TESTIMONY OF DR. KENNETH J. ZDUNEK

VICE PRESIDENT AND CHIEF TECHNOLOGY OFFICER
ROBERSON AND ASSOCIATES, LLC

on

S. 3756
Public Safety Spectrum and Wireless Innovation Act

before the

Committee on Commerce, Science and Transportation

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Introduction

Good morning Chairman Rockefeller, Ranking Member Hutchison, and Members of the Committee. My name is Kenneth Zdunek, and I am Vice President and Chief Technology Officer of Roberson and Associates, LLC, a technology and management consulting firm with government and commercial customers. We provide services in the areas of RF spectrum management, RF measurements, and technology management. I also served as Vice President of Network Research at Motorola, Inc. for nine years. I am an IEEE Fellow and research faculty member in Electrical Engineering at the Illinois Institute of Technology. Thank you for inviting me today to testify regarding S. 3756, the Public Safety Spectrum and Wireless Innovation Act.

Summary

Our company was asked by T-Mobile, USA to perform a technical analysis of a shared 700 MHz D-Block commercial/public safety system, as recommended in the *National Broadband Plan*. While there is understandable frustration about the delay in creating an interoperable public safety broadband network, any decision about how to proceed may still be premature until the FCC, with guidance from the public safety community and industry, is able to fully evaluate the complex issues that implementation of such a network raises. It is important to note that the types of public safety networks proposed in the *National Broadband Plan* and in S. 3756 have much in common -- both seek to ensure the creation of a nationwide interoperable public safety broadband network introducing new levels of priority access to, and roaming on, commercial networks. The implementation and deployment of such a first responder network

integrated with commercial systems presents a unique, once-in-a-generation opportunity. In order to proceed, careful analysis of many complex technical matters implementing the long term evolution ("LTE") platform that 700 MHz systems are expected to share is required. These analyses are critical to the creation of an effective public safety broadband network regardless of whether S. 3756 is enacted.

While we would welcome a more complete analysis of these technical issues before the FCC, our study confirms the conclusions of the FCC's June 2010 White Paper that assessed public safety spectrum needs. Like the FCC, our study concluded that allocation of 10 megahertz of 700 MHz spectrum for broadband applications, in combination with the spectrum that public safety already holds both in the 700 MHz band and elsewhere, is sufficient to meet current and future requirements and that those needs can best be satisfied under the *National Broadband Plan*. The allocation of the D-Block for commercial purposes, combined with the convergence of commercial and public safety networks on a common LTE standard, presents a unique opportunity in the 700 MHz band to satisfy public safety needs on a combined public/private network better, and more quickly, than they could be satisfied on a stand-alone public safety network. While the goals of the *National Broadband Plan* and S. 3756 are the same, the results of our study leads me to recommend the Committee to support the *National Broadband Plan* and FCC's thoughtful and expert proposals as the best way forward for our public safety and wireless systems to meet the growing first responder interoperability and spectrum needs of the 21st century. The remainder of my testimony summarizes our study.

Public Safety Broadband Needs and Spectrum Capacity

Our analysis strongly confirms the FCC's June 2010 White Paper assessing public safety's spectrum needs, which is the only recent realistic, systematic assessment of first

responders' needs conducted to date. The capacity and throughput provided by a 10 megahertz network using the 700 MHz public safety broadband spectrum with LTE technology is sufficient on a system and sector-cell basis to meet immediate public safety broadband non-voice spectrum needs for day-to-day purposes and incident scene scenarios. Multiple high-quality video streams can be provided by this 700 MHz LTE network over a wide geographic area and commercially available technologies exist to provide increased throughput at cell-edges where signal strength may be lower. Indeed, the ability to re-use frequencies in a cellular format will make more video stream capacity available if an incident occurs over a broad geographic area. The broader the geographic area, the more potential base station sites a public safety user can access. In a geographically large disaster situation, public safety entities will have more capacity because of frequency re-use, an advantage further amplified through access to commercial networks.

Operation of a first responder network which takes advantage of a more densely deployed commercial system may feature even more frequency re-use. While a public safety system featuring frequency re-use may employ hundreds of antenna sites in an urban area, a commercial system in that same urban area will employ many more transmitter sites, each sectorized to allow frequency re-use and enhanced capacity. For example, in its proposal for a 700 MHz public safety broadband system, the San Francisco Bay Area proposes the use of 203 sites. Over about the same area, T-Mobile uses more than fifteen times the number of sites – 3,649. Therefore, by partnering with a commercial system, public safety entities can take the greatest advantage of frequency re-use to dramatically expand capacity.

In instances where all of the 700 MHz spectrum is being used in a small geographic area with no opportunity for frequency re-use, additional broadband capacity is available through the 50 megahertz of 4.9 GHz public safety broadband spectrum. In particular, the 4.9 GHz band can

be a complement to the 700 MHz network, in much the same way as WiFi networks complement commercial wireless cellular networks today. Indeed, this use of the 4.9 GHz band is precisely what public safety had in mind when they urged the FCC to dedicate this spectrum for public safety operations. Sometimes, where there is a WiFi hotspot, wireless traffic connects to the WiFi network and not a cellular base station. Similarly, 4.9 GHz networks can take traffic off of the 700 MHz broadband network to provