SDR Implications for the Public Protection and Disaster Relief (PPDR) Sector

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Briefing Outline

- The SDR Forum's Public Safety Special Interest Group (PS SIG) and its SDR Request for Information.

- Requirements statements for local/national public safety first responders (ambulance, fire and police) - Project 25, Project MESA, TETRA, US Project SAFECOM SoR.

- Intellectual property issues surrounding emerging and legacy PPDR waveforms.

- Transfer of technology from defense sector industries, particularly the US JTRS and associated programs.

- Product testbeds and potential time lines for product introduction into the PPDR sector.

WHO/WHAT IS NPSTC?

- *National Public Safety Telecommunications Council*
- Federation of 13 national public safety associations, with liaison from 5 Federal agencies/groups
- Supported by US DHS SAFECOM Program
- Follow-on to PSWAC, and NCC after July 2003
- Oversight group for many national public safety communications issues:
  - Major regulatory issues (700 MHz, 800 re-banding, 4.9 GHz)
  - Investigating & promoting new and innovative technologies

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NPSTC SDR Working Group

- Funded by US DHS SAFECOM Program
- Public Safety Representative on SDR Forum
- Involved in all aspects of the SDR Forum
  - Regulatory Input to FCC's SDR activity
  - Active Participation on SDR TCs/WGs
- Provide government input to SDRF Board
- Educate Private Wireless (LMR) industry, and encourage SDR Forum participation
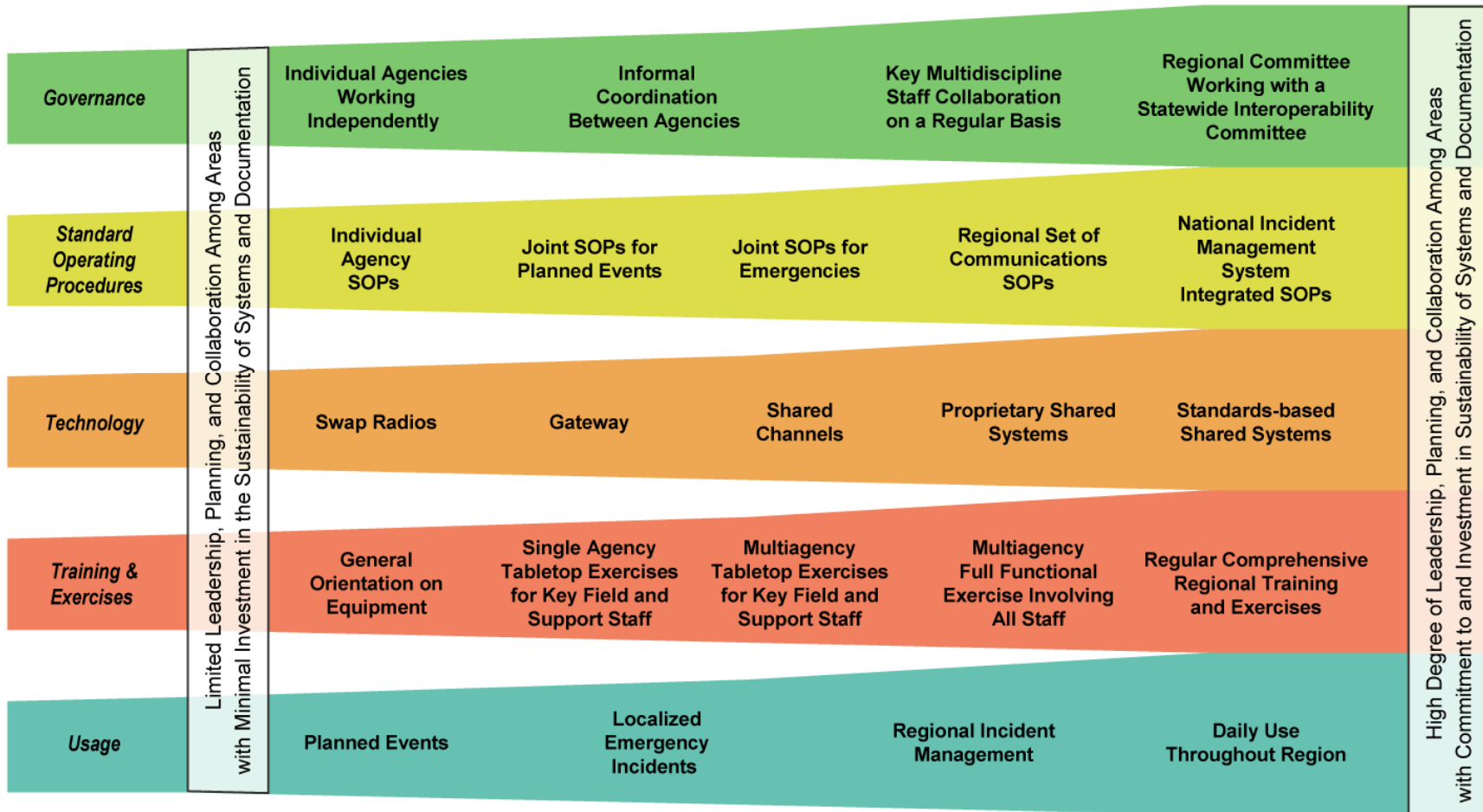
INTEROPERABILITY

