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*

High

- Full-Duplex Video Conferencing
- Near-Real-Time Video Streaming
- Bulk File Transfer
- Email

Medium

- Web Browsing
- Device Status/Telemetry <10 kbps
- Remote Database Access
- Automatic Database Transactions
- Geolocation

Low

- Instant Messaging

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

<table>
<thead>
<tr>
<th>1st Generation (1G)</th>
<th>2nd Generation (2G)</th>
<th>3rd Generation (3G)</th>
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<td>(2.5G)</td>
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<td>Packet Data</td>
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<td>(~100 kbps)</td>
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<td><strong>Voice</strong></td>
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<td>Circuit-switched</td>
<td>Med Capacity</td>
<td>Higher Capacity</td>
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<td>Voice (Analog)</td>
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<td>Ckt &amp; Pkt-switched</td>
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<td>and Packet Data</td>
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<td>Short Message Service</td>
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<td>Email (Text)</td>
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<td>Music Downloads</td>
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<td>Enterprise Network Access</td>
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<td><strong>Data</strong></td>
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<td>Expensive Service</td>
<td>Low-cost Service</td>
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<td>Spotty Coverage</td>
<td>Ubiquitous Coverage</td>
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<td>Good Coverage</td>
<td>Wireline Replacement</td>
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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

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)

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

Seamless Interoperability between Legacy Public Safety Radio and Commercial Wireless Technologies

Services that enhance public safety mission effectiveness

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)


- 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
FCC Specifies Narrowband + Wideband
Public Safety 700 MHz Channel Plan

1998

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
FCC Revises Public Safety 700 MHz Band Plan, Public-Private Public Safety Network Based on State-of-the-Art Commercial Broadband Technologies

Aug 10, 2007
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
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.