SGA Task Force: Achieving Interoperability for Public Safety Communications

Response of Verizon Communications and Verizon Wireless
March 16, 2007

I. Introduction and Summary

Verizon Communications and Verizon Wireless (collectively "Verizon") respectfully submit for consideration by the SGA Task Force their recommendations for achieving interoperability for public safety communications and for ensuring effective communications for first responders over the long term. Public safety has long suffered from a lack of technological, spectrum and financial resources that have severely affected its ability to provide first responders with access to effective, interoperable communications. But, new technologies are now available, and public safety has been given new spectrum and money to address the problem. The time is now to set public safety on the right path for the future – a path that will enable it to fully exploit advanced technologies with maximum benefit and minimum cost. The following actions should be taken:

- Fix voice interoperability first, as it is mission-critical. Modern technologies are available now to solve the problem without significant investment in new equipment or more spectrum.
- Provide public safety with a dedicated broadband network that uses advanced, commercial technologies and infrastructure to minimize cost, is built through federal funding, and is supported on a "fee-for-service" basis with state/local tax dollars.
- Provide public safety with priority access to commercial networks in the 700 MHz band during emergencies.
- Auction the commercial TV spectrum by September 2007 to secure federal funding of interoperability initiatives.

II. Framework for an Effective Solution

To be effective, any proposed solution must satisfy public safety's current and future needs. This includes providing voice, data, and other broadband services to first responders where and when they are needed, ensuring interoperability across multiple work groups and jurisdictions, enabling nationwide roaming and access to the public switched telephone network, and providing reliable, redundant networks that can withstand natural disasters. Beyond these core requirements, however, we believe there are other factors that should guide the SGA's decisions.

Interoperability for Existing Voice Systems: Existing mission-critical voice communications systems are not interoperable. While these systems could be replaced with newer technology, it would be difficult (and costly) to do so in the near term. And, fixing the interoperability problem can't wait. Existing systems must be made interoperable in the most effective manner possible.

Broadband Capability for the Future: First responders need access to advanced capabilities. Police officers need prompt access to law enforcement databases to help catch criminals. Fire

fighters need access to imaging and other data applications at the scene of a fire to save lives and property. Today's systems can't support such applications, and can't be easily upgraded. New networks that use broadband technology must be built.

Commercial Technologies: Advances in computer and wireless technology have yielded significant benefits for consumers – providing them with greater capabilities at lower cost. These same benefits can be afforded to public safety – if they use the same technologies. Public safety must abandon old solutions that favor proprietary technologies with less capability at greater cost. Standardized technologies developed for the broader commercial marketplace should be used to enable greater economies of scale and provide access to the most advanced technologies and capabilities available. In addition, public safety use of commercial infrastructure that is already deployed will reduce construction costs and speed deployment.

Congressional Plan for Interoperability: Congress and the Administration have charted a three step process for addressing interoperability. (*Digital TV Transition and Public Safety Act*). First, public safety will be provided valuable new spectrum as part of a plan to clear TV air waves for public safety and commercial uses. Second, the FCC has proposed an innovative approach for using the spectrum to promote public safety access to broadband technologies. Third, the commercial spectrum will be auctioned to provide $1B for interoperability and nearly $2B for other programs important to the states (digital TV subsidies, enhanced 911 systems, national alert system). We agree with former FCC Chairman Michael Powell that any alternative plan should be tested against several criteria, including whether it would delay achieving interoperability or disrupt the funding provided by Congress. (*Letter to Vice Chairman Ted Stevens, Senate Commerce Committee*). We recommend accelerating the interoperability initiative by expediting the auction, and making more money available for public safety's use.

III. Voice Interoperability

The first priority must be to provide interoperability for the thousands of incompatible legacy systems that provide voice communications to first responders today. These systems have been deployed over a span of several decades in different spectrum bands (e.g., 450 MHz and 800 MHz), and most use older technologies. While broadband technology would solve this interoperability problem, it would take years to deploy interoperable broadband networks. What we need is something that can bridge the gap between the old and the new.

Using the same kind of technology that drives the Internet (called "Internet Protocol" or "IP"), legacy radio networks can be made to be interoperable without the need for significant investment in new equipment and without new spectrum allocations. Similar to the way in which different commercial devices using different operating systems communicate in the commercial world, an IP-based network would enable widespread communications interoperability for public safety in the short term, while also allowing agencies to plan a reasonable migration to newer radio technologies as budgets allow. The market for IP-based interoperability solutions is extremely competitive, with products currently available from companies like Catalyst Communications Technology, Cisco Systems, CoCo Communications, M/A-COM, Motorola, Raytheon, Twisted Pair, and others.

Congress has provided $1 billion in funds to address interoperability problems. The National Telecommunications and Information Administration and the Department of Homeland Security will administer the grant program, and have indicated they intend "to achieve a meaningful and measurable improvement in the state of public safety communications interoperability and provide the maximum amount of interoperable communications with a minimum impact to, or replacement of, existing local radio assets." We believe this is the right approach, and believe that implementation of IP-based technologies is an important step to accomplish that objective.

