Before the
Department of Commerce
National Institute of Standards and Technology
Washington, D.C.

In the Matter of	)	
	)	Docket No: 110727437-1433-01
Soliciting Input on Research and Development	)	
Priorities for Desirable Feature of a Nationwide	)	
Public Safety Broadband Network	)	

COMMENTS OF SAFETYMESH TECHNOLOGIES, INC.,

A SUBSIDIARY OF COCO COMMUNICATIONS CORP.

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INTRODUCTION

SafetyMesh Technologies, Inc. (SafetyMesh) hereby respectfully submits its comments in response to the National Institute of Standards and Technology (NIST) in the Department of above-referenced matter. The management of SafetyMesh strongly supports the National Public Safety Broadband (NPSB) initiative and believes it to represent a major step forward for first responders across our nation.

SafetyMesh was recently formed as a subsidiary of CoCo Communications Corp. (CoCo), which was formed in 2002, to assist in resolving issues relating to our nation's public safety communications infrastructure. CoCo has developed innovative products and technology solutions in the areas of wireless mobile networking and public safety interoperability that have been deployed with a variety of state, local, and federal customers. CoCo has also deployed radio interoperability solutions in response to the Department of Homeland Security's (DHS) Information Technology & Evaluation (ITEP) grant program[1], provided input to the Department of Commerce's Public Safety Interoperability

[1] http://www.dhs.gov/xnews/releases/press_release_0515.shtm, http://www.cococorp.com/press_DLFSessions.html

Communications (PSIC) grant criteria[2], assisted Urban Area Security Initiative (UASI) customers[3] including assistance during the Deepwater Horizon disaster response, and has deployed interoperability solutions to local school districts. A variety of Department of Defense (DoD) and DHS customers have used CoCo's Man-to-Man networking technology to solve in-building, interoperability, and coverage-related problems. These systems provide public safety and military personnel with mission critical off-network communications when their primary infrastructure fails or is congested[4].

SafetyMesh welcomes this timely opportunity to provide comments to the Institute with the intent of improving our nation's public safety communications infrastructure. As subject matter experts in the field of wireless networking for critical voice, we concur with the four cornerstone themes and fifteen specific requirements laid out by the Justice Community Oriented Policing Services (COPS) office. We strongly support the need to unify all public safety communication into a single device, and for that device to support each of the enumerated requirements.

SUMMARY

SafetyMesh supports efforts by NIST to create clarity around how federal grants should be allocated. We support the desire of the Federal government to accelerate the development and implementation of a national broadband network available for organizations directly involved in providing public safety services.

DISCUSSION

A. Requirement Item Comments

[2] Department of Commerce National Telecommunications and Information Administration (NTIA) Public Safety Interoperability Communications (PSIC) Grant Program, http://ntia.doc.gov/psic/
[3] New Orleans Region Urban Area Security Initiative, http://www.neworleansuasi.org/
[4] U.S. Coast Guard Boarding Team Communications, U.S. Navy Damage Control Communications System

Item 1: A critical aspect of network availability will be spectrum reuse. Each cell tower is able to reuse the spectrum allocated, so if you have 200 towers, you have 10 times the bandwidth capability of a network of 20 towers. No local or regional operator can begin to build a network with the comparable density of a commercial carrier. It will be faster and more cost effective to invest in only the incremental costs to add public safety (P/S) Long Term Evolution (LTE) frequencies to a commercial tower versus zoning, leasing or building a new cell site from scratch.

Item 2: Original Equipment Manufacturers (OEMs) benefit from the proprietary nature of their command and control software. Creating a standard methodology for communications between command and control centers with devices such that any conforming device can communicate with any confirming command and control center, and deliver all the capabilities first responders need from their networks, will allow application developers and third party manufacturers to lower the cost and accelerate the development of new features and capabilities

Item 3: An evaluation of the methods available to carriers which will allow them to dynamically implement a "priority pre-emption scheme" providing first call on network capacity to first responders during emergencies will allow them to meet first responder requirements without the need for an inflexible (with regard to capacity) redundant network. LTE Rev 8 and Rev 10 are supposed to be addressing this issue.

