Enabling National Public Safety Interoperability with Commercial Wireless Broadband Solutions in the 700 MHz Band

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Outline

Wireless Network Trends

- Public Safety vs. Commercial

The Commercial Broadband Wireless Revolution

Market-driven Technological Innovation

Adapting Commercial Broadband Technologies for Public Safety

Enhancements to Meet Public Safety Requirements

National Capital Region Regional Wireless Broadband Network

The New Public Safety 700 MHz Band and Its Impact on the Future of Public Safety Wireless Communications

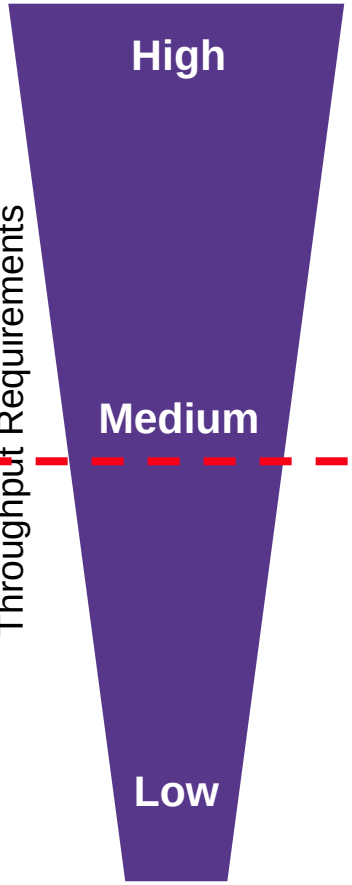
- Nationwide, interoperable Public Safety Broadband Network based on common, commercial, broadband technology

Wireless Networks for Public Safety Today

- Narrowband circuit-switched
  - 25 kHz → 12.5 kHz → 6.25 kHz
- Proprietary Solutions, No Scale Economies
  - "Single-vendor interoperability"
  - Project 25 standard
- Push-to-talk Group Voice
  - Limited use of user-to-user voice

- Wide Area Data @ <10 kbps data (if at all)
- Use of Commercial Wireless Service for non-mission critical services
- Re-banded Local Area Network Technologies in Public Safety 4.9 GHz Band
  - Hot Spot LAN coverage
  - Limited Coverage, Many Access Node Muni-WiFi Networks

Public Safety Wireless Data Needs*



Full-Duplex Video Conferencing

Near-Real-Time Video Streaming

Bulk File Transfer

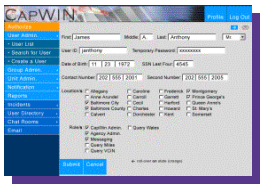
Email

Web Browsing

Device Status/Telemetry <10 kbps

Remote Database Access

Automatic Database Transactions



Geolocation

Instant Messaging

*"Statement of Requirements for Public Safety Communications & Interoperability," SAFECOM Program, Department of Homeland Security, Version 1.2, October, 2006

Public Safety Data Needs Can Not Be Met with Current Wide Area Public Safety Technologies

Commercial Wireless Networks Today

Circuit voice, packet data

- Data speeds in excess of 3 Mbps (peak) today

Open Standards, True Multi-Vendor Interoperability

- Commercial Scale Economies
  - >2 Billion users globally; ~1 public safety user for every 100 commercial customers

Backward Compatible Technology Evolution

Wide RF Channel Bandwidths

- 1.25 MHz, 5 MHz today → Evolution to 20 MHz and Higher
  - Higher Data Rates, Spectral Efficiencies

Point-to-point voice and data

- Technologies support broadcast

Migration to All-IP Networks

Commercial Wireless Technology Revolution

	1st Generation (1G) →	2nd Generation (2G)	(2.5G) Packet Data (~100 kbps) →	3rd Generation (3G) →
Voice	Circuit-switched Voice (Analog)	Med Capacity Circuit-switched Voice (Digital)		Higher Capacity Ckt & Pkt-switched Voice (Digital)
Data		**Low-speed Circuit and Packet Data without Quality of Service (~10 kbps)** Short Message Service Email (Text) Lightweight Client-Server Apps		**High-speed Packet Data with Quality of Service(> 1Mbps)** Email (with attachments) Web Images Video VoIP Music Downloads Enterprise Network Access
	Expensive Service Spotty Coverage	Moderately-priced Service Good Coverage		Low-cost Service Ubiquitous Coverage Wireline Replacement
	1980	**1990**		**2000**

