

Wireless Enabled Homeland Security

May 15, 2002

FCC Briefing

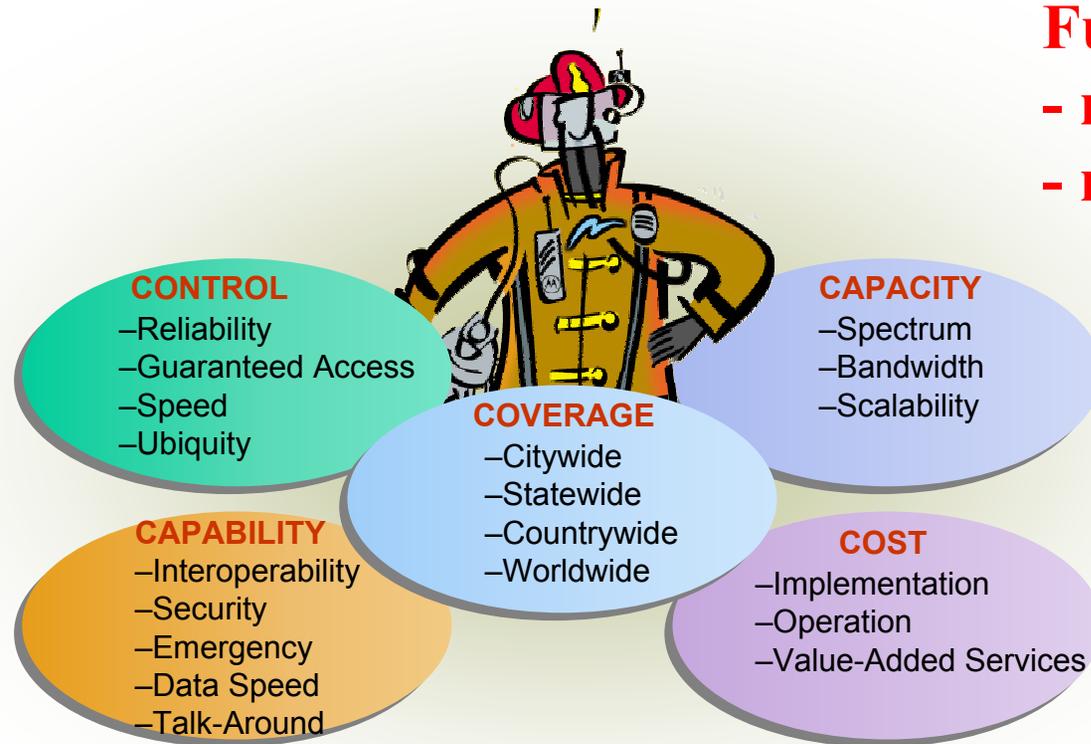
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Public Safety Radio Systems are Designed to Address Key Requirements (5C's)

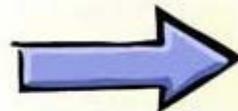
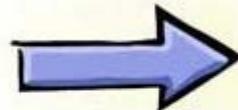
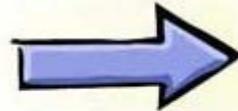
Future directions
- multi-media
- mobile office



Solutions to Evolving Operational User Requirements

Current Needs

- ✓ Priority Access
- ✓ **Fast Access Group Calling**
- ✓ Call Center Support
- ✓ Basic data & messaging
- ✓ Crypto for voice & data
- ✓ Scalable capacity
- ✓ Cost effectiveness for private users
- ✓ Integrated mission critical voice & data networks
- ✓ Future proof



Additional Future Needs

- **Mobile office support**
- Personal Area Network
- High Speed file transfer
- Images - high resolution
- Video - high resolution
- Smartcard solutions
- Advanced browsers & agents
- Advanced speech based email
- Integrated mission critical voice & data applications
- Telematics for public safety



Mission Critical Spectrum, Standards and Applications

	Application	Spectrum		Standards
		licensed	unlicensed	
Narrowband	Up to 9.6 kb/s < 12.5kHz Channels Wide Area Networks Digital Voice Low Speed Data	VHF, UHF, 700, 800,		APCO-25 (U.S.) TETRA (Europe)
	~384 kb/s 150kHz Channels Wide Area Networks Real Time Video Higher Speed Data	700 MHz U.S.		APCO-34 (U.S.) TETRA 2 (Europe) (in process)
Broadband	Up to 54 Mb/s 5-20MHz Channels Local/Personal Area Networks “Hot Spots” Multi-Media Very High Speed Data	4.94-4.99 GHz U.S.	2.4-2.483 GHz (ISM)* 5.15-5.35 GHz* 5.75-5.825 GHz (ISM)*	IEEE 802.11/ 802.15 Bluetooth 802.11a/ HiperLAN ASTM (in process)