- The ability to talk to who you need to talk to when you need to talk to them (data and *voice*, realtime).

  – As authorized by the agency

- NOT the ability to talk with everyone all of the time!

Interoperability Continuum

Homeland Security — U.S. Department of Homeland Security

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Category		Minimal Level				Optimal Level
Governance	Limited Leadership, Planning, and Collaboration Among Areas with Minimal Investment in the Sustainability of Systems and Documentation	Individual Agencies Working Independently	Informal Coordination Between Agencies	Key Multidiscipline Staff Collaboration on a Regular Basis	Regional Committee Working with a Statewide Interoperability Committee	High Degree of Leadership, Planning, and Collaboration Among Areas with Commitment to and Investment in Sustainability of Systems and Documentation
Standard Operating Procedures		Individual Agency SOPs	Joint SOPs for Planned Events → Joint SOPs for Emergencies	Regional Set of Communications SOPs	National Incident Management System Integrated SOPs	
Technology		Swap Radios	Gateway → Shared Channels	Proprietary Shared Systems	Standards-based Shared Systems	
Training & Exercises		General Orientation on Equipment	Single Agency Tabletop Exercises for Key Field and Support Staff → Multiagency Tabletop Exercises for Key Field and Support Staff	Multiagency Full Functional Exercise Involving All Staff	Regular Comprehensive Regional Training and Exercises	
Usage		Planned Events	Localized Emergency Incidents	Regional Incident Management	Daily Use Throughout Region	

Minimal Level ←——— **Interoperability Continuum** ———→ **Optimal Level**

INTEROPERABILITY:
The Importance of Standards

- Standards must be based upon a detailed user needs analysis vetted through actual users, not just engineers
- A detailed user needs-based Statement of Requirements must be developed
  - Project 25 Statement of Requirements
  - SAFECOM Statement of Requirements for Public Safety Communications and Interoperability

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INTEROPERABILITY: Forward migration with backward compatibility

- The 802.3 example
  - 10Base-T
  - 100Base-T
  - Gigabit

- The Project 25 example
  - Phase 1 (12.5 kHz), Phase 2 (6.25 kHz), Phase ?

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SDR Forum Public Safety SIG

- Examining the key issues to move technology into the market
  - Technical
  - Business case
  - Deployment strategies
  - Standards
- Published RFI to solicit information from community
  - Published: 1 Nov 2004
  - Final close date: 23 Feb 2005
- Report scheduled to be released in early 2006
  - Target is January SDRF meeting

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Report Objectives - 1

- Summarize and analyze responses
  - Identify areas of consensus
  - Identify areas of divergence
  - Are there open issues that technical or operational research can clarify?
  - Are there open issues that can be/should be referred to other organizations to address?
    - e.g., standards issues to ETSI and TIA

Report Objectives - 2

- For the public safety community and government sponsors
  - Define the potential value of SDR technology for public safety
  - Identify cost drivers and key tradeoffs
  - Identify technology gaps
  - Provide input to a roadmap and projected time frames
- For manufacturers
  - Identify standards issues whose resolution will enhance market activity
  - Input to the strategic planning and future business case development
    - Identify critical cost breakpoints
    - Identify product improvements and prioritization of features

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Report Objectives - 3

- ## For the SDR Forum
  - – Focus direction of Public Safety SIG
    - Identify topics/issues for further analysis by the PS SIG
    - Identify critical technical issues
      - – Interface with other Working Groups within the Forum
      - – Interface with groups outside the Forum
    - Structure test, evaluation, and demonstration activities

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Status

- Analysis of responses completed
  - Results documented in storyboards that include high level themes
- Resolution of remaining issues being completed
- Final draft completion scheduled for Jan 2006 SDR Forum meeting

THE STATE OF SDR IN THE U.S.

