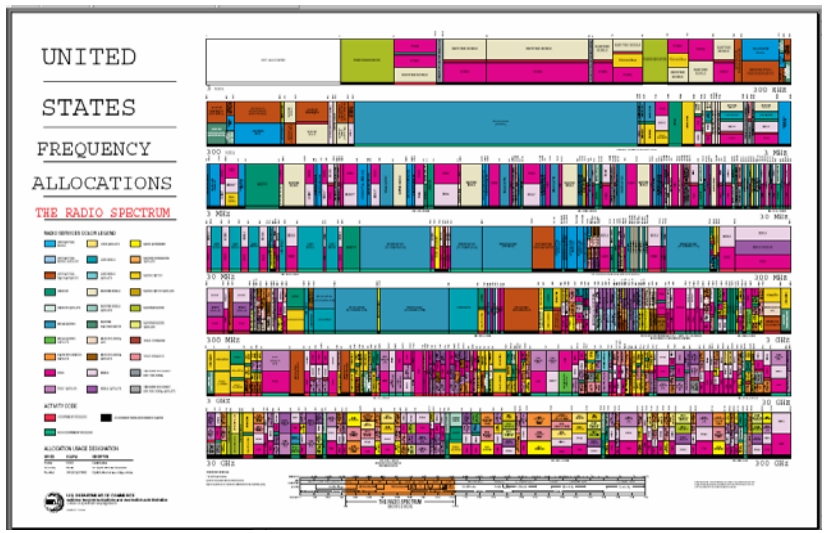
Spectrum Policy Reform
Why Now?

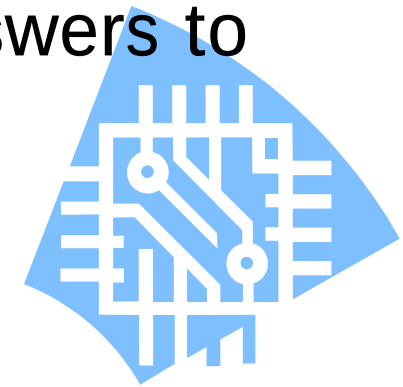
- Most “prime spectrum” has already been assigned to one or more uses

- But greater access to spectrum can be achieved through flexibility and other means



Spectrum Policy Reform
Why Now?

- New technology provides potential answers to current spectrum policy challenges.
- Increased use of digital technologies
  - Higher throughput
  - More robust and interference-resistant than analog
- Development of software-defined radios
  - "Smart" or "opportunistic" technologies that can access multiple bands to find and operate in spectrum not in use by others



Spectrum Task Force: Major Findings & Recommendations

- Spectrum access is a more significant problem than physical scarcity
  - Most spectrum is not in use most of the time
  - New technologies can operate in “white spaces” (in time and space)
- A new approach to interference protection is necessary
  - New technology is more interference-tolerant
  - More measurement is needed to quantify spectrum usage and availability.
- Spectrum policy must evolve towards more flexible and market-oriented regulatory models
  - Regulatory barriers inhibit spectrum access

Spectrum Task Force:
Major Findings & Recommendations

- Spectrum regulation must be based on clear definitions of rights and responsibilities
- No single regulatory model should be applied to all spectrum
- Pursue balanced spectrum policy that includes
  - Granting of exclusive spectrum rights through market-based mechanisms
  - Creating open access to spectrum “commons”
  - Command-and-control regulation used in limited circumstances (e.g., public safety)

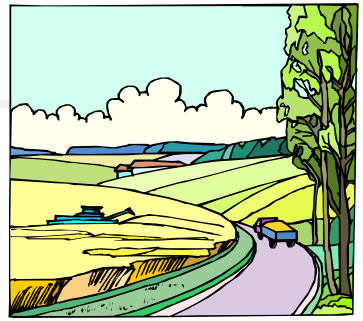
Spectrum Usage Models
One Size Does Not Fit All

- "Exclusive use" model
  - Exclusive and transferable flexible use rights
  - Defined spectrum and geographic limits
  - Rules focused on interference protection
- "Commons" model
  - Unlicensed users share frequencies
  - Usage rights governed by technical standards or etiquettes
  - No interference protection rights
- "Command-and-control" model
  - Traditional spectrum management process in US
  - Spectrum uses defined by regulation

Promoting Access to Spectrum
Recommendations

- Designate additional bands for unlicensed spectrum use
- Apply secondary markets policies to licensed bands (e.g., spectrum leasing)
- Consider granting “easements” for opportunistic uses in new spectrum bands
- User fees to improve spectrum efficiency when marketplace is inadequate
- Use wireline or hybrid technologies where they are more efficient than using radio spectrum

