BROADBAND

Transitions

- An evolutionary trip through time

LEADING THE PUBLIC SAFETY COMMUNICATIONS COMMUNITY

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4TH ANNUAL WINTER SUMMIT
Connect, Collaborate and Communicate
February 12-14, 2007 | Florida Mall Hotel | Orlando, FL

2007 WINTER SUMMIT ORLANDO FLORIDA

In the Beginning

There Was Broadband Spark Gap

- Propagation of electromagnetic waves
  - Predicted in 1862 – James Maxwell
  - Verified by Heinrich Hertz
- 1888 - First spark gap transmitter (and receiver)
- 1891 - Nikola Tesla U.S. Patent 447920
  - First use of tuned “resonant” circuits
  - Magnified the signal
- 1901 - Guglielmo Marconi
  - First Transatlantic transmission

Broadband was Born

•But lacked essential efficiency

In the Beginning

- One very broad signal carrying a single content
- By 1906 the band width was reduced to 750 kHz
- Vacuum tubes brought the end to spark gap and similar spark technologies
  - 1907 - Lee De Forest developed the triode
- The movement up the technology ladder had begun
- FM – Frequency Modulation
  - The typical technology behind the common land mobile radio
  - 1935 - Edwin Armstrong
  - WWII technology developments enable practical equipment
- Drive for efficiency

State of Public Safety Comms

- Evolutionary history of mobile radio communications
  - Moving up the spectrum ladder
    - Low band 30-50 MHz
    - High band 150-170 MHz
    - UHF 450-512 MHz
    - 800 MHz
    - 700 MHz
  - Drivers
    - Following the technology curve
    - Need for more spectrum