Item 4: "Talk-Around" is a deliverable capability as part of an LTE network with the following considerations:

a. The first issue is capacity. The network needs to have sufficient capacity to provide mission critical voice on top of data requirements. A commercial network with a high level of spectrum re-use can achieve that level of utility.
b. A second issue is latency. Operating systems vary from smartphone to smartphone and the prioritization given to sound packets may be higher on some phones than others. To

minimize latency, the operating system needs to provide the application developer an ability to move time-sensitive voice packets to the top of the queue when that application is running and preclude other non-core programs from attempting to re-prioritize other packets. Lower latency is achieved when a Voice over Internet Protocol (VoIP) packet is processed before a "navigation image" packet. The capability within the operating system, loaded onto a phone, to specify the priority of individual programs would be helpful in this regard.

c. A third issue is power management. Talk-Around requires the device to be constantly monitoring the environment for information coming from other authorized "Talk-Around" devices. This monitoring uses up a lot of energy. Technologies such as Qualcomm's Flashlinq™ endeavor to put functionality into "sleep" mode at specific coordinated times so that battery life is extended. First responders will want devices that can last a full shift on one extended battery.

d. A fourth issue is mesh architecture. Current Push To Talk (PTT) systems in use by public safety limit a user to communicating with other devices that have adequate signal strength to directly connect. A self-organizing and self-healing mesh architecture assures that anyone in the mesh can communicate with anyone else in the mesh, and has access to any network connectivity of any device in the mesh even if some devices in the mesh are individually too far away for that device to communicate directly. This capability assures each first responder has access to the same information at the same time and no first responders are receiving only a subset of the information available at any point in time.

Item 5. A fifth issue is Geographic Coverage. Any NPSB network with limited capital to invest in coverage will need to allocate capital investments between higher cell site density in urban areas (better coverage and spectrum reuse) versus lower cell site density to cover rural areas with less frequent usage. Creating a structure that would allow commercial carriers to manage the spectrum in either rural

or urban environments may allow communities to invest in only the incremental cost of adding radios to existing commercial sites and therefore optimize the coverage/spectrum re-use per dollar spent. A clear legally acceptable methodology for communities to contract with commercial carriers to manage their public safety spectrum should leverage the amount of utility gained for each invested dollar

Item 6. A sixth issue is Dynamic management and control of the network. A set of capabilities should be defined addressing what features need to be managed dynamically so that developers can work to a specification, rather than independently create that list of requirements. For example, users would want to have a way to dynamically modify talk-groups with drag and drop functionality at either the network or local level.

Item 7. A seventh issue is Interoperability. Interoperability should be made available at both the network and the local "Talk-Around" level. Full interoperability should include the ability for a device sold for NPSB spectrum use to be able to make a direct dial call to any Public Switched Telephone Network (PSTN) number and go out over a commercial carrier network (GSM, CDMA, or LTE multi-mode). Additionally interoperability should allow first responders or organizations directly supporting first responders (i.e. public utility workers) to participate in LTE network talk groups with first responders when desirable. There would be additional value in having NIST support the development of capabilities that would allow public safety agencies to access and deliver information to commercial networks for the benefit of first responders using commercial networks (i.e. EMER/Man Down alarm signaling).

Item 9. Non-Proprietary: The use of proprietary technology should be well defined to explain that operating systems and hardware platforms should be open and potentially attract multiple application developers. However it should be recognized that with regard to end-user applications they often offer capabilities that go beyond the scope of existing standards. For example the military has defined a FIPS-140-2 crypto stack certification which may be achieved by two independently created applications that cannot talk with one another. Multiple applications may have similar security capabilities but communication security is, by its nature, not an open book. And communication security

is critical for first responders who are often dealing with information that must remain inaccessible to interested outside parties. At some point communities will want to have the ability to select the best applications to run on their devices that are available in the market. Two applications developed by different companies to achieve the same purpose will likely not be compatible unless a standard is created that each will adhere to. The development of standards is a long and time consuming process that is generally led by large organizations over a period of years. Allowing end users to have the option of selecting the best in class applications without a requirement that each be able to operate seamless with the other (proprietary) will allow for faster development of applications that capture the full potential of new devices and operating systems. Excluding the need for end user applications, especially those with integrated secure communication capabilities from different vendors, to be compatible, will attract a wider pool of application developers and accelerate the time to market for applications that can enhance the value of any smartphone device on a public safety network.