Promoting Access to Spectrum
Rural Areas



- Flexible regulation of power levels in less populated areas
  - Applies to both licensed and unlicensed spectrum
- Expanded use of secondary markets and easements to promote rural spectrum access
- Consider rural needs in defining geographic license areas
  - Smaller license areas – rural service providers can obtain spectrum tailored to areas they serve
  - Larger license areas – economies of scale and scope can be leveraged to benefit rural service

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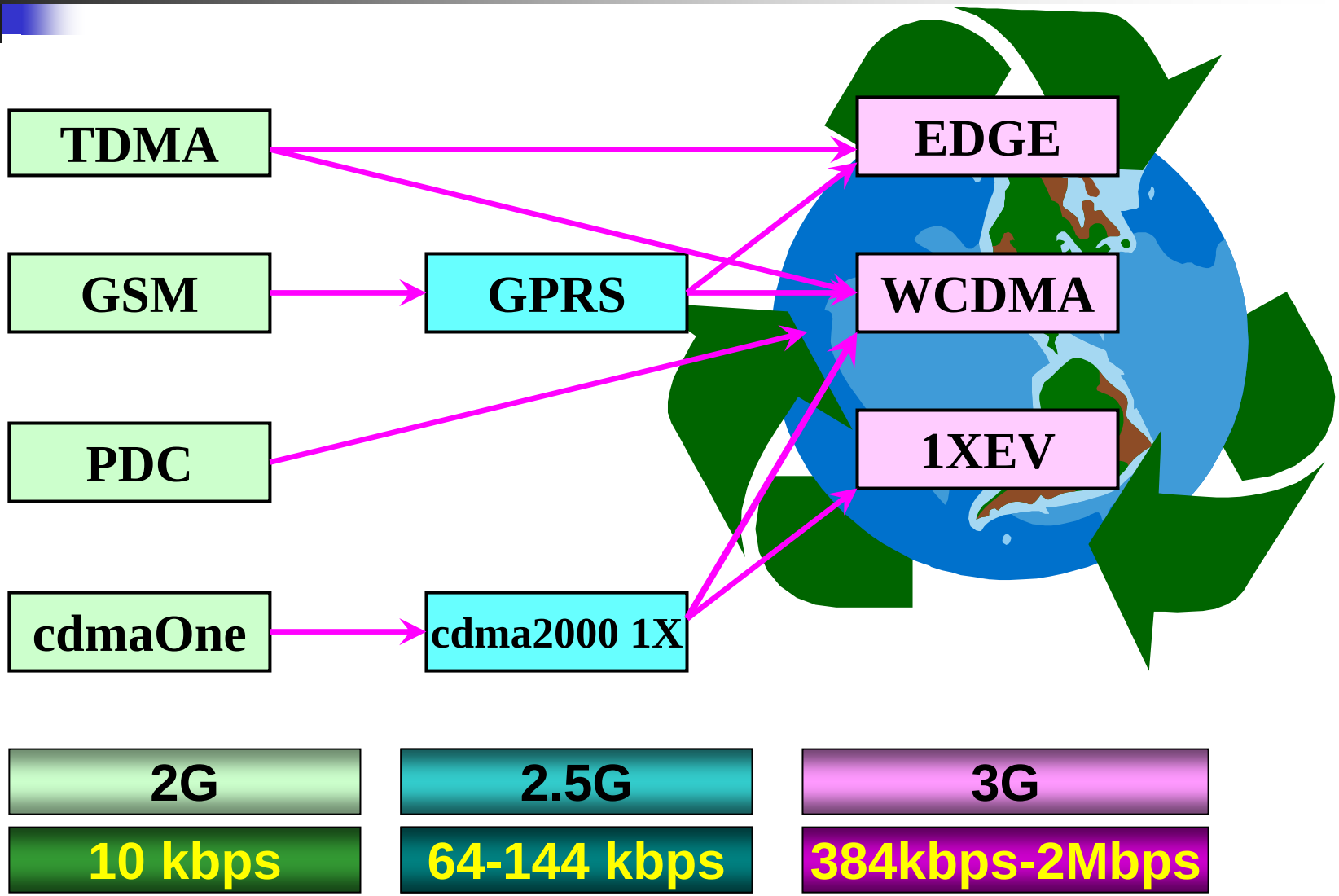
Third Generation Wireless (3G)