- Many cellular and private wireless radios (LMR) meet today's FCC definition of SDR

- To date, only one platform (Vanu's GSM base station) has been certified by the FCC as an SDR device

- SDR-based radios now available in the commercial (cellular) and Defense sectors

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Software Defined Radio
Why Is Public Safety Interested?

- Ultimate interoperability solution - single "on the belt" handset with today's characteristics, supporting:
  - Public safety & commercial bands (below ~2 GHz)
  - Applicable commercial and public safety waveforms
  - Permissible communications links as determined by the agency
- Cost effective solutions
- Graceful upgrade of products (handset & infrastructure)
- Graceful migration of technologies
- Clearly "*the wireless future*" and already here <u>today</u>

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Benefits of SDR Technology to PPDR

- **Interoperability:** Change operating parameters of a radio for compatibility with other radios being used for the same incident

- **Cost Reduction:** Radio systems could be upgraded by changing the software, preferably over the air, rather than requiring new hardware

- **Flexibility:** Single radios could access multiple services including private wireless (LMR), public cellular, etc

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SDR Technology Issues for PPDR

- **Antennas:** Work still ongoing to provide a practical multiband antenna for portable units

- **Operational:** Need to consider how to exploit flexibility without creating chaos

- **Regulatory:** Flexibility changes the traditional protocols for regulation of devices since operating parameters can be changed post-manufacture (and potentially) in near-real time

- **Security:** Need to ensure that changes to operating parameters do not cause unintentional or malicious disruption of services

- **Standards:** Work initiated to determine what interfaces should be standardized to most effectively benefit public safety

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Critical Issues for PPDR Adoption

- How can SDR support interoperability among public safety personnel? Between public safety personnel and other responders?
- How can SDR technology facilitate a systems of systems approach?
- Where can SDR technology be applied to greatest advantage (terminal versus infrastructure)?
- How can SDR reduce costs?
- Cross-licensing of legacy waveforms.

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Critical Issues for PPDR Adoption

- What interfaces should be standardized?

- What are the advantages and disadvantages of the SCA for PPDR?

- What are the advantages and disadvantages of the OMG PIM/PSM for Software Based Communication for PPDR?

- What is the value of CORBA, POSIX, and XML for future PPDR communications?

Critical Issues for PPDR Adoption

- What is the role of cognitive radio in future PPDR communications?

- What other enabling technologies are critical?

PPDR Cognitive Radio Applications

- Public Safety Interest/Concern:
  - Performance optimization (simple example: adjust squelch tail parameters based on repeater characteristics when roaming from one repeater to another)
  - Dynamic frequency/spectrum utilization: Access frequency on demand based on availability (DOUBLE EDGED SWORD)

- Issues:
  - Technical issues on how to sense environment and complexity of adaptation algorithms
  - Regulatory: Ability to dynamically access spectrum could change the traditional approaches to spectrum regulation (public safety needs protected/on-demand spectrum)
  - Operational and Standards issues currently undefined as technology area is still in early development

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PITFALLS FOR PUBLIC SAFETY

- Concern that evolution of cognitive radio and SDR respect the public safety needs for on-demand and immediate spectrum availability for mission critical communications and for extremely high reliability

- SECURITY

        SECURITY

                SECURITY

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PITFALLS FOR PUBLIC SAFETY

- Absolute protection of public safety mission critical spectrum from interference/intrusion:
  - From within the band (shared spectrum)
  - From outside the band
    - Accidental/malfunction
    - Intentional (especially hacking of networked devices)
  - Hardware-based protections (???)

IN CONCLUSION: WHEN?

- SDR radios are now available in the DoD space that clearly meet many PPDR needs
    - Harris AN/PRC-152 (SCA-based)
    - Thales MBITR (non-SCA)
- Both offer:
    - 30-512 MHz, near-PPDR form factor
- Needed: antennas, battery life, upper bands (700 and 800 MHz), PPDR waveforms

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IN CONCLUSION: WHEN?

- Test beds are being funded by the US DOJ National Institute of Justice
  - MBITR radio at San Jose (CA) Police Dept
    - Special FCC authorization for non-FCC type certified radio on local/state frequencies
    - Radio Service personnel to carry 2 radios vs. 5
    - Can go to 1 radio when P25 waveform available
  - Interest in fielding test of the AN/PRC-152

IN CONCLUSION: WHEN?

- Consider that:
  - Bleeding edge for public safety involves real blood
  - Most public safety mission critical radio systems are designed for 99.99999% reliability.
  - Maximum allowable delay in subscriber access to a channel is 250 msec across a large network.

- Then it is safe to say public safety will welcome these technologies only when fully tested in the field and mature… 2008, 2009?

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