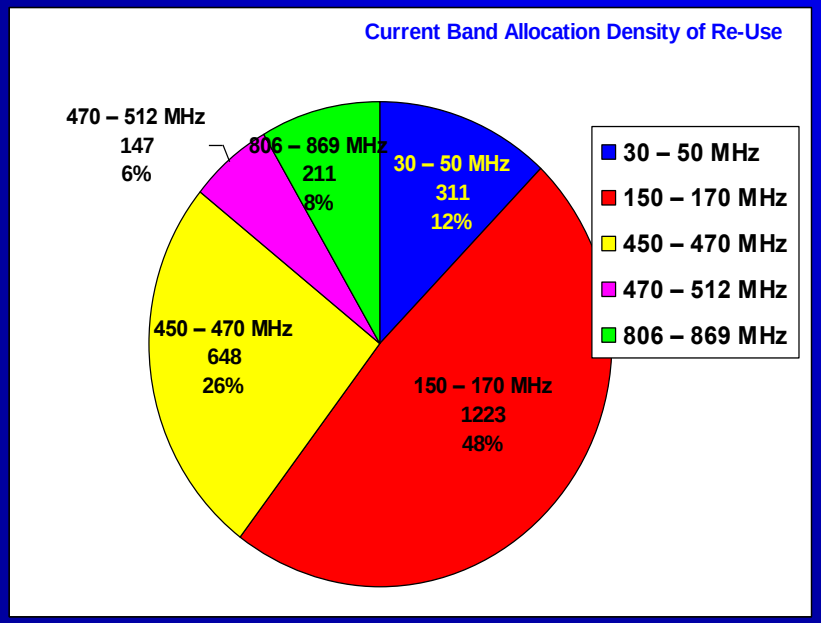
State of Land Mobile Radio

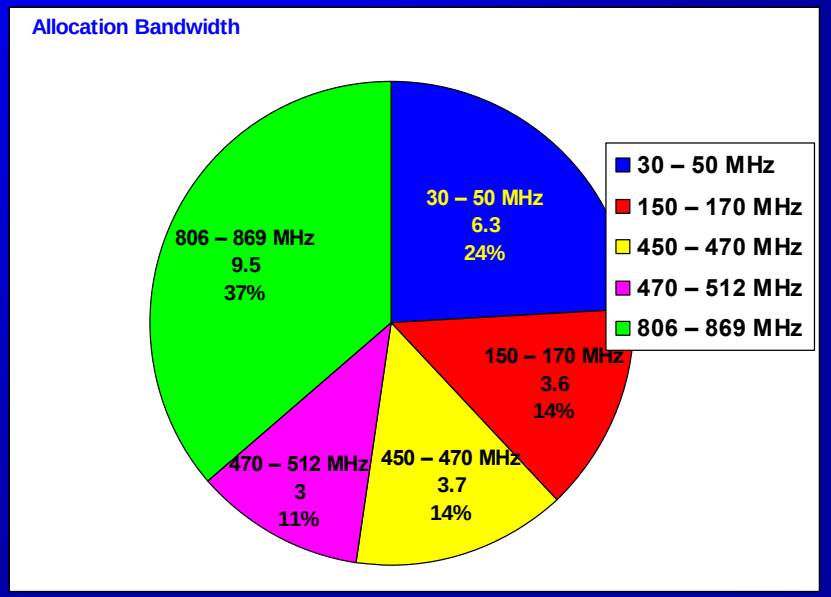
- Evolutionary history
  - 65 year love affair with frequency modulation
  - Technical development
    - Increased number of channels
    - Duplex pairing (repeaters)
    - Simulcast
    - Trunking
    - Narrower channels
      - (Capacity equals channel numbers???)

Becoming More Efficient

Public Safety Likes High Band VHF

Density of use vs. actual allocated bandwidth of the various popular public safety allocated frequency blocks.





Density of use based on FCC data for the number of times any given frequency is reused times the typical channel bandwidth. **11,205 MHz**

Number of individually allocated channels times the typical channel bandwidth. **26.1 MHz**

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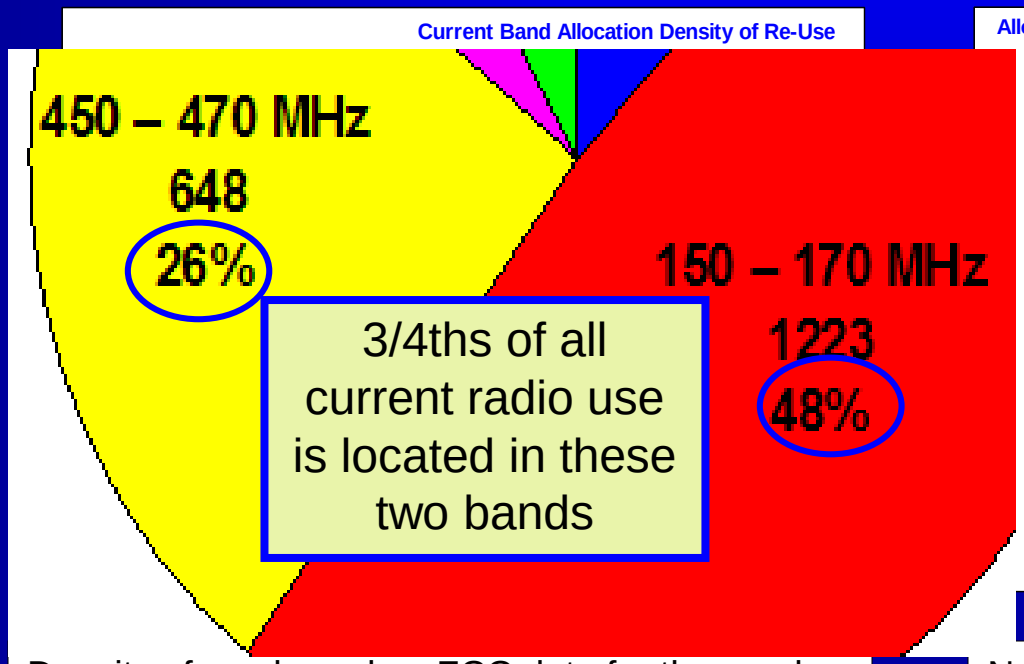