- Integrated voice and high-speed data to mobile devices
  - Allows richer array of potential applications than 2G (e.g., full motion video)
- 3G minimum performance requirements
  - Vehicle in motion: 144 kbps
  - Pedestrian: 384 kbps
  - Indoor office (stationary): 2 Mbps
- Requires 5 to 20 MHz bandwidth

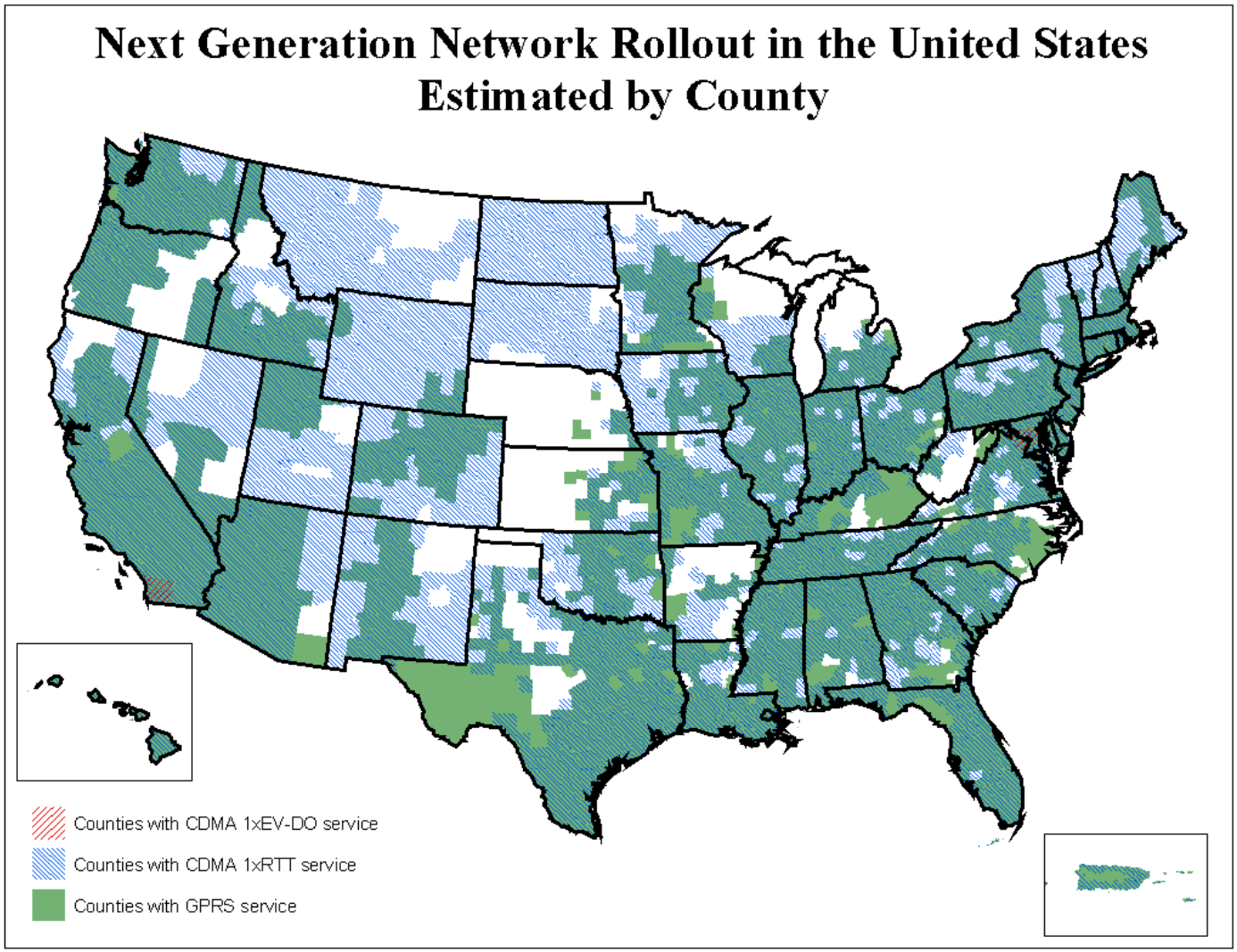
FCC Spectrum Policies Affecting 3G

- Allow licensees flexibility to develop any technologically feasible services that best accomplish their business plans
  - No mandated technology
  - Rules permit multiple, evolving standards
  - Flexible approach differs from original cellular rules and European 3G model
- Identify new spectrum for Advanced Wireless Services (includes 3G)
- Allow evolution within existing bands to more advanced services (e.g., evolution from 2G to 2.5G/3G)

Evolution of 3G Standards



2.5G/3G Rollout in U.S.