Factors Driving the Commercial Broadband Revolution

Billions of Customers

Competition Between Service Providers

- Low Cost, High Capacity Voice
- New Services (Differentiation) → Demand for Higher Bandwidths/Capacities

Limited Spectrum

- Leverage Large Investment in Existing Spectrum Licenses

Huge Investment in Network Infrastructure

- Backward Compatibility, Re-Use of Existing Equipment

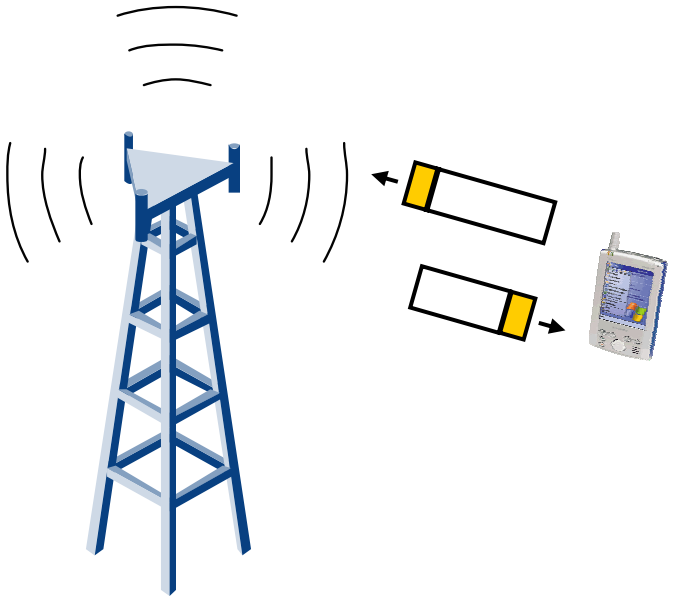
Global Standards

- Intense inter-vendor competition, competition between standards
- Scale Economies, Ecosystem

Devices

Commercial Broadband Wireless Innovations

Commercial Innovation: All IP Networks



Over-the-Air IP Header Compression
Inter- and Intra-User Quality of Service
Optimizations for:
- **VoIP**
- **Push-to-Talk**
- **Video**

Broadcast Multicast Service
…
It's all data…

Support of All Applications (voice, video, data) on a Common Technology

Commercial Innovation: Devices & Scale Economies (e.g., cdma2000)

1,079 user devices currently on the market (184 supporting 1xEV-DO today)

Handsets

Personal Digital Assistants

Wireless Modules

PCMCIA Cards

Ruggedized PCs

Wireless Modems

- **Built-in cameras**
- **Global Positioning Satellite (GPS) capabilities**
- **Color displays**
- **Common-off-the-shelf equipment can be ruggedized for use by first responders**