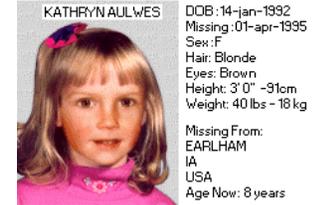
*expected to be congested with interfering devices/standards



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4.9 GHz Broadband Mission Critical Uses



- Voice
- Video
- Information Access



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TV Blocks 700 MHz Public Safety Deployment

- Need to clear both co-channel and adjacent channel TV under FCC rules
- Current clearing deadline is 12/31/06, but current law allows a big loophole beyond that date.
- Canadian 60-69 clearing and a U.S./Canadian agreement is also needed for border areas



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Technology Applications for Homeland Security

How Technology Supports the 5 Key Areas of Homeland Security

Preparedness	Assessment plan, interoperable & secure communications
Detection	Real-time access to crime data bases, rapid decision-support & analysis tools
Prevention	Interoperable communications, information sharing across agencies
Protection	Digital image storage, search & retrieval, mobile access to databases
Response & Recovery	Interoperable communications, information management

5 Key Areas of Homeland Security

Preparedness Review and assess emergency response plans

Ensure preparedness & readiness

Examples:

Coordinate efforts in Washington, DC.

5 agencies responded with their own radios and achieved interoperability with the turn of a knob

“The on scene communications were flawless.”
System Manager, Fairfax County



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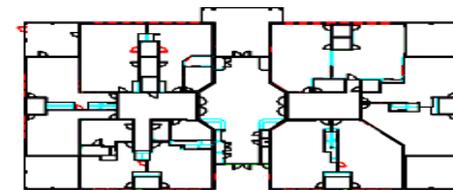
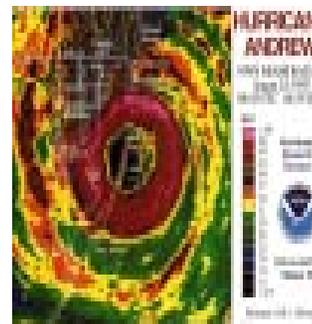
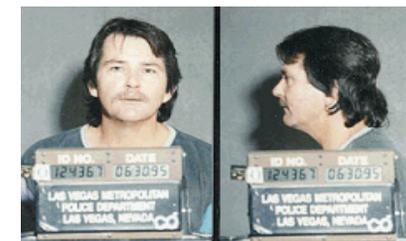


5 Key Areas of Homeland Security

Detection Ensure the dissemination and exchange of information

Examples:

- Real-time wireless access to federal, state and local crime databases
- Mug shot databases
- In-vehicle mapping
- Access to web sites
- Video transfer



5 Key Areas of Homeland Security

Prevention Facilitate the exchange of information across agencies.

Interoperable communications

Examples

- Integrates data within departments, across agencies and between states
- Gather and integrate data for rapid decision-making, analyzing crime trends
- Monitor response times and call loads to adjust patrol areas and street strength