IV. Dedicated Public Safety Broadband Network

The increasing responsibilities of first responders make access to advanced technologies critical. While today's commercial networks provide these capabilities, first responders want access to a broadband network that is dedicated for their use and not one that they must share with other commercial users. Such a network can be, and should be, built in the 700 MHz spectrum that was set aside for public safety's use more than a decade ago and will soon be made available.

A National Approach Implemented by the States: The broadband network should be national in scope – a "network of networks" that provides broadband access for all communities regardless of how big or small. A national licensing approach would yield considerable benefits: (1) compatible deployments that will provide inherent interoperability; (2) greater purchasing power that will substantially reduce equipment costs; (3) greater redundancy and survivability in times of crisis; and (4) more focused use of scarce funds. The national licensee should be comprised of representatives of the public safety community, and should not include commercial entities.

A national licensing approach should not alter the critical role of state governments. The states should have the primary role of building the networks to ensure they meet the specific needs of first responders in different parts of the country. A national licensee, however, can facilitate coordination among the states and establish appropriate standards, while permitting customization to meet local needs. A national licensee can also facilitate use of the networks by federal agencies, which are critical partners during times of emergency.

Use of Commercial Technologies & Infrastructure: Public safety use of commercial off-the-shelf technologies and existing commercial infrastructure will allow the broadband network to be built more quickly and economically while providing first responders with access to the most advanced capabilities available. First responders have historically had to rely on technologies designed for a limited public safety market. By leveraging commercial technologies that are widely deployed and constantly refreshed as advances occur, public safety will have access to more advanced and affordable equipment with ever-increasing innovation and efficiency and without the risk of premature obsolescence. The cost savings associated with using commercial technology will apply to network equipment as well as handsets and other devices used by first responders. While these devices might be customized to meet public safety's special needs, the fundamental technologies supporting them would be the same as those used for the broader commercial market. The days of having to buy $4,000 radios should come to an end.

Industry has considerable experience in building and operating wireless networks, and has deployed broadband networks throughout the country. Those considerable assets can be

leveraged by public safety through infrastructure sharing arrangements that will reduce the cost of building and operating broadband public safety networks. Verizon Wireless has estimated that shared use of certain components of the commercial infrastructure (e.g., towers, back-up generators, and backhaul facilities) can reduce the cost of initial deployment by approximately one third and the total costs of building, operating, and maintaining a broadband network by nearly one half over a ten year period. Further, the shared use of existing commercial infrastructure could reduce the deployment time for a nationwide broadband public safety network by several years. (See Appendix 2).

Multiple Sources of Funding: Lack of funding has always been a problem, and that challenge must be overcome if broadband public safety networks are to be successfully deployed. Private investment can provide substantial assistance, e.g., through the use of commercial technologies and infrastructure sharing arrangements that will significantly reduce costs. Funds might even be available through commercial use of the network under certain circumstances, though those instances should be incidental and at public safety's discretion.

The need for a dedicated public safety network requires that the majority of funds come from public sources. Significant federal funding is required to provide the initial capital outlay associated with building a nationwide broadband network. Revenues from commercial spectrum auctions can help to generate these funds. State Governors should urge Congress to make more funds available in the near term and should call for a plan that ensures access to sufficient funds over the long term. The FCC's "fee-for-service" proposal would enable state/local funding to be used to support ongoing operations and maintenance of the nationwide network. Thus, instead of requiring state and local governments to spend considerable sums to build separate broadband networks, limited state/local tax dollars could be used to pay for devices used by first responders and to cover the ongoing expense of running the networks. Enabling federal agencies to use the network on a "fee-for-service" basis would provide an additional source of funding.

Spectrum Requirements: Spectrum is critical to any wireless network. However, a national framework and the use of commercial technologies will ensure efficient use of spectrum resources and eliminate it as a barrier to future advancements. The DTV transition mandated by Congress provides the new spectrum that public safety needs for the future, more than doubling the amount of spectrum currently used. The attached technical analysis demonstrates that just half of this new spectrum would support a broadband network that meets public safety's broadband data needs, while serving more than thirteen million first responders (five times the current number of state and local first responders). An additional 50 MHz of spectrum in the 4.9 GHz band has recently been made available to support additional broadband applications, such as streaming video. (See Appendix 3).

V. Priority Access to Commercial Networks

Commercial operators have deployed advanced wireless networks throughout the country, and these networks satisfy most, if not all, of the requirements that the SGA has determined are critical to public safety communications. This includes wide availability of mobile voice, data, and other broadband services, nationwide roaming, access to the public switched telephone network, and full interoperability regardless of the host network or the type of device used by the

customer. In recent years, many of these commercial networks have also been "hardened" to withstand the effects of a natural disaster.

