Desirable Attributes of Public Safety Networks

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VCAT Chair

18-19 Oct 2011

Members of Public Safety Net Sub-Committee

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- 2. Shaygan Kheradpir
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- 4. Michael McRobbie
- 5. Roberto Padovani
- 6. Darlene Solomon

Charge to VCAT

- Key architectural recommendations for wired and wireless networks that take into account public safety sector needs
- Comments and recommendations for establishing and structuring a NIST program in this area

Objectives

- Characterize desirable attributes and features of a Public Safety Network architecture
- Analyze potential implications
- Augment commercial designs and/or services with new capabilities
- Set stage for exploratory design, prototyping and testing

Tactical Plan

- VCAT Working Group meets and hears presentations from a variety of sources
- Draft questions circulated; comments from a range of experts
- Synthesis by the WG via email
- Final report to the full VCAT and report submitted to Undersecretary of NIST and WH (CTO)

Context

- 500 MHz bandwidth new assignment
- Funding driven by 700 MHz auction
- State/Local: 758-763 (D),763-768, 788-793 (D), 793-798 [no guard bands]
  - Note: lower band: Base Station Tx
  - Note: upper band: Mobile Tx
- PSN Narrowband
  - 769-775, 799-805 MHz in 12.5 KHz channels

Context

- NATIONWIDE BROADBAND NETWORK CONCEPTUAL DESIGNS
  - MARCH 1, 2011
  - SAN ANTONIO, TX.
  - NATIONAL PUBLIC SAFETY TELECOMMUNICATIONS COUNCIL
- Against “network of networks”
- Promotes “One Nationwide Network”

Context

- Wireless Technology, Prospects and Policy Options, NRC, 2011
- FCC NPRM Nationwide, Broadband Interoperable Public Safety Network, Jan 2011
- WINNFORUM, Software Defined Radio, Dec 2007, Dec 2008
- PSCR (“P25”) Compliance Assessment Program
- DARPA: Maingate (inter-radio-net gateway)
- Wireless Innovation Forum Public Safety Special Interest Group analyses (London bombing, chemical plant explosion)

Public Meetings

- June 7-8, 2011 VCAT Meeting
- August 10, 2011 APCO (Philadelphia)
- Sept. 7, 2011 SAFECOM (Chicago)
- Sept 13, 2011 PCAST Planning Meeting
- October 18-19, 2011 VCAT Meeting

Conceptual Features

- Resilient
- Self-organizing
- Strongly access controlled
- Meshed
- Compatible with commercial infrastructure
- Adaptable (e.g multi-frequency? SDR?)
- Multi-modal (voice, video, data, sensor)
- Open Standards (explain)
- Scalable
- Power-aware (battery limits); signal power
- Affordable (!)
- Business/opex models

Observations

- Scope of Public Safety “community”
  - Distinct from National Security
- Modern Communications
  - Voice, video, data
  - Packet switched

Observations - 2

- Resilience, Robustness, Recovery
  - Redundant provisioning
  - Rapid deployment of temp or perm infra
  - Critical role of standards (national or local caches of equipment)
  - Ruggedization (not everything has to be)
  - Regional Resilience Networks (?)

Observations - 3

- Security, Authentication, Access Control
  - User Name/Password - weak
  - Pre-authorization
  - Role authorization
  - Two-factor authentication
  - Distributed authentication

Observations - 3

- Cost
  - Serious barrier: affordability
  - Standards, competition
  - Bulk purchase, warehousing
  - Commercial compatibility
  - Non-ruggedized for less hostile environments

Observations - 4

- Interoperation w/Commercial Systems
  - LTE
  - Prioritization question
  - Extensions beyond LTE (multiradio?)
- Role of 911 and other online systems
  - GPS, other location methods
  - Sensor networks, civilian inputs

Observations - 5

- Frequency Allocations
  - 763-768 MHz (base stn)
  - 758-763 MHz (D block)
  - 793-798 MHz (mobile)
  - 788-793 MHz (D block)
  - 769-775 MHz (12.5 KHz channels)
  - 799-805 MHz (12.5 KHz channels)
  - 4940-4990 MHz
  - 2.4 GHz, 5 GHz license-free
  - Television White Spaces
  - 60-100 GHz Public Safety Allocations

Observations - 6

- Wired Communications
  - Backhaul for wireless (underprovisioned?)
  - National and global grid (e.g. Internet)
  - Essential for flexible incorporation of all potential public safety incident actors