Interoperability – Wireless Voice is Key

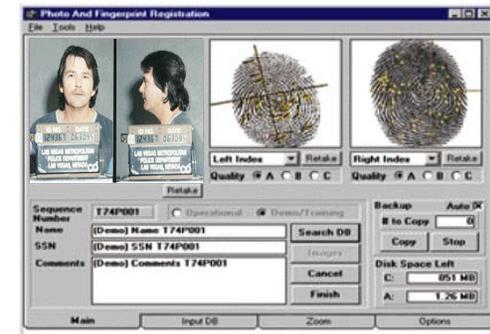
Interop Level	Process	Benefit	Issues	Best Applications
5	Multi-Vendor Multiple Band Roaming (Standards)	<ul style="list-style-type: none"> • Required Std. Exists (P25) • Instant access • Full system features available • Event scale is immaterial • General subscriber operation is similar 	<ul style="list-style-type: none"> • Costly if new system is needed • Region must be operating w/std. • Minimal planning—"out of the box" interoperability • Many—not all—vendors building to standard 	<ul style="list-style-type: none"> • Small to massive scale events • Urban to rural locations • Any band/bands •
4	Vendor-Specific Roaming	<ul style="list-style-type: none"> • Connects multiple types of systems • Full system features available • Full system range 	<ul style="list-style-type: none"> • Requires plan/setup & adv. knowledge of respondents • Costly component with infrequent use 	<ul style="list-style-type: none"> • Medium scale events (3-7 agencies) • Cross band • Limited response areas
3	Gateway (Console Patch)	<ul style="list-style-type: none"> • Connects disparate Systems/bands • Cost efficient • Moderate (1 site) range 	<ul style="list-style-type: none"> • Requires console intervention • Requires planning and additional SW • No advanced features • Multiple systems required • Moderate (1 site) range 	<ul style="list-style-type: none"> • Small to moderate events (2-4 agencies) • Preplanned events (Concert sports, etc.)
2	Mutual Aid Channels	<ul style="list-style-type: none"> • Defacto standard—commonly used • Cost efficient 	<ul style="list-style-type: none"> • Plan/radio programming req'd. • No advanced features • Radio removed fr. home system • Limited range, needs infrastr. • Frequency dependent • Requires conv. & trunk. in radio 	<ul style="list-style-type: none"> • Small to moderate events (2-4 agencies) • Unplanned events (Channel plan required in advance) • Works for urban/rural
1	Talkaround	<ul style="list-style-type: none"> • Simple to implement • Point-to-point • Direct communication • Cost Efficient 	<ul style="list-style-type: none"> • Limited range • Frequency dependent • Requires compatible systems 	<ul style="list-style-type: none"> • Small events (2-3 agencies) • Tactical coordination
0	Swap Radios	<ul style="list-style-type: none"> • Simple to implement • No administration necessary 	<ul style="list-style-type: none"> • Product cross-training required • Slow to setup physical exch. • Limited range • w/o talk-around, multiple systems are required 	<ul style="list-style-type: none"> • Small events (2-3 agencies) • Preplanned events with key players coordinating (Concert, sports, etc.)

5 Key Areas of Homeland Security

Protection Digital image storage, search & retrieval, mobile access to databases

Examples:

- Fingerprint and palmprint capabilities (airport and border security)
- Digital image storage, search and retrieval
- Sharing information among multiple agencies in multiple jurisdictions
- Mobile identification units integrated with the central site



5 Key Areas of Homeland Security

Response & Recovery

Interoperable communications, incident management

Coordinate efforts to ensure rapid restoration of critical infrastructure

Examples

- Transportable communications sites
- Interoperable communications for federal, state agencies on scene



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Public Safety System Design Considerations.... 800 MHz Interference

shortened version of:
CTIA Briefing Feb 8, 2002

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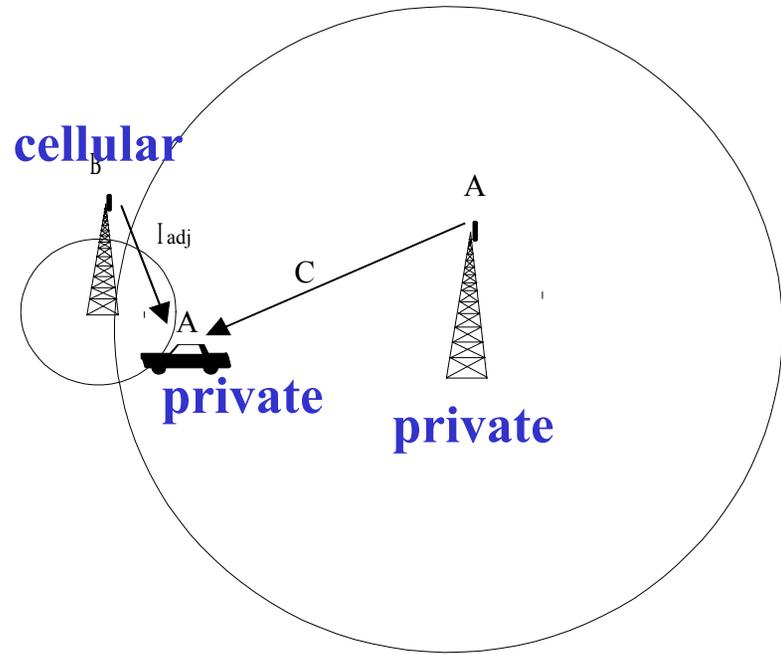