Public safety agencies have found commercial wireless networks to be extremely valuable and a critical part of their overall communications solution. Hundreds of thousands of first responders use these networks today to help them do their jobs. The DHS National Interoperability Baseline Survey, which was completed in December 2006, determined that 68% of public safety agencies use commercial wireless phones as part of their daily routine, and 79% use a personal digital assistant (PDA) to access basic data applications. An increasing percentage (27% in 2006) are using laptop computers and broadband commercial wireless networks to access an increasingly sophisticated set of data applications such as accessing criminal records, mug shots, building floor plans, or medical information.

Even if (or when) a dedicated nationwide broadband public safety network is built, commercial networks will continue to play an important role as a back-up during times of emergency, or whenever they are needed. In fact, the availability of commercial broadband networks to first responders on a priority access basis can actually assist in the construction of a nationwide broadband public safety network. By ensuring access to commercial networks on a priority basis during emergencies, state governments can deploy broadband public safety networks that are designed to handle "normal" loads, which include incidents of a smaller scale that occur regularly, rather than the "peak" loads associated with large-scale emergencies that rarely occur. This will substantially reduce the cost of deploying broadband public safety networks, while still ensuring that effective communications is supported in times of emergency.

The wireless industry currently provides Wireless Priority Service to tens of thousands of government users. The same type of service can be extended nationwide to support public safety access to commercial broadband networks (for voice, data, and other applications). Deployment of commercial off-the-shelf technologies by state and local governments will make it possible to integrate public safety and commercial networks into one integrated solution for first responders. The availability of commercial broadband networks for public safety's use will also enable first responders to have access to broadband applications now, while a nationwide broadband public safety network is being built. While it will take years to construct such a network, commercial networks can help to provide a bridge to public safety's future.

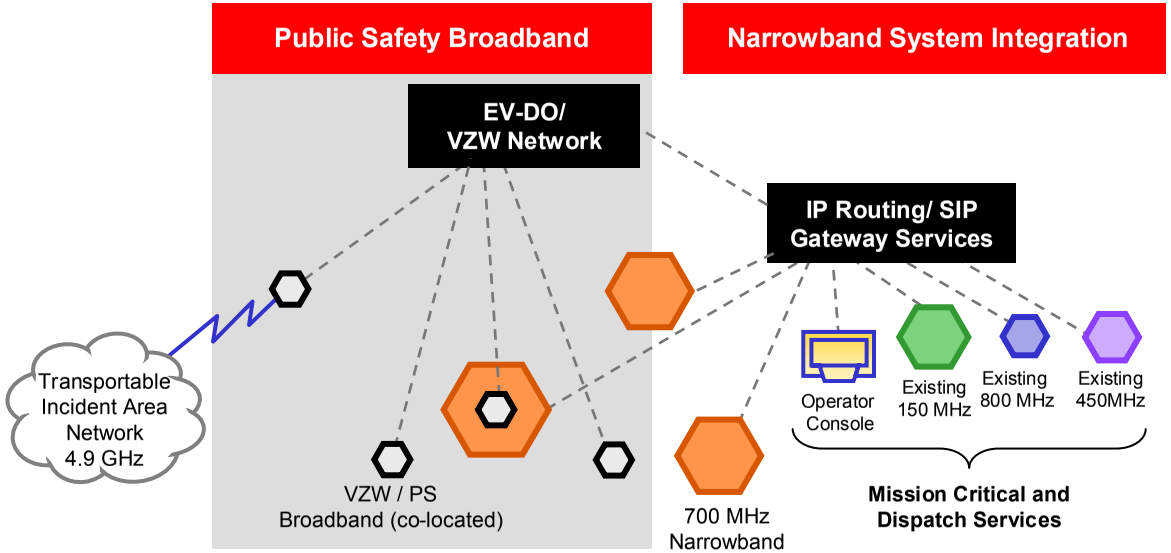
VI. Conclusion

Ensuring first responders have access to effective communications in times of emergency and the most advanced technological tools to protect and serve the public are absolutely critical and should be national priorities. The commercial wireless industry can help federal, state, and local government to accomplish this goal. By applying commercial solutions to solve public safety's problems, first responders will be able to take advantage of commercial innovations that will ensure access to the most advanced capabilities available. By leveraging the use of commercial networks and other assets, public safety can deploy advanced networks at the lowest cost possible. We urge the SGA to consider supporting the approach outlined in this paper.

Appendix 1:
A Comprehensive Public Safety Communications Solution

Comprehensive solution: (1) a dedicated public safety broadband network; (2) integration of narrowband systems with interoperability provided via IP-based technology; and (3) priority access to commercial broadband networks.