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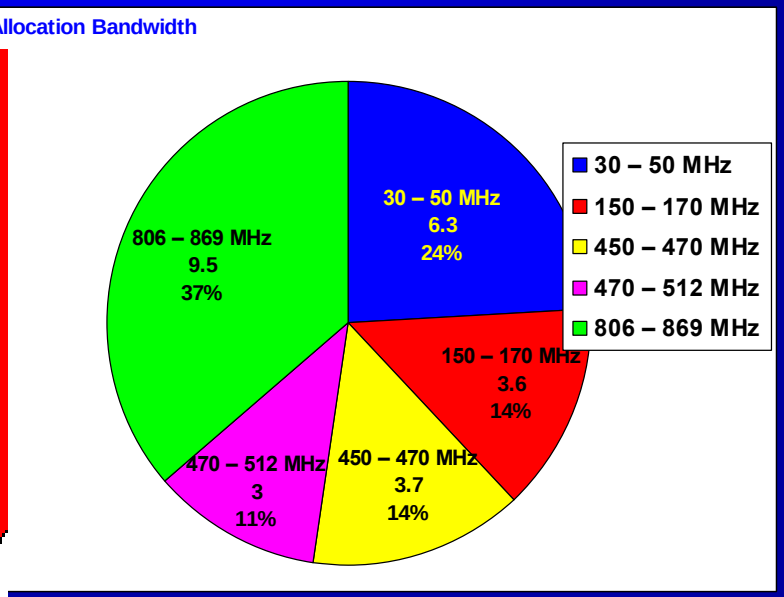

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Public Safety LMR Spectrum Use

- **80%** of Public Safety spectrum in ***ACTIVE*** use for land mobile radio operation is limited to **7.3 MHz** of allocated spectrum
  - Mostly high band VHF (50%) and UHF (25%)
  - Compare - One analog TV channel uses 6 MHz of spectrum.
- 800 MHz use is only 8% of total actively used spectrum
  - Lower coverage area density efficiency
  - High application/user density efficiency
- 700 MHz brings 24 MHz of additional bandwidth
  - Lower coverage area density efficiency
  - High application/user density efficiency
  - Half reserved for wide/broad band new technologies
- 4.9 GHz brings 50 MHz of additional bandwidth
  - Hot spot broadband high density use

State of Public Safety Comms

- Public safety drives the technology
  - Most classic radio feature sets
  - Until the last 10-15 years
- Industry and the public "*discover*" WIRELESS
  - Cell phones and other devices
    - Expansion of
      - Size/Cost reduction
      - Convenience
      - Coverage
      - *Convergence of Features/Applications*
  - High speed wireless data
    - ***Features/applications unleashed***

State of Public Safety Comms

- From technology driver to technology follower
  - PS can no longer drive the unique technology it needs to deliver the required grade of service
  - Limited cost incentives for vendors (features)
    - Limited economy of scale ($$$)
  - Glacial public safety implementation
    - Planning, development and procurement time lines
    - Deeply imbedded bureaucracy
  - Light speed commercial industry development
    - Applications
    - Functional convergence
    - Life cycles
    - Private capital investment
    - Significant economy of scale

State of Public Safety Comms

- ***Why does public safety communication require something different?***
  - A critical component to classic public infrastructure
    - Needed to support
      - Roads/bridges
      - Schools
      - Utilities
      - Police/fire/EMS
      - Safety of life and property
      - Virtually all basic required/expected functions of classic pillars of public infrastructure
      - Sanctity of life
- A cost we must pay

Transition for Public Safety

- From individual systems to shared systems
  - Stovepipe channelization to trunking and TDMA infrastructure based systems
- Mobile data
- Increasing use of commercial wireless
- Exclusive broadband/wideband wireless spectrum
  - 4.9 GHz
  - 700 MHz