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Near - Far Scenario is a major cause

- Cellular Type Systems can cause Interference with private systems
 - Classic Near-Far Problem
 - Interference Zone around Multi-transmitter Sites
 - Strong Interference Signal and Medium to Weak Desired Signal
 - Frequent Changes to Frequency Plan to increase Capacity
 - Average Power kept high to provide portable in-building coverage

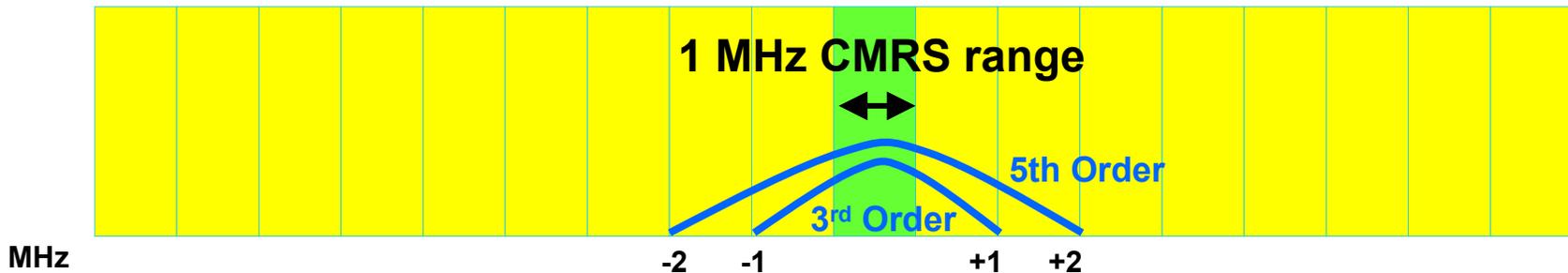


Private unit **far** from desired private site is interfered with when close (**near**) to nearby undesired cellular channel base.

Intermodulation Range is Dependent on the CMRS Frequency Range at a Site

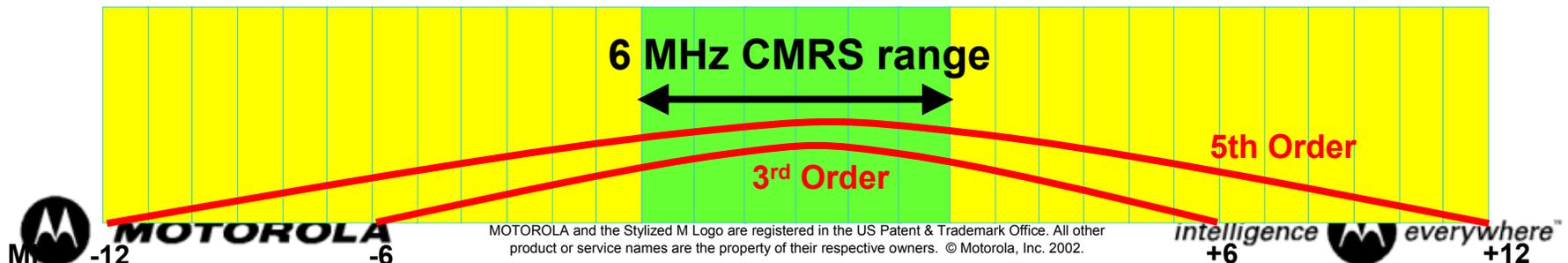
Example A:

If low to high CMRS frequency range is 1 MHz,
Intermodulation interference can range another 1 MHz in each direction for 3rd Order IM,
and 2 MHz in either direction for 5th Order IM

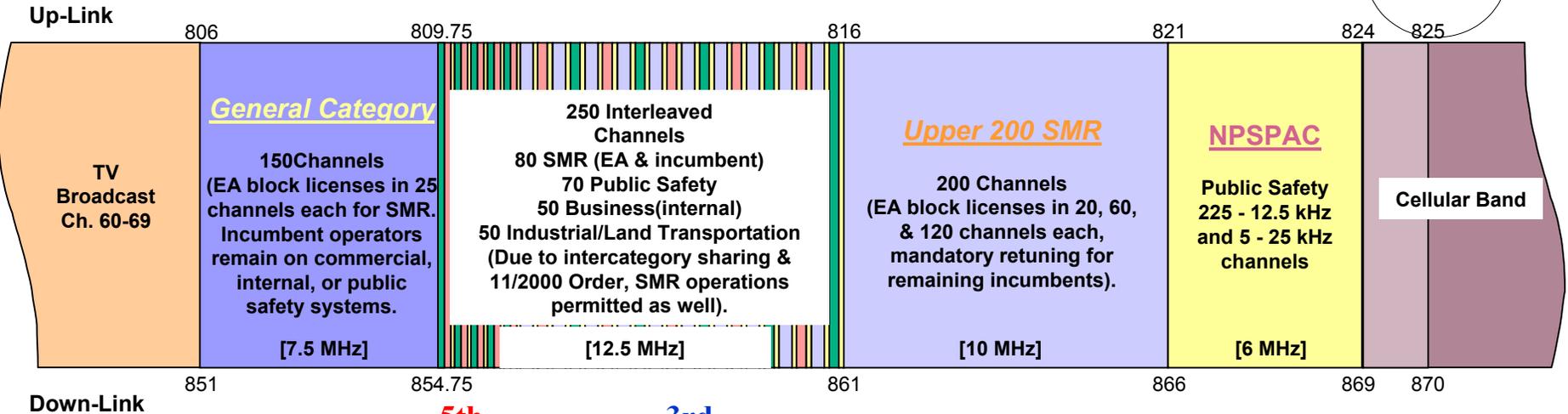
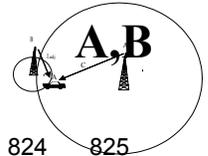


Example B:

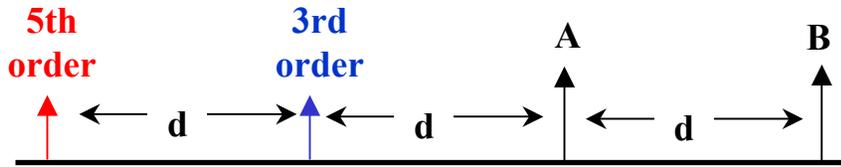
If low to high CMRS frequency range is 6 MHz,
Intermodulation interference can range another 6 MHz in each direction for 3rd Order IM,
and 12 MHz in either direction for 5th Order IM



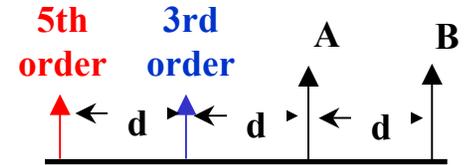
Near - Far Scenario Intermodulation



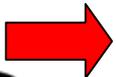
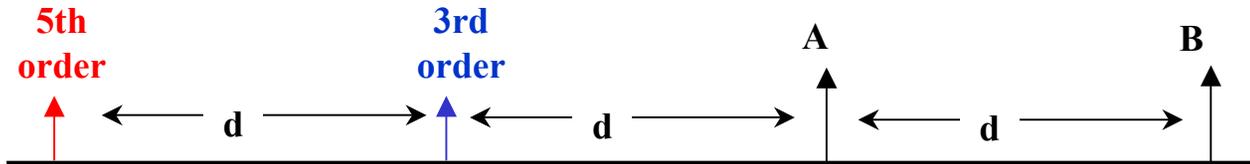
Nextel to Public Safety