- Dedicated Public Safety Broadband Network
  - 700MHz PS spectrum (12 MHz)
  - Commercial off-the-shelf technologies (e.g., EV-DO)
  - System attributes
    - Complement (not replace) existing PS voice-centric narrowband infrastructure
    - Primarily data
    - Dispatch and mission-critical voice satisfied in existing frequency bands and applications
    - Evolutionary path to migrate selected services from other frequency bands
    - Incident area capacity satisfied by 4.9 GHz PS spectrum
- Integration of Narrowband Systems
  - Legacy 150/450/800 MHz
  - 700MHz Narrowband
  - Interoperability via IP technology
- Priority Access to Commercial Broadband Networks
  - Commercial spectrum and broadband services enhanced to support public safety applications
  - Capacity overflow (e.g., major emergencies)
  - Available now, while PS systems are built
  - Pay-As-You-Go service option



APPENDIX 2: INFRASTRUCTURE SHARING

This appendix provides a detailed analysis of the cost savings that could be attained by leveraging existing commercial network infrastructure in the construction of the Public Safety Broadband Network. We note that infrastructure sharing arrangements could be established with any commercial operator. However, for the purposes of our analysis, we assumed sharing only with VZW. The following general conclusions are reached.

- Analysis assumes that certain VZW assets (i.e., tower, shelter, power systems, backhaul facilities and some network equipment) are shared with the Public Safety Broadband Network. If VZW were a 700 MHz licensee, there would be an additional opportunity to share antennas systems, which would yield additional savings.

- Coverage provided using combination of existing Public Safety and VZW sites, as well as new sites that would need to be constructed under either the "Public Safety Stand-alone" or "VZW Leveraged" scenarios. Assumes a 63.5% geographic coverage with a total of 37,000 sites.[1]

- **Shared use of VZW network infrastructure would reduce initial capital costs from an estimated $19B to $13B (32% savings). (Additional savings with sharing of other commercial infrastructure beyond VZW)**

- **Over a ten year period, infrastructure sharing would reduce the total cost of building, operating, and maintaining the network from an estimated $61B to $35B (43% savings).**

- **Infrastructure sharing would facilitate 100% deployment of the proposed networks 2 ½ years earlier than public safety could do it alone.**

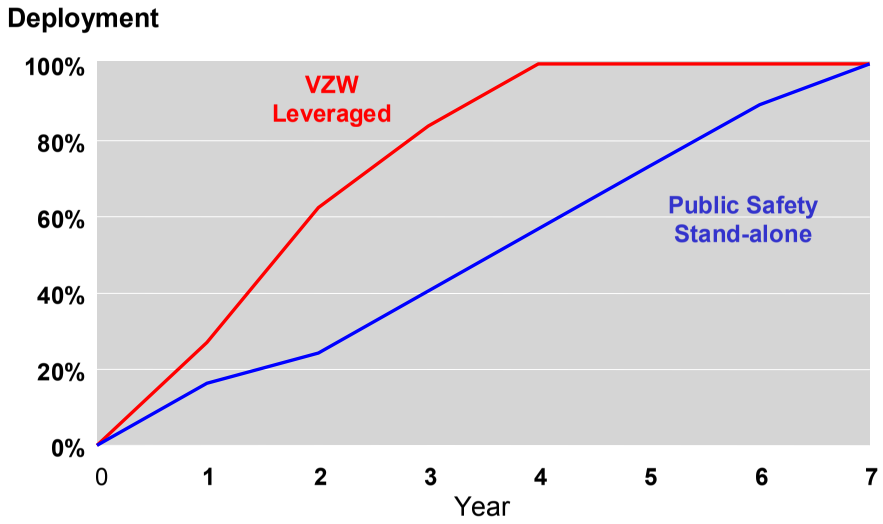
[1] Taken from Cyren Call assumptions.