Desirable Features - 1

- Flexible System Architecture
  - Internet Protocols
  - Small Cells
  - Packet multicast and broadcast
  - Multi-modal (voice, video, data)
  - Maingate concept (US Army, DARPA)
  - Delay and Disruption Tolerance
  - Peer-to-Peer (“talk around”)

Desirable Features - 2

- Backward Compatibility
  - P25 (versions?)
  - LTE (and 2G, 3G, 4G?)
  - Auto-configuration (gateways)
  - Voice broadcast fallback?
- Mesh (MANET) Networking
  - Aerostats, Packet Relays
  - PSSIG London Bombing Analysis

Desirable Features - 3

- Robustness and Recovery
  - Reconstitution
  - Rapid deployment
  - Redundant provisioning

Desirable Features - 4

- Security and Authentication
  - Strong Authentication
  - Device, Person, Role Authentication
  - Two factor, biometric (?)
  - Distributed Authentication Databases

Desirable Features - 5

- Standards
  - Use and Development
  - SGIP analogy: PSIP
  - Facilitate Standards development and adoption
  - Facilitation of Public Safety “App” Dev’t

Desirable Features - 6

- Ruggedization
  - Interworking of “commercial” and “ruggedized” devices (standards again)
  - Impact on affordability
  - Use while wearing haz-mat protective clothing

Desirable Features - 7

- Sensor and Location Systems
  - Location of responders
  - GPS, Radio Triangulation, WiFi locations
- High Density Radio Operation
  - What to say about congestion with high density usage?

Prototyping, Collaboration, Testing

- NIST Boulder Facilities
- Ft. Bliss? Ft. Huachuca?
- Municipal Facilities (Seattle?)
- Interoperability confirmation
- Realistic Testbeds and Testing
- In regular use to support evolution (not just development)

Multiple Stakeholders

- Conventional First Responders
- Volunteers
- Military, National Guard
- Civilian agencies and Private Sector
- Implication: broad ability of PSN to support wide range of stakeholder interaction.
- Note funding variability

Programmatic Considerations

- Public Safety Interoperability Panel
- Coordinated Research, Development and Testing
  - NIST, DARPA, NSF, OSTP, NSTC, DHS, NIJ, State and Local agencies, private sector public safety organizations
  - $300M, 5 year program
- Private or Quasi-Public Entity for Development (and operation??) of National Public Safety System

Research and Development

- Dynamic Spectrum Management
- Power Management
- Mobile, Adhoc Networks and Protocols
- Packet Broadcast and Multicast
- Peer-to-Peer LTE
- Strong Authentication Technology
- Platforms for public safety applications

Research and Development

- Certification regimes and practices
  - Note scope (horizontal, vertical!)
- Multi-media applications and integration
- Tools for collaboration (e.g. collaborative display)

National Incident Management System

- Role for NIMS in the design of the public safety network
- See also Emergency Support Function (ESF)
- Policies and procedures for information sharing, collaboration, planning
- (should this be placed earlier in the document?) - see relevance to scenarios section of report.

Notes from Oct 18-19

Notions

- Commonality of functions across system
- Prioritization at need
- QOS (when required)
- Coherent release cycles (implications for funding model?)
- Common interfaces (protocols, API, application platforms, radio capabilities…) - allows competitive provisioning
- Uniform, universal access to system

Historical Material

Additional considerations

- Next generation 911 (role for Internet-like facilities) - leveraging location-based services in private sector
- Operational Cost Model(s)
- Business Model(s)

Resilience

- Overcomes local failures (alternate routing, alternative transmission options, rapid back up deployment)
- Self-relaying mesh capability
- Redundancy vs armor/gold plate
- Simplex modes of operation? (also broadcast?)
- Peer-peer voice (and data)

Self-Organizing

- Neighbor discovery
- Strong Authentication to join network
- Pairwise/Groupwise interoperation (direct exchange of “data” by mutually authenticated devices)
- Make use of broadcast for efficiency
- Note: LTE may evolve to peer-peer and neighbor discovery capability

Strong Authentication

- Nodes mutually authenticate with crypto certs
- Cryptographic passwords to join network
- Two-factor authentication by users

Meshed

- Nodes are store/forward devices
- Form network using variety of underlying transmission alternatives
- Can work with encrypted payloads
- [Is DTN a useful adjunct?]