Source: Federal Communications Commission

Potential Additional Spectrum for 3G

- Advanced Wireless Services (AWS)
  - 90 MHz in 1.7/2.1 GHz bands
  - Additional 30 MHz reclaimed from MSS
- 700 MHz Band
  - 66 MHz of spectrum being vacated by analog TV broadcasters
- 2.5 GHz Band
  - New band plan and regulatory flexibility for 196 MHz of spectrum
- All bands have relocation/band clearing issues that will slow availability for new services deployment

Challenges to 3G Growth

- Capital-intensive
- Limited spectrum availability
- Resources still needed to improve 2G coverage and service quality
- Uncertain market potential for 3G services
  - What do consumers want and how much are they willing to pay?
  - Wi-Fi and other wireless broadband technologies will compete for consumer dollars
  - European/Asian 3G experience has been mixed so far

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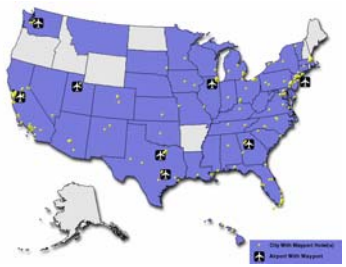
Wi-Fi (IEEE 802.11b)

- Local wireless networking standard developed by IEEE
- Key features:
  - Low power < 100 mW
  - Short range < 100 m (optimized for indoor use)
  - Supports portability but not mobility
  - Bandwidth: 22 MHz; data rates up to 11 Mbps
  - Operates on unlicensed spectrum (currently 2.4 GHz & 5.8 GHz)
  - Widely available in consumer equipment (Wi-Fi capability now built in to all new laptops)

FCC Spectrum Policies Affecting Wi-Fi

- FCC has opened multiple bands (e.g., 2.4 GHz, 5.8 GHz) to unlicensed use
  - Considering additional bands as well (e.g., “white space” in TV broadcast band)
- Unlicensed bands are well-suited to very low-power, high-bandwidth wireless applications
  - “Open access” model reduces entry costs
  - Lack of interference protection places premium on spectrum efficiency and robust technology
- But overuse of unlicensed bands can lead to “tragedy of the commons”

Wi-Fi Applications



Wireless Access Points

Wireless Bridge to Ethernet Backbone

Community Networks

Access Points at Public Gathering Places

Wi-Max (IEEE 802.16)

- New IEEE standard that offers greater range, data speed, and capacity than Wi-Fi
- Potential platform for wireless broadband networks covering substantial distances (business applications, rural areas)
- Can operate in licensed or unlicensed spectrum
  - Possible bands include 2.4/2.5 GHz, 3.6 GHz, 5 GHz, and higher bands
  - Licensed spectrum may be more attractive to Wi-Max providers (particularly in urban areas) because of interference protection and greater operator control over spectrum access

3G, Wi-Fi, and Wi-Max Comparison

	3G	Wi-Fi	Wi-Max
End user equipment	Mobile devices	Laptops & portable devices Wi-Fi capability can be added to mobile devices	Laptops, portable devices & fixed computing devices
Spectrum used	Licensed bands below 3 GHz	Unlicensed bands up to 5 GHz	Licensed or unlicensed bands up to 11 GHz
Network platform	Mobile wireless networks	Extension of DSL/cable networks (hotspots, WLANs, home office) Some WISP networks	Fixed wireless networks WISP networks
Signal range	5-10 miles	100 meters or less	3-5 miles (non-line of sight) Up to 30 miles line of sight
Data speed	144-344 kbps (mobile) 2 Mbps (stationary)	Up to 11 Mbps Higher-speed variations being developed	Up to 75 Mbps

Potential Broadband Platforms and Combinations

- Wireline Platforms
  - DSL
  - Cable modem
  - BPL (broadband over power lines)
- Wireless Platforms
  - Wi-Fi
  - Wi-MAX
  - 3G wireless
  - Ultra-Wideband
  - Satellites
  - Millimeter wave bands

Thank You!

- For more information
  - FCC website: www.fcc.gov
  - WTB website: wireless.fcc.gov
  - Commissioner Adelstein's website: www.fcc.gov/Commissioners/Adelstein

Thank you!

Questions?