Cellular to Public Safety



Co-located Nextel & Cellular to Public Safety



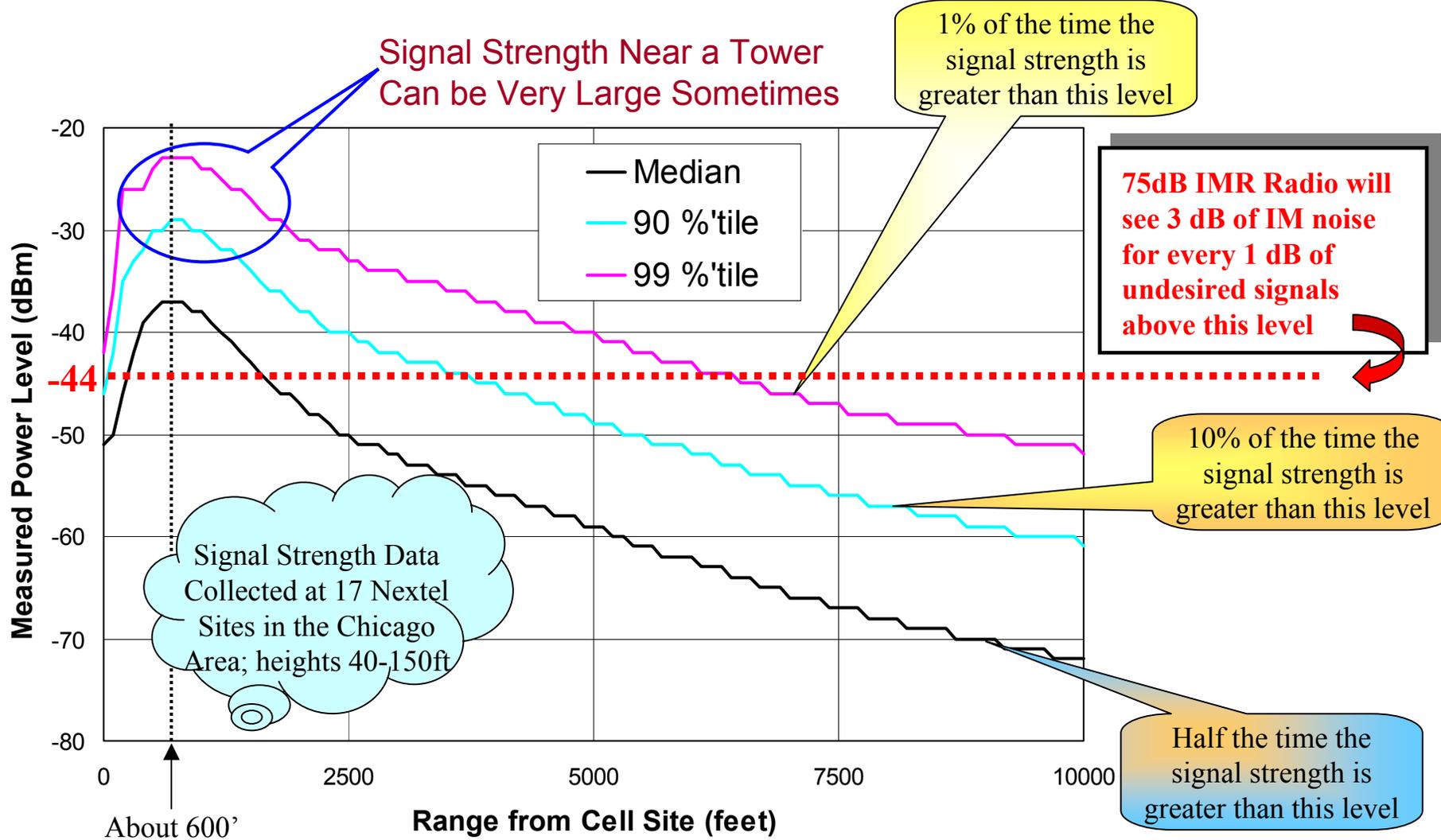
IM products can be sourced from cellular carriers and/or Nextel