B. Feature Item Comments

Item 1. SafetyMesh is specifically focused upon the *resiliency* theme in the NIST request for comments (RFC). Below are its responses to individual features.

Item 2. Self-Organizing: Because first responders deploy in accordance with the National Incident Management System (NIMS) and issue orders according to the Incident Command System (NIMS/ICS), it is vital that their communication devices can aggregate and disband with a similar level of modularity. It is impractical to imagine each fire truck or police squadron halting to reconfigure their radios each time an incident changes scope. For that reason, SafetyMesh believes that the requirement for self organization is an issue of highest priority.

SafetyMesh's parent CoCo has repeatedly demonstrated this capability in mobile mesh and mobile infrastructure networks while satisfying the concerns of security, availability, and affordability. Therefore, we believe that this requirement is also feasible currently.

Additionally, it is especially important that local (Talk-Around) functionality be self-organizing so as to avoid the need for first responders to have properly trained personnel onsite to benefit from the capabilities of their technology. All functionality that is managed in the field needs to be intuitive to manage and minimize the need for specialized training.

Item 3. Meshing: As stated in the 9/11 Commission Report and in Hurricane Katrina recovery analyses, the ability for public safety devices to operate in austere environments and during infrastructure failure is mandatory[5]. There is little to say except that the technology is proven and available in current generation smart devices, with amazing breakthroughs already on the way to commercial availability. The core challenges of meshing in secure, available, affordable, and usable devices are: power management and spectrum availability.

For LTE equipment, one commercial solution is already in the development stage: Qualcomm's recently announced FlashLinq chips offer a meshing mode directly from the infrastructure radio. This implies that a second radio will not be needed and so the battery life will double with respect to current two-radio solutions. In addition to this example, the LTE Forum recently announced its intent to include "Talk-Around" meshing capability in an upcoming standard release.

Between these two options, SafetyMesh believes that a single radio device will be able to support both the daily infrastructure usage and emergency meshing as well. When combined with the CoCo secure mesh routing stack, we believe that this requirement can be met. Since it is mandated and feasible, we believe it should be upheld as a significant hallmark of NPSB devices.

[5] www.gpoaccess.gov/911/pdf/fullreport.pdf

This is absolutely essential for first responders. The current P25 network when used in conventional simplex radio mode does not have mesh capabilities, so any speaker may or may not be heard by other first responders onsite. A mesh architecture assures each speaker that anyone on the mesh can hear each person on the mesh, even when they can only make a radio connection with one other device on the mesh.

Item 4: *Adaptability:* The public safety software stack of the future needs to be built from standard components that permit flexible reconfiguration when a new problem rears its head. This should be treated as a mandate to use open source software and standard communication protocols when possible. This model has been adopted by the Department of Defense's Joint Tactical Radio Systems program with good result. Vendors are prevented from achieving "lock in" and are instead required to continually innovate and compete their highly compatible solutions. The competition cycle brings new performance and capability guarantees with each product release, ensuring an adaptable device ecosystem rather than stagnant "tide pools" of obsolete vendor deployments.

Item 6. QoS: Quality of service should be defined as Personal Communication Service (PCS) voice grade duplex communications with a vocorder equivalent in quality to commercial cell phones. The local area mesh needs to have the ability to dynamically replace packet loss.

Item 7. Strong Dynamic Access Control: Local users should have the flexibility to add, remove, or manage outside party participation in talk groups without relying on network support personnel. That capability should be intuitive, using well known interface concepts like "drag and drop".