Commercial Compatibility

- Use organic and commercially available transport (LTE, 4G, 3G, 802.11, 802.15.4, White Spaces? …)
- Roberto's List!!!!
- NOTE: LTE DOES NOT YET SUPPORT VOICE! However, it IS digital (and packetized?).
- Distinguish services from equipment - interested in both cases of compatibility.

Adaptability

- Multiple radios and/or software defined radio(s) for flexibility
- Using packet methods, support all forms of communication
- Allows for mesh networking, error recovery, forward error correction…
- Can use alternative routes and transport
- What are the operational modes that need to be supported?
- Higher protocol layer awareness of network conditions!?

Multi-modal

- Should be able to carry voice, data, video, sensor information in digital form
- System should be insensitive to application (except perhaps for latency?) - prioritization?

Open Standards

- Should use or develop open standards
- Maximize potential for competitive procurement
- Maximize interoperability among multiple suppliers
- Create Public Safety Interoperability Panel (PSIP) to facilitate and identify standards requirements and conformance to the standards?

Power-Aware

- Protocols sensitive to available battery power
- Transmitter power adaptation to minimize near-far and hidden transmitter problems
- Standards are available to deal with these issues.

Affordable!

- Take advantage of commercially available designs
- Operational expense model(s)?
- Business model(s)?
- First responder markets - 4-5 M?
- Are the features of the PS devices also of interest to commercial market? Private sector security fire services? Federal services? Military services?
- Note implications of volunteer fire dept operations
- Apparent scale of PS market will not produce economy of scale on its own.
- Is there a commercial “play” to increase $ support for the PS “network” (but can be pre-empted)

Questions

1. Can MANET work in same bands as LTE? Tentative answer: NO
2. Can we use multiple radios and/or software-defined radios to operate in multiple bands? YES
3. How can we make “joining” the (a?) logical network easy but strongly access controlled? TBD

Questions

4. How can we make “roaming” work in MANET design? TBD (R&D?)
5. What frequency bands are available? 802.11? 802.15.4? White Spaces? PSN BB and D-Block? 60-100 GHz?
6. Does satellite have a role? Yes, at least for backhaul.
7. What about blimp/balloon or aerostats for connectivity?

Questions

8. How can co-habitation work? CDMA? OFDM? Roberto: nope.
9. SDR economics? TBD but probably more expensive

Actions

Additional Consultants

- Dave Liddle
- David Reed (ex-MIT)
- Justin Ratner/Craig Mundie
- Milo Medin
- Robin Chase (MIT/Paris)
- Sascha Meinrath (NEA)
- Stagg Newman (ex-FCC)
- Donna Dodson (NIST)
- John Gustafson, TX
- Hans-Werner Braun
- Farnam Jahanian (NSF/CISE)
- Robert Kahn (CNRI)
- Preston Marshall (USC/ISI, ex-DARPA)
- Dereck Orr (NIST)
- Paul Steinberg (cto, motorola)
- Henning Schulzrinne (FCC)

Summary Public Safety Net Subcommittee

June 8, 2011

Members of Public Safety Net Working Group

- Public Safety Networks
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- Uniform, universal access to system
- Public Safety Interoperability Panel ?

Actions

- Get “Nationwide Broadband Network Conceptual Design” report to team (softcopy)
- Develop report outline (Cerf) - July 1
- Final Report Target 9/30 (or earlier if PCAST requires)
- Face/Face or Telephonic meetings during summer? How many? 3-4 two hour calls. At least one f/f meeting in Boulder - Doodle poll for date (CERF) - July??? Aug??? Ask Carla to pursue the call schedules.
- Target report for 9/30? Sooner? 9/11 (!)
- Can we also have a non-VCAT working site? Maybe use Google Docs? Need to query each participant for gmail address for access control. Also set up a mailing list for use in discussions.
- Recommend additional consultants to review and comment on draft ideas.

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This is a sample slide that is used for video B-roll

- Gotta get back to woodhurst for dinner and remember to open the wine in time to breathe!
- Gotta check out the chardonnay - is it really ok? Meusault vs the puligny-montrachet, for example.

Dinner menu?

- Jose Andres is going to enjoy product from his own team but they don't know that yet!!
- Lessee, we will start with appetizers and then go to salad and main courses. I can't remember whether we are going to have a fish course or not. Have to check with Sigrid.
- Also need to make sure we can keep the white wine cool - we have a problem in that we only have the one cooling bin for white wine. Maybe we can order a couple more of them?