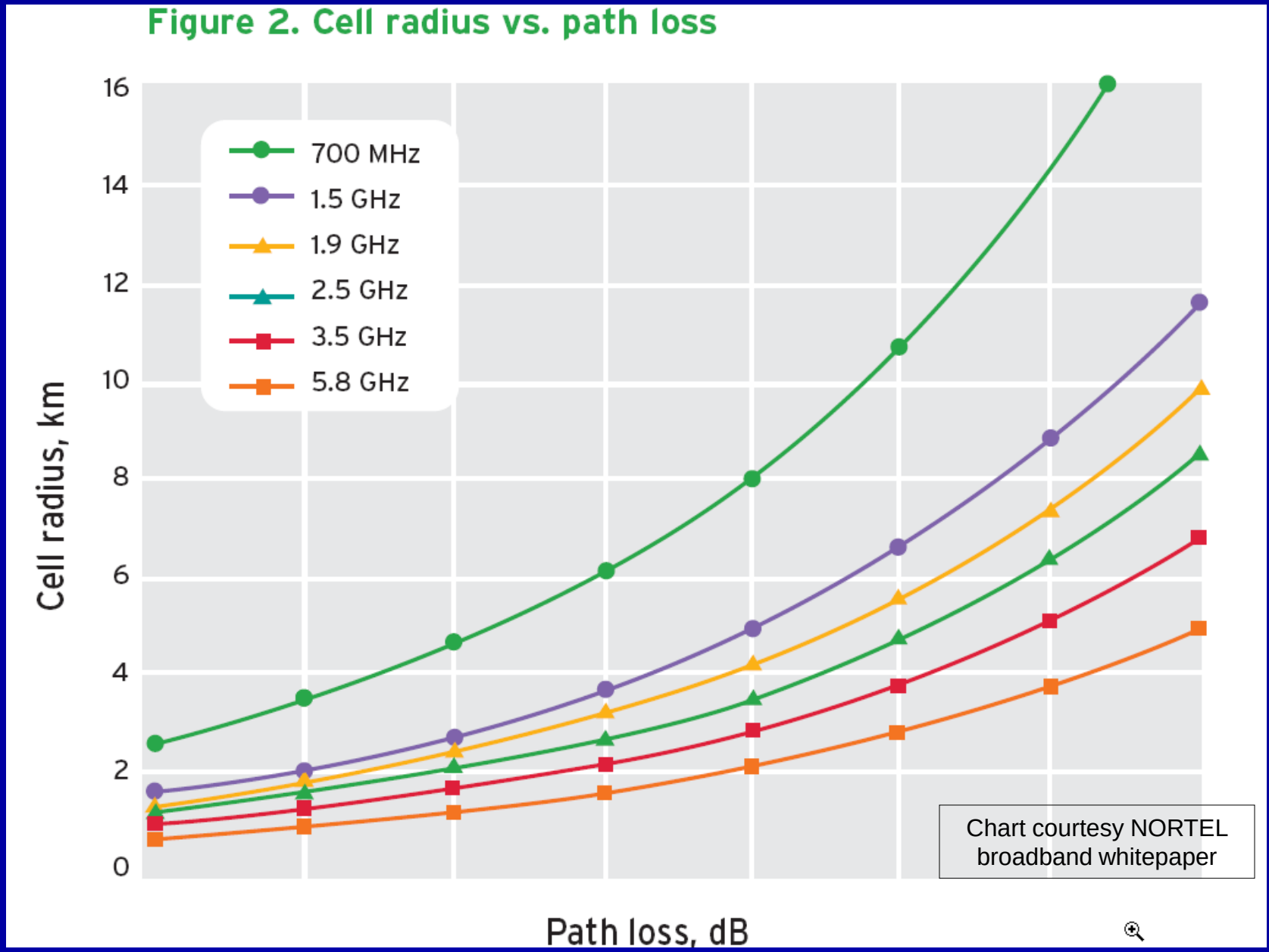
Future of Public Safety Comms

- Leverage the developments of commercial industry
- Develop use for spectrum that capitalizes upon commercial products
- Retain "***Public Safety Grade of Service***"
  - Robust, reliable "physical plant"
  - Coverage
  - Priority access
  - Interoperability