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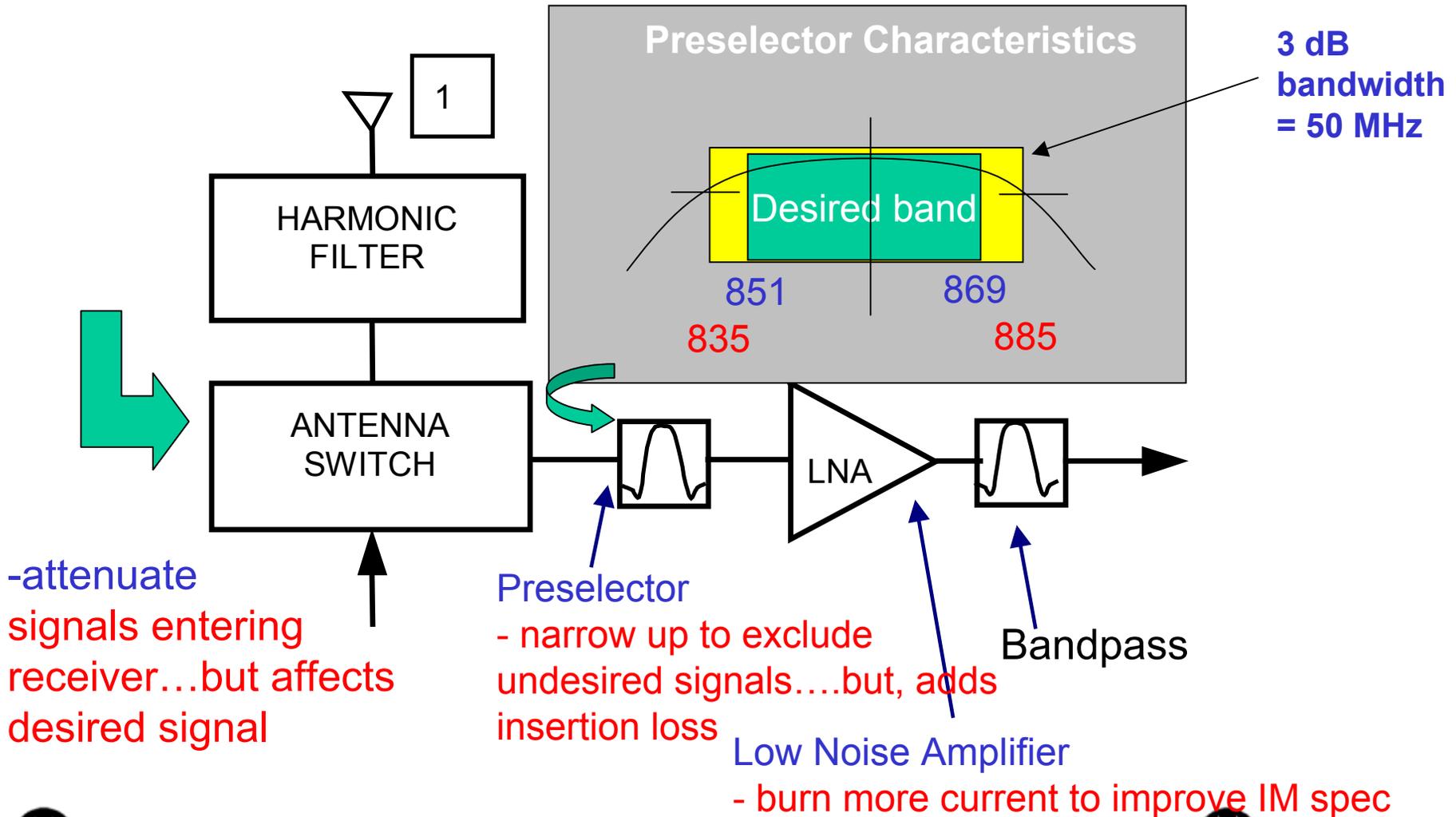