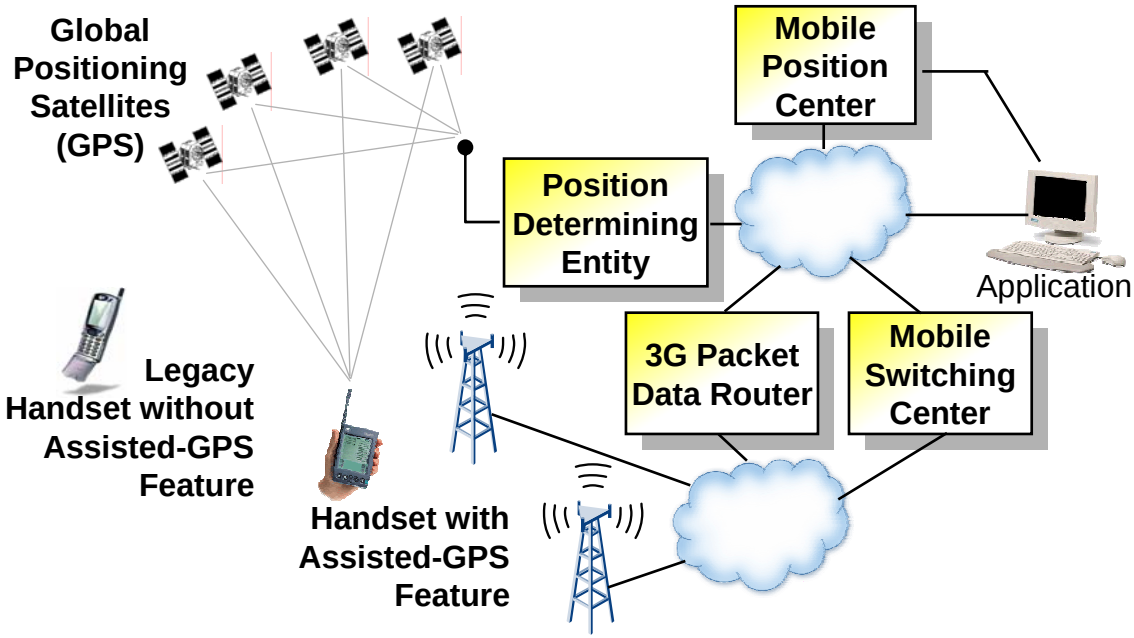
69 user device manufacturers

AirLink, Amoi, AnyDATA, Axesstel, BenQ, Benten, Casio, CEC, Cellvic, Commerciant, Compal, Curitel, Cyberbank, Cyberlane, Cypress Solutions, Daxian, eAnywhere, Ericsson, Gava Plus, Giga Telecom, Growell, GTRAN, Haier, Hanwha, Hisense, Hitachi, HP, Huawei, Intermec, Kyocera, Land-Cellular, LG, Maxon Australia, Mobile Compia, Modotel, Motorola, Movistar, Multitech Systems, National Semiconductor, Nokia, Novatel Wireless, PalmOne, **Panasonic**, Research In Motion, Samsung, Sanyo, Sanyo Tottori, Sewon Telecom, Sierra Wireless, SK Teletech, Skyworks, Sony Ericsson, Soutec, Synertek, TCL Mobile, Telson, Telular, Topex, Toshiba, Ubiquam, UTStarcom Audiovox, Vacom, VeriFone, Via Telecom, VK Corporation, Wavecom, Yiso Telecom, ZTE

Commercial Innovation: 3G Geolocation

Network Determines Best Method to Find Mobile

- **Backward compatibility with legacy devices**
- **Technique selected depends on device, network capabilities**



Handset-based techniques
- **50m (67% of calls)**
- **150m (95% of calls)**

A-GPS

- **Network-based techniques**
  - **100m (67% of calls)**
  - **300m (95% of calls)**

A-GPS Fallback, Legacy Handsets

Alcatel-Lucent: 3G Wireless for Public Safety

Bring the Benefits of Commercial Wireless Technologies to First Responders…

Unified communications infrastructure shared across cooperating public safety agencies

Services that enhance public safety mission effectiveness

Seamless Interoperability between Legacy Public Safety Radio and Commercial Wireless Technologies

Ruggedized dual-mode user devices

While Leveraging Existing Investment in Public Safety Radio Infrastructure and Training

Commercial Wireless Enhancements for Public Safety

Multi-level Priority Support

- End-to-end (pre-emptive) priority support for mission-critical services

Broadcast Multicast Service

- Streaming video, audio

High Capacity Uplink

- Video streaming

Fast call setup

- ~½ second Push-to-talk call setup times

System Hardening: Devices, Network

Communication In Absence of Fixed Infrastructure

- Deployable Equipment

National Capital Region Wireless Broadband Network

3G Commercial Technology (cdma2000 EV-DO Rev A) in Public Safety 700 MHz Band

- Multi-agency, multi-jurisdiction (DC, MD and VA) ~35K users across 18 jurisdictions
- Initial Operation (FCC Waiver)
  - Same 2x1.25 MHz Channel Used in Every Sector
  - Engineered Coverage (for in-vehicle)
    - Downlink 306 kbps/Uplink 153 kbps (95% coverage)
- Applications: Video, Digital Imaging, Automatic Vehicle Location, Computer Aided Dispatch, Email, Mapping/GIS, Remote Database Access, Report Management System, Text Messaging, Telemetry/Remote Diagnostics
- March 2007: First Broadband Public Safety 700 MHz Two-Way Video Call