Future of Public Safety Comms

- 4.9 GHz
  - 50 MHz of bandwidth
  - Public safety's version of Wi-Fi
    - Exclusive frequencies
    - Emission masks compatible with commercial deployments
- 700 MHz – From TV digital transition
  - 24 MHz of bandwidth
  - Ch 63, 64, 68, 69
    - Narrowband digital voice – 6.25 kHz (or equivalent) channelization - 12 MHz BW
    - Wideband data 50 kHz to 150 kHz channelization - 12 MHz BW

Note: PS currently has approximately 26 MHz of band width pre-existing in spectrum allocations below 1 GHz, however, 80% of PS active operation is currently conducted in less than 8 MHz of bandwidth.



Value of 700 MHz

Future of Public Safety Comms

- 700 MHz
  - 2001 Rules for wideband data 50 kHz to 150 kHz channelization - ***Bypassed by technology???***
  - 2006 FCC Eighth NPRM
    - Address the possibilities of other channelization which could provide true ***Broadband*** capabilities.
      - http://gullfoss2.fcc.gov/prod/ecfs/comsrch_v2.cgi
        - Under proceeding, enter “96-86”
    - APCO/NPSTC – Flexibility to plan for 50 kHz up to 1.25 MHz bandwidth (or more?)
    - Access and other’s proposals

Future of Public Safety Comms

- 700 MHz - Other proposals
  - Public Safety Broadband Trust
    - Petition by Cyren Call
    - Recover 700 MHz scheduled for FCC auction
      - 30 MHz of bandwidth (pulled from auction)
      - Held in public safety trust
      - Leased to commercial service providers
      - Installed with "**Public Safety Grade of Service**"
      - Secondary access to public via commercial carriers
        - (primary cost recovery)

http://www.apcointl.org/frequency/broadband.htm

Future of Public Safety Comms

- 700 MHz - Other proposals
  - Access Spectrum – “Broadband Optimization”
    - Realignment of currently allocated 700 MHz including:
      - Band manager spectrum
      - Guard Bands
      - Possible realignment of PS 700 MHz
        - 24 MHz of band width channelized to accommodate narrowband, wideband and broadband

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Future of Public Safety Comms

- "Broadband Optimization"