Item 8. Compatibility with Commercial Infrastructure: It will be important to provide the legal authority for a designated party to contract with a commercial carrier in such a way as to allow that carrier to utilize public safety spectrum on an exclusive or non-exclusive basis. Commercial carriers will be reluctant to certify a NPSB phone for use on their network without some economic incentive. Additionally, they will be reluctant to add a NPSB spectrum capability to their devices without some level

of control as to how that device interoperates with their network. The ideal scenario is to provide a chosen carrier with exclusive rights to NPSB or other public safety spectrum in exchange for giving first responders first priority on channel access. Then the carrier acquires much needed spectrum to support their existing customer base. They can also leverage their existing infrastructure and equipment buying power to provide public safety agencies with a commercial grade, state of the art network, with significant spectrum reuse, at a fraction of the cost of building a brand new network.

Item 11. Scalability: Mobile wireless carriers are currently providing voice, data, text and video services to over 303 million subscribers in the United States[6] and the vast majority of that traffic is carried over 120 MHz of spectrum between 1850 and 1990 GHz[7]. The amount of spectrum needed to support 5-7 million public safety workers is quite small if that spectrum was used as efficiently as our carriers are achieving today. The efficiency of the spectrum is a function of bandwidth and reuse. A network of 250 cell sites will have 25x the user capacity of a network with 10 cell sites, even though both networks may have the same amount of spectrum. This is because a well designed and implemented cell site sector can reuse the same spectrum as another cell site sector and carry simultaneous conversations on the same frequency without interference.

First responders want to assure themselves that they will have the capacity they need during emergencies. That problem can be handled in two ways.

a. We can create a parallel network to the existing commercial networks and assume we will get comparable capital efficiencies, however the ability to gain zoning approvals for towers in most urban areas has been getting harder and harder as the good locations are already leased. We have been told that some carriers believe it will cost around $50-75 billion dollars to build a national network with frequency reuse comparable to current commercial networks.

[6] http://en.wikipedia.org/wiki/List_of_countries_by_number_of_mobile_phones_in_use
[7] http://en.wikipedia.org/wiki/Cellular_frequencies

A network can be built for $10 billion, but we will have a much smaller number of cell sites than commercial carriers, and that means our frequency reuse will be much less efficient.

b. We can contract with a commercial carrier to add LTE radio frames to existing networks at a small fraction of the price of a new network. This will eliminate the cost of the physical structure, tower, zoning, leases, power, backhaul, etc. The marginal cost is a small number of radios for each existing tower. Carriers may not bid aggressively on the "D" block because they perceived cost of building a stand-alone network to be higher than the value of the unused spectrum by their calculations. However, if we reduce their cost by allowing them to leverage their existing networks, then the return on investment becomes much more attractive for them. If we look at the value of unused spectrum in a full network deployment it could justify some significant investment by one or more carriers. One problem remains to be solved, however. The public safety users will want assurances that their spectrum is available to them on a first priority basis. That may not be possible with the current version of LTE, but should be available with the next version of the LTE standard. At that point you could conceivably have a public safety agency provide the spectrum in their market to a carrier of their choice in exchange for a fully functional network with lower capital and maintenance costs.

If that can be done, the next question is what would be provided. If a carrier such as Verizon can support 80 million subscribers with 30 MHz of spectrum[8] in the 1.8-2.0 GHz range, then the focus should be on how to leverage that spectrum with as much value as possible for public safety agencies.

The most scalable network is a commercial network that can provide priority to first responders. No NPSB network can match the coverage and density of a commercial network at a cost acceptable to the American public. Leveraging an already existing network provided by commercial carriers and

[8] http://www.fiercewireless.com/story/verizon-adds-1-1m-subs-q2/2009-07-24

allocating available funds to handheld devices and operating costs will maximize the return on the investment for the public at large.

Item 12. Power Functions: Integrating a power management function like Qualcomm's Flashlinq application will dramatically expand the capabilities that application developers can add to a handheld device.