Infrastructure Sharing Overview

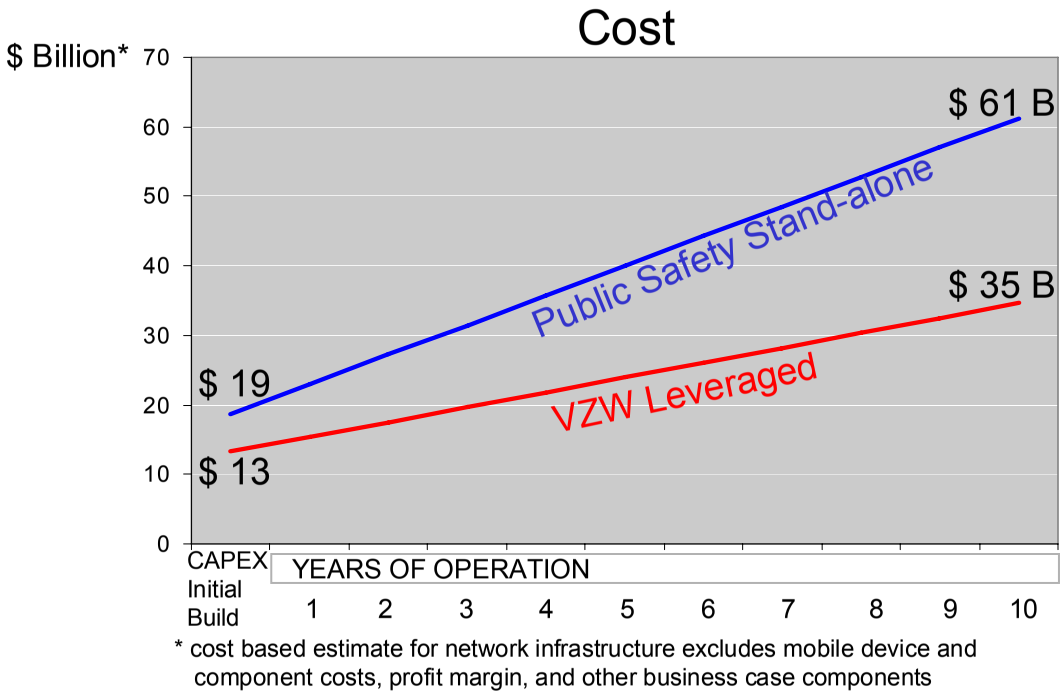
- Leveraged Resources
  - Regional Public Safety decision-making
  - Regional determination for desired tradeoff between dedicated resources, cost, and deployment timeframe
- Faster deployment
  - Leverage existing VZW network completes deployment more than 2½ years earlier
- Network/Service Support
  - Leverage engineering, customer care, etc.
- Handsets*
  - Specialized, but based on high volume commercial components

	Shared with Carrier	Dedicated to Public Safety
Site (Shelter, Tower)	X	
Generator	X	
Backhaul	X	
Antenna	*see note*	X
Base Station Equipment		X
Channel Specific Equipment		X
Spectrum		X
RNC, PDSN core infrastructure	X	X
PSTN, IP Gateway core infrastructure	X	
Application Server		X

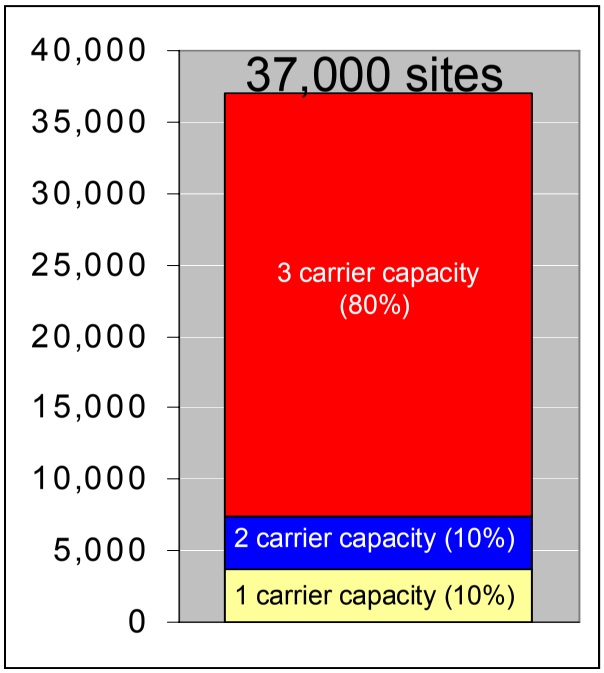
Note: Opportunity for 700MHz commercial licensee to leverage antennas



** Handsets not included in financial analysis*



* cost based estimate for network infrastructure excludes mobile device and component costs, profit margin, and other business case components

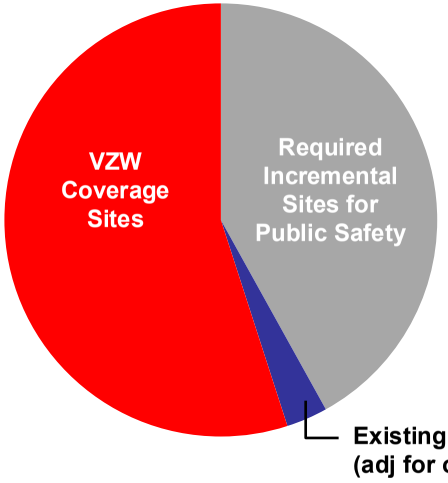


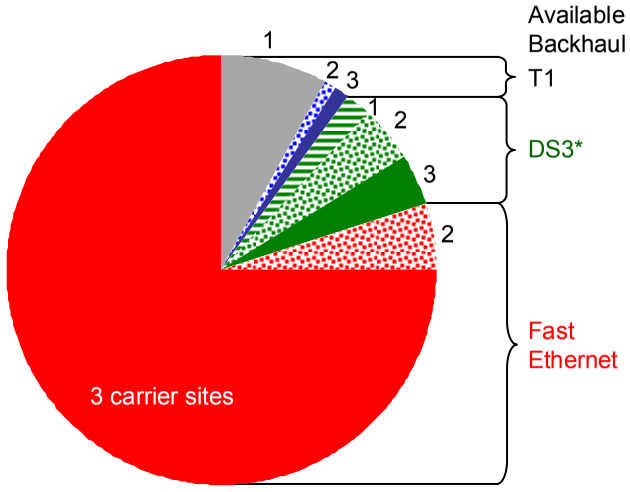
- Funding
  - Regional control (assume no smaller than state-wide)
    - Determination to participate
    - Tradeoff between dedicated resources, cost, and deployment time (cost range between "Leveraged" and "Stand-alone" shown on graph)
  - Competitive RFP; awarding contract to build and operate
  - Federal assistance supported by earmark funds from 700 MHz commercial auction
  - Less than $ 3 B per year nationally, 20 year lease term