Interference will be Close to Small Cell Tower



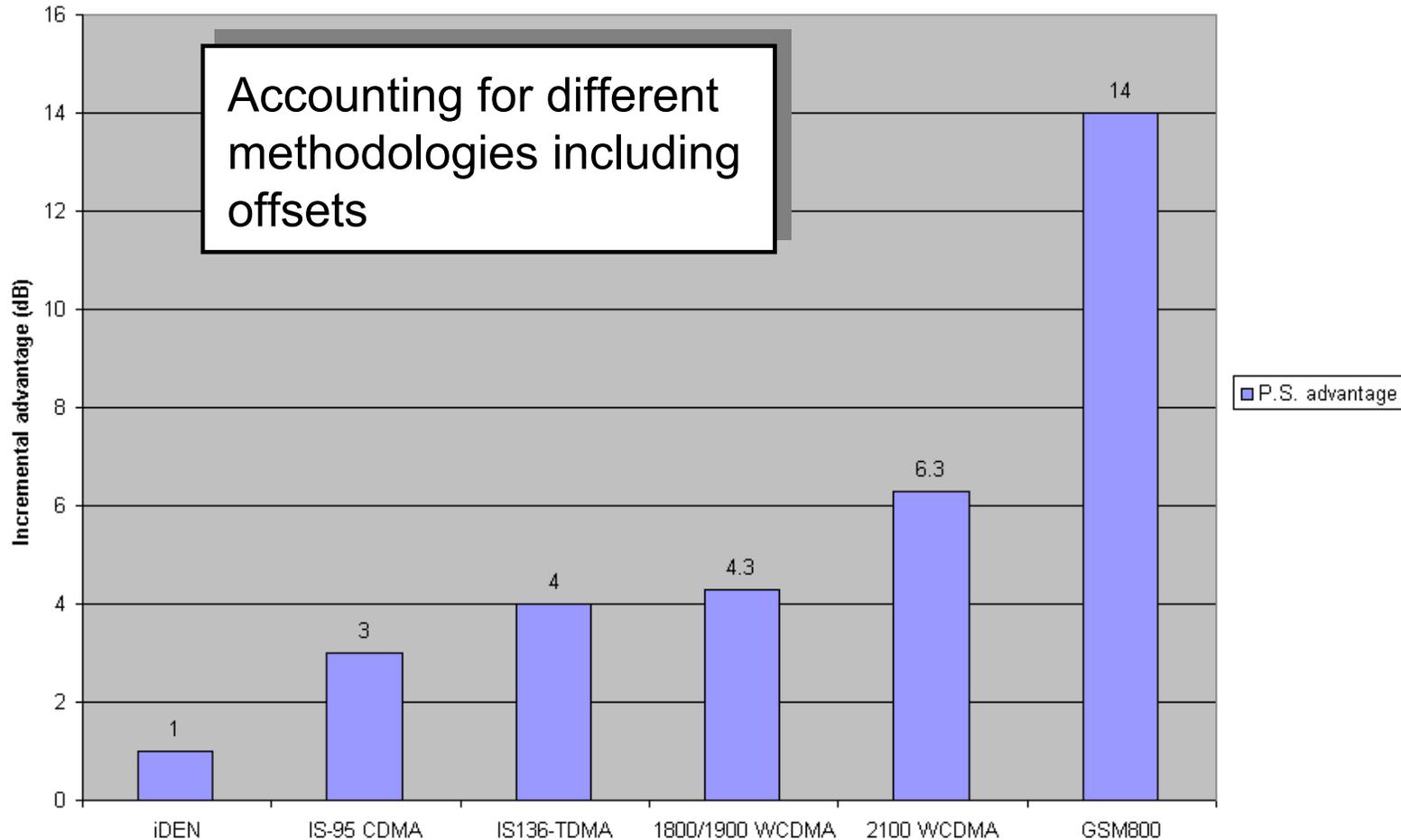
-44 dBm = -119 dBm (12 dB SINAD) + 75dB (IMR)

Potential Receiver Abatement



Low Noise Amp: Public Safety Radios Today are Already World Class Receivers...on a normalized basis as well

Normalized Advantage of a 73 dB IMR Public Safety Radio



Recommendations for Operators

- Perform IM calculations
 - **Select Frequencies to protect private users**
 - **Minimize frequency interleaving (band change?)**
 - **Selective co-location**
- Share site specific frequency data
- Reduce Site ERP when possible
 - **-1 dB = 3 dB improvement of 3rd order IM**
 - **-1 dB = 5 dB improvement of 5th order IM**
- Use auto-tune cavity filters when necessary

Recommendations for Private Users

- Design for Portable In-building Coverage
 - Delivers more desired signal....more immune to interference, but just get 2/3 dB IM improvement for every 1 dB of more desired signal
 - But, challenge is to meet FCC rule of maximum of -94 dBm at edge of service area (the 40 dB μ rule)
- Coordinate with all Carriers
 - Proactively prevent 3rd and 5th order IM combinations
 - Co-locate when IM combinations must be deployed
- Deploy products that meet TIA 102.CAAB (class A recvr)
 - 75 dB IMR for mobiles
 - 70 dB IMR for portables
 - Avoid using external antennas for portables in car operation



Practicalities of Retuning at 800 MHz

- Retuning is more involved than it appears on the surface.
- Some portables/mobiles not economically retunable
 - Insufficient hardware memory capacity for new software
 - Diagnostic tools no longer available
 - Documentation no longer available
 - Would require system-wide software upgrade
- Most base stations are retunable
- Some site work, e.g, filter & antenna changes needed
- Significant trained resources needed to execute quickly



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Interference Realities

- Most interference is intermodulation near CMRS base sites
- When implemented and resourced, combination of zero tolerance and Best Practices normally works
- Rebanding within 800 MHz alone does not solve the interference issues, still need to apply Best Practices
- PS portables have better intermodulation rejection than cellular phones
- ANSI standard a guide for any receiver standards: 70 dB portables; 75 dB mobiles