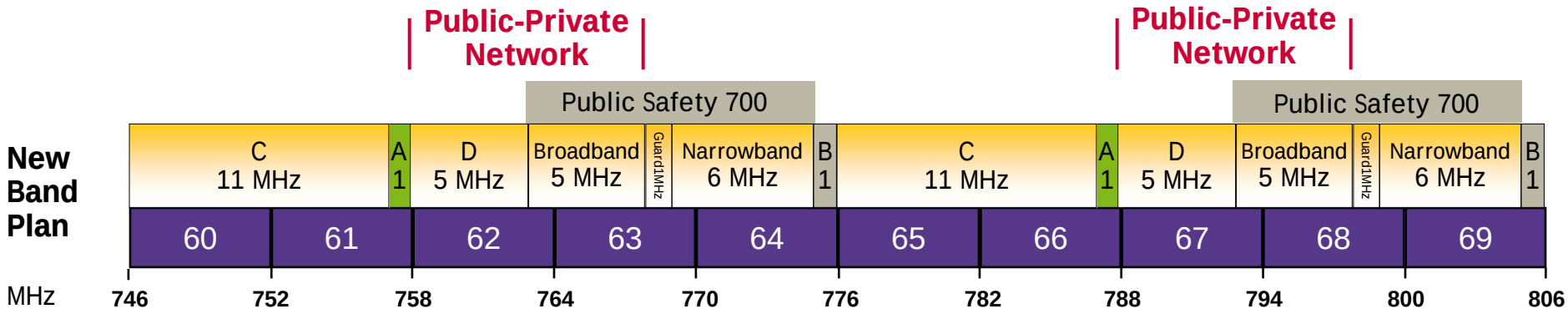
Alcatel-Lucent Deploys Nation's First Public Safety 700 MHz Broadband Network

Public Safety 700 MHz

Public Safety 700 MHz

1997	Congress Allocates 24 MHz of 700 MHz TV Spectrum to Public Safety
1998	FCC Specifies Narrowband + Wideband Public Safety 700 MHz Channel Plan
2005	Congress sets Feb 17, 2009 Clearance Date for 700 MHz Spectrum
	DHS/NTIA Report asks FCC to Investigate Whether Public Safety 700 MHz Band Should Accommodate Broadband
2006 - 2007	FCC Solicits Input on Changes to the Public Safety 700 MHz Band, and other portions of the band
Aug 10, 2007	FCC Revises Public Safety 700 MHz Band Plan, Public-Private Public Safety Network Based on State-of-the-Art Commercial Broadband Technologies

Licensing (Public-Private)



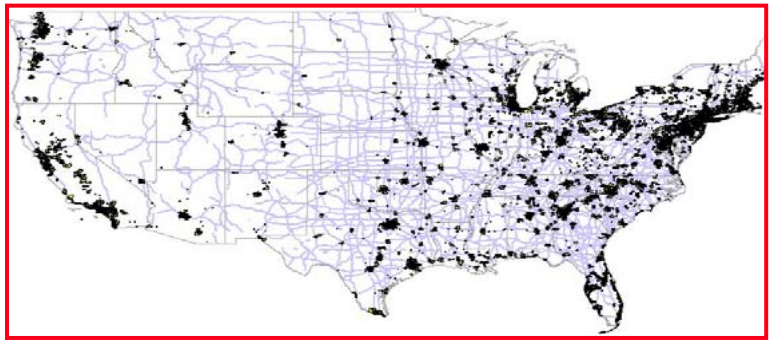
Public Safety Broadband Block

- Single, Nationwide Public Safety Broadband Licensee
- FCC Ends Regional Licensing Regime used for Narrowband spectrum
  - Regional Planning Commissions don't control broadband spectrum