C. Additional Comments

The NPSB requirement set should focus on defining a platform that leverages the full potential of application developers, rather than a subset of those potential capabilities in the interest of simplicity or perceived spectrum capacity. That means the specification must include on-net or off-net IP traffic providing; voice, video, chat, and the capability of handling all forms of IP data currently known or unknown without restriction.

Virtually every function available to first responders today can be delivered to a first responder, on a commercial phone loaded with the right applications. If you define the requirements such that applications can run on a device that is capable of delivering a full suite of capabilities (voice, data, text, and video), then the applications will be ready by the time the phones are ready.

Smartphones are inherently difficult to use for a "gloved" first responder but it is likely that a specification could be created to transfer "gloved" operations like "EMER-Man Down" and "PTT" functionality being moved to a peripheral device like a clip on speaker microphone similar to the ones used on P25 radios. If specifications were developed such that a device could be plugged into a USB or microphone port and provide functionality comparable to a P25 radio, then you move closer to the point where the smartphone could become a replacement to the P25 or UHF/VHF radio.

The last missing piece would be the operations control center functionality, but developers could set up communications such that the commercial network would deliver IP based inputs into a command center identical to the current inputs and allow those command centers to continue operating without any

significant changes in their standard operating methodology. The end result would be an open architecture that allowed competition to deliver the best designed, most reliable, and most cost effective solutions to first responders.

Commercial networks can currently meet 68% of the 31 requirements and features outlined in the request for comments. SafetyMesh has application software available today that can bring that up to 100% of the requirements and features if commercial carriers were allowed to comingle commercial and public safety user support on public safety spectrum.

By expanding the requirements associated with a NPSB network to include mission critical voice, you align the capabilities of the spectrum with the specification so that the public safety industry is not working with a specification that is a subset of the capabilities of LTE. In addition, you are going beyond the LTE protocol by adding "Talk-Around" capabilities which are a function of the software defined capabilities of the phone itself, rather than the network supporting that phone. Talk-Around can be very easily achieved using Wi-Fi spectrum which is already in place in many locations, but can also be integrated into the phone so that no external routers are even necessary.

By providing a well-defined platform for application developers that can operate on a standards-based network run by an experienced carrier selected by a competitive bidding process, you have delivered a system that can be reliable, cost effective, and flexible enough to keep up with advances in commercial network devices and capabilities.

Power management will be a challenge for the market and grants which support the development of improved power management (i.e. FlashLinq) and will allow additional functionality and capabilities to be integrated into devices. The major challenge preventing phones from including router capability as a software defined function is power management.

Developing a specification for public safety peripherals will also shorten development times and reduce risk for investors. A number of devices can be developed to change conventional smartphones into public

safety devices, but no standardized specs exist for that now. Funding to develop industry accepted specs for PTT devices, remote cameras in infrared/visual spectrum, "EMER" button functionality, etc. will accelerate the market for those products to be made available to first responders by the time the network is ready to support those devices.

CONCLUSION

Our local and regional government agencies are struggling with a governance model that can take many years to make a decision, and these decisions often have to balance different perspectives, needs, and capabilities. Commercial carriers are not constrained by the same process and are economically incentivized to adopt new technology quickly. As a result, if first responders want to maintain equivalence to commercial network reliability, coverage, bandwidth, and features, they need to embrace commercial carriers as the logical partner to manage their spectrum. A collection of public organizations with different interests and capital resources simply cannot move as fast as a commercial carrier. It is impossible to know today all of the things that can be done on devices in five or ten years. As a result a flexible definition of NPSB requirements that allows application developers to create products that can work on any commercial or government network, and make them available to first responders, will optimize our investment for the benefit of first responders. Such a definition should not limit the NPSB to data applications, or specify how the network should be managed. Instead it should encourage application developers to work on a broad palate of capabilities equivalent to what commercial networks can provide (including Voice over LTE) and provide a mechanism for communities to contract with approved commercial carriers who have agreed to allow roaming between markets for NPSB first responders regardless of their chosen carrier.

Respectfully Submitted,

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