- Notes and assumptions
  - Years of operation normalized to costs at full deployment
  - Incremental backhaul: 2 x T1 per EV-DO carrier, leveraged backhaul provides synergy
  - Base Station Equipment cost premium: +20% for Public Safety
  - Device outlay not included
    - Devices: handsets, vehicle-based devices and repeaters, incident command post, etc.
    - Specialized equipment with economies of scale based on high volume commercial components
  - Additional synergy for potential commercial 700 MHz licensee not included

Financial Methodology

- Estimated sites
  - Existing Sites
    - VZW coverage
    - Public Safety
    - Adjusted for overlapping coverage
  - Incremental sites required to satisfy Public Safety coverage
- CAPEX
  - Site construction (including tower, shelter, generator, real estate, etc)
  - Site equipment (including base station, antenna, installation, etc)
  - Additional carriers (3 carriers at 80% of sites; 2 carriers at 10%)
- OPEX
  - Salary, Rent, Plant, Other
- Backhaul
  - Availability (T1, DS3, Fast Ethernet)
  - Annual cost





* Despite availability of DS3, economics drive T1 deployment in 1 carrier sites (also 2- and 3-carrier sites in non-synergy scenario)

APPENDIX 3: TECHNICAL ANALYSIS

This appendix provides a detailed technical analysis that evaluates the capacity requirements of the Public Safety Broadband Network. It considers the total number of public safety users that could be supported on such a network and makes a conservative assessment as to how well that network would satisfy public safety's communications needs in the event of a major incident in which a large number of first responders would require access to broadband applications (voice, data, video) within a relatively small area. The following general conclusions are reached.

- Using commercial off-the-shelf technology, a public safety broadband network deployed in the 700 MHz public safety band **could support at least 13 million public safety users**.

- The analysis also shows how a broadband 700 MHz "Jurisdiction Area Network" using **three CDMA EV-DO channels at 2 x 1.25 MHz each** could be used in conjunction with a 4.9 GHz "Incident Area Network" to meet public safety's data communications needs even under a worst case scenario.[1]

- This analysis does not consider the additional capacity that would be made available through the use of commercial broadband networks available on a priority access basis during the incident.

[1] As APCO and others in the public safety community have previously noted, the 4.9 GHz is the preferred spectrum for local broadband applications, while the 700 MHz band is preferred for wide area communications. Equipment vendors and others are developing solutions for the public safety market that employ this type of integrated approach to addressing public safety's communications needs.

In order to assess the capacity requirements for public safety on a national scale, one could assume that first responders are uniformly distributed across the country and then use reasonable assumptions about how many users could be supported at each of the 37,000 deployed sites to determine the total number of users supported.

For our analysis, we assume an EV-DO Rev A network is constructed with 3 radio channels (2 x 1.25 MHz each) deployed at most sites, but with fewer channels deployed at other sites based on reduced capacity requirements in some low density areas (as shown below). Based on EV-DO Rev A standards, each of these channels would support 342 users, and three channels would support 1,026 users. However, our analysis considers the robust demands of public safety's requirements. Consequently, we conservatively assume that each cell site in the broadband network would support 500 first responders, if 3 EV-DO channels are deployed. Applying this assumption to our modeled deployment scenario and adjusting for non-uniform distribution of users, we conclude that the proposed network **could support 13.3 million public safety users**.

Capacity		per channel		3 channels	
		Uplink	Downlink	Uplink	Downlink
Thruput (Mbps)	Peak	1.8	3.1	5.4	9.3
	Effective	0.5	1.3	**1.5**	**3.9**
Maximum Users		342		**1,026**	

% sites	channels	cell sites	users supported	total users (M)
80%	3	29,600	500	14.8
10%	2	3,700	333	1.2
10%	1	3,700	167	0.6
Total		37,000		16.7
Adjustment for Non-Uniform Distribution of Users (80%)				**13.3**

We also take our analysis beyond the national scale, to more conservatively assess the ability of a public safety broadband network to meet first responder needs in an area where a specific incident has occurred. The following slides provide a summary of that detailed analysis. In that analysis, we assume a worst case scenario in which a single sector within a single cell site is used to serve the incident area, and assume that first responders needs are met through a combination of a Jurisdiction Area Network using 700 MHz spectrum and an Incident Area Network using 4.9 GHz spectrum.