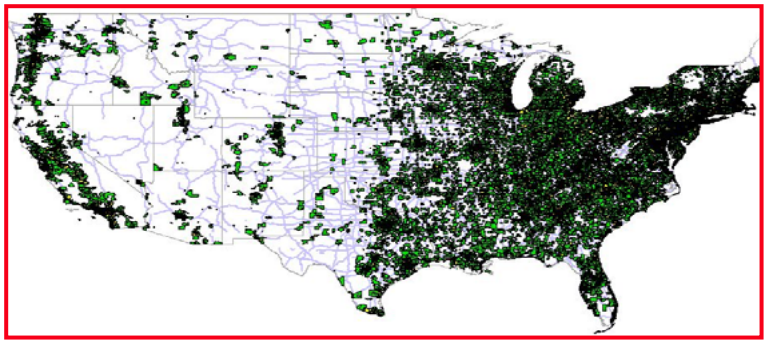
D-Block

- Auction of a Single, Nationwide License with encumbrances
  - D-block winner must build Public-Private Public Safety Broadband Network
  - Public Safety Broadband Licensee negotiates Network Service Agreement on behalf of ALL public safety users/agencies

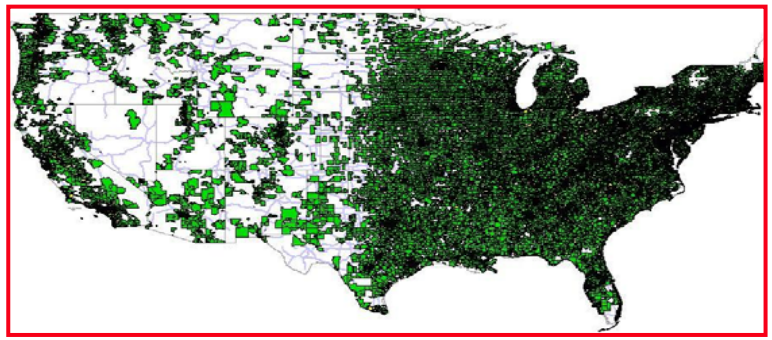
Public-Private Network Buildout Requirements



75% of US Population by 2013



95% of US population by 2016



99.3% of US population by 2019

Actual Rollout Schedule to be Specified in Network Sharing Agreement

Alcatel·Lucent

Public-Private Network Services for Public Safety

"Broadband Technology Platform supporting mobile voice, video and data…seamless interoperability…platform should include state-of-the-art technologies reasonably made available to the public safety community High Speed Data"

- Voice, Video, Data
- Push-to-Talk
- 1-to-1 and 1-to-Many Communications
- Handset with Satellite Capability

Spectrum Auction to Begin Jan 16, 2008

Public Safety Devices Envisioned for Public-Private Network

PCM/CIA Cards

Ruggedized External Modems

PDAs (non-ruggedized)

Ethernet Bridges

Ruggedized PCs with internal modems

Ruggedized Public Safety Handhelds (without satellite)

Ruggedized Public Safety Handhelds (with satellite)

New (Market-Driven) Devices ?