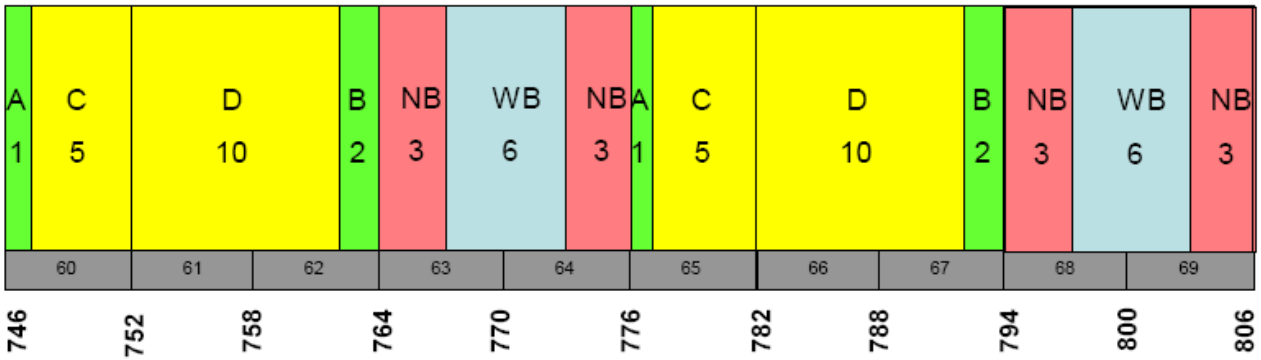

Figure 1 Current Upper 700 MHz Band Plan

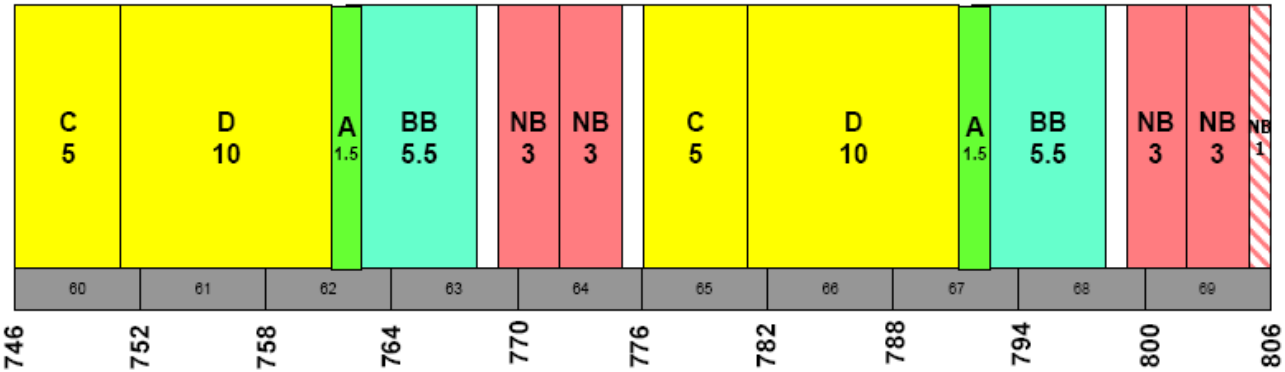

Figure 2 Broadband Optimization Plan

Future of Public Safety Comms

- 9th NPRM – FCC sponsored
  - 12 MHz of current public safety 24 MHz allocation
  - Single National Licensee – non-commercial
  - National system based on commercial technology
  - Lease channels to commercial for funding
    - Ruthless pre-emption
    - Potential shared systems with commercial carriers with criteria

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Future of Public Safety Comms

- M2Z 2155-2175 GHz
  - National Broadband Radio Service
  - “Free” to public safety
  - FCC accepts for filing 01/31/2007

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Future of Public Safety Comms

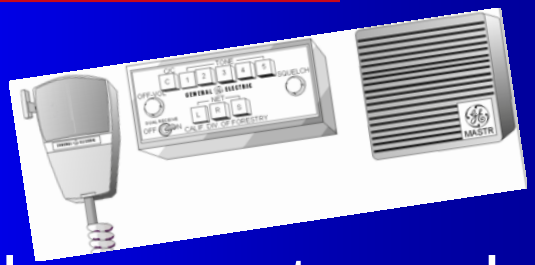
- Others
  - The rest of current commercial broadband providers "wireless broadband", Wi-Max, etc.
  - Mobile Data applications
    - Conversion from CDPD to EVDO etc.
  - Commercial convergence of ALL media applications on many wireless platforms.

Future of Public Safety Comms

- Challenges for the future
  - Coverage
  - Control
  - Security
  - Priority
  - Applications
  - Management
  - Interoperability
    - Direct mode capability outside of infrastructure level
  - Reliability
  - Redundancy
  - Cost

Demand **Public Safety Grade of Service**

Challenge for Mobile Comms



- 65 years ago
  - We had a box under the dash where we turned a knob to select with whom we want to talk
- Today and tomorrow
  - We need a box under the dash where we turn a knob to select with whom we want to talk

Questions???

www.apcoafc.org

Look for the Broadband Link

also

PSBroadband discussion E-group

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