Capacity Analysis for Public Safety Broadband Network

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- Supporting definitions
  - Jurisdiction Area Network (JAN): Network operating in 700 MHz Public Safety spectrum, providing coverage throughout the jurisdiction
    - Background Users: Day-to-day use of the network for "normal" public safety operations
    - Additional Incident Load Users: Incremental demand on the 700MHz JAN for additional users and more robust data services during an incident
    - Also provides off incident communications backhaul from Incident Area Network
  - Incident Area Network (IAN): Network operating within an incident area utilizing 50MHz of Public Safety allocation in the 4.9GHz band
    - Available immediately on scene based on field devices using mesh technology to establish an adhoc network without any infrastructure
    - Supplemented by transportable incident command post infrastructure as incident escalates

- Analytical approach
  - Establish data services in 6 classes of demand
  - Include day-to-day and incident demands in 700 MHz JAN as well as 4.9 GHz IAN
  - Establish incident scenario
    - 500 First Responders on scene
    - Full incident demand in a single sector (worst case) in average coverage of 3-channel cell site
    - Normal background use of 700 MHz JAN remains fully supported during incident
  - Calculate demand
    - EvDO rev A technology available today, estimates based on effective throughput
    - Greater spectrum efficiency, capacity, and supported users achievable with less conservative assumptions
      - Technology evolution (beyond EvDO rev A) currently in development
      - Estimates do not assume improved link margin for incident command post to cell site
- Outcome
  - Localized users supported, based on demand requirements on 700 MHz JAN: 500
    - Includes incident demand from additional users and IAN backhaul as well as fully supporting "normal" public safety operations during incident
    - Satisfied within 3 carriers of EvDO rev A at 2 x 1.25 MHz each
  - Requirements on 4.9GHz IAN to satisfy on scene needs

Supported Data Services

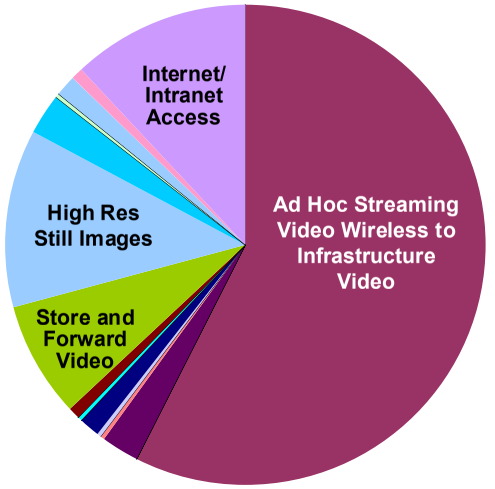
Class	Application	System Demand (kbits/Sec) Uplink	Downlink	Priority High Med Low	Back-ground Users A: JAN (700 MHz)	Additional Incident Load Users B: JAN (700 MHz)	C: IAN (4.9 GHz)
Real-time Imaging							
	Ad Hoc Streaming Video Wireless to Infrastructure Video	700.000	5.000	H		1	3
	Ad Hoc Streaming Video Wireless to Wireless Streaming Video	700.000	700.000	H			17
	Ad Hoc Slow Scan Video Wireless to Wireless Streaming Video	24.000	24.000	H			10
Real-time Voice							
	VoIP Interconnect with PSTN	1.500	1.500	H	10	10	
Messaging							
	Instant Messaging	0.008	0.008	M	5	500	
	Email	0.160	0.160	L	10		
Database Access							
	Emergency Equipment Inventory and Management	4.000	4.000	M		1	
	EMS CAD System	8.000	8.000	H		2	
	Drawing Downloads	0.800	800.000	M		1	
	On-scene maps	0.800	800.000	M	1	1	
	AVL Lookups	0.480	0.480	H		5	
	NCIC	0.120	0.240	M		5	
	Store and Forward Data	16.000	0.016	L	1		
	Store and Forward Video	160.000	0.160	L	1		
	High Res Still Images	240.000	240.000	L		1	4
Telemetry							
	AVL Polling	0.400	0.004	M	10	100	
	Sensor data (ad-hoc and fixed)	0.080	0.080	H	5		10
	Traffic light control	0.080	0.080	M	10		
	Robotics Remote Control	0.800	0.800	H			10
	Personal Bio Monitoring	0.080	0.080	H		250	
	EMS Telemetry	0.200	0.200	H		50	
Internet/Intranet							
	Internet/Intranet Access	4.000	40.000	L	10	50	

* Blended service set derived from public documents, not intended to be exhaustive