Public Safety Network of the Future

Commercial, Open-Standard Broadband Technology

- Leveraging Commercial Technology Innovation today and into the future

Support of All Envisioned Public Safety Applications

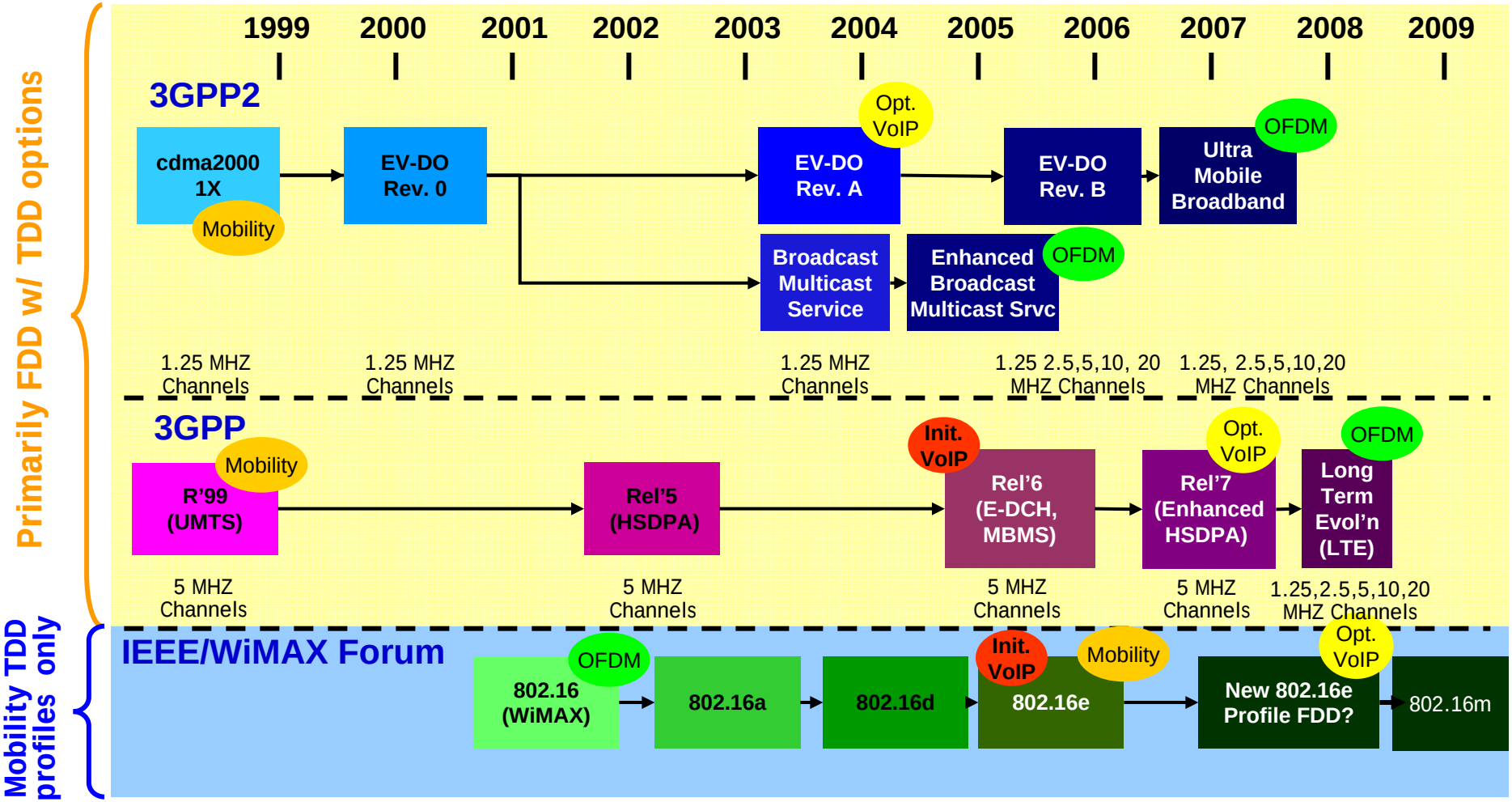
- Voice, video, data

Shared Spectrum, Shared Infrastructure

Lower-cost User Devices, Multi-vendor, Multiple Form Factors

Seamlessly Interoperable Nationwide Network for our Nation's First Responders (Finally!)

Standards Evolution: Commercial Broadband Technology



Note:

- **Dates shown are standards completion dates** (or expected completion dates). Initial deployment lags standards by >1-3 years.
- "Initial VoIP" not as spectrally efficient as "Optimized VoIP". "Optimized VoIP" for 802.16 is TBD.
- "Mobility" indicates when each particular standard supports mobility inter-operability between the terminal and BTS.