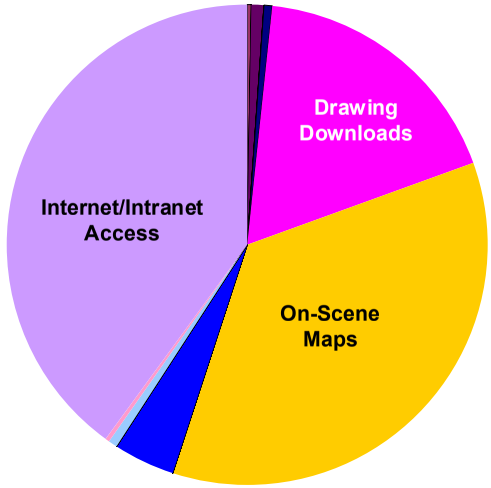
* IAN concept technology to be developed

Column labels **A**, **B**, and **C** refer to charts on this and following slide

JAN Background(A) + JAN Incident(B) Uplink = 1.2 Mbps
(out of 1.5 Mbps effective throughput in 3 channels of EvDO rev A)



JAN Background(A) + JAN Incident(B) Downlink = 3.6 Mbps
(out of 3.9 Mbps effective throughput in 3 channels of EvDO rev A)

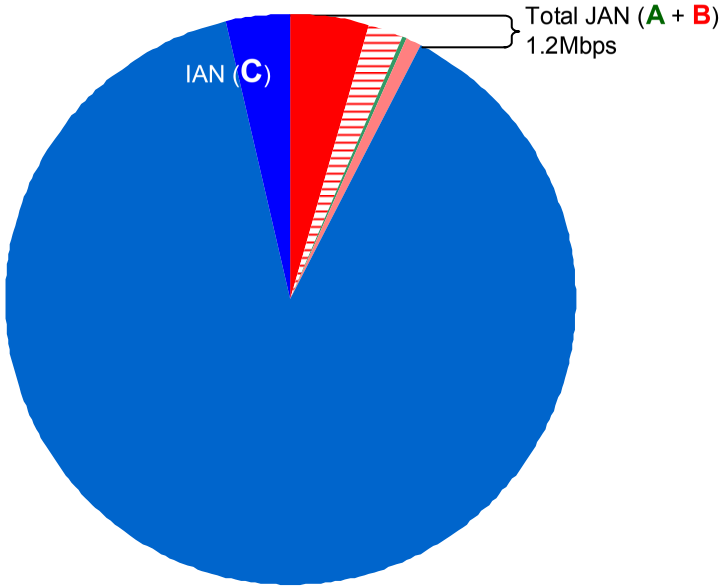


Spectrum Requirements for Broadband Network

- Most need is satisfied by Incident Area Network (4.9 GHz)
  - Incident Area Network satisfies on-scene needs
  - EV-DO network provides backhaul from Incident Area Network for off-scene data communication requirements
- Demand on 700 MHz satisfied by 3 channels EvDOrA (2 x 1.25 MHz each)

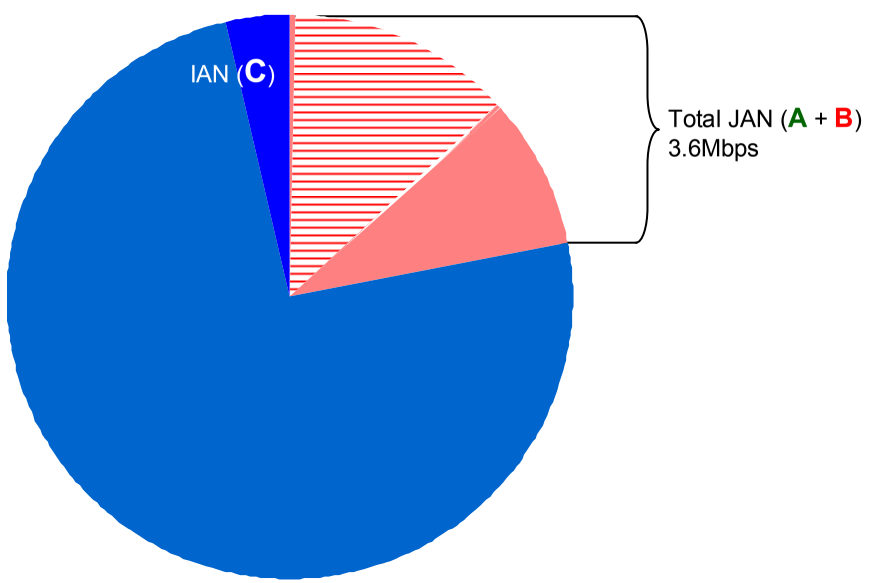
JAN / IAN Combined

Incident and Background Uplink (16Mbps)



JAN / IAN Combined

Incident and Background Downlink (16Mbps)



JAN: Real-time Imaging | JAN: Real-time Voice | JAN: Messaging
JAN: Database Access | JAN: Telemetry | JAN: Internet/Intranet
IAN: Real-time Imaging | IAN: Database Access | IAN: Telemetry

Labels **A**, **B**, and **C** refer to columns in table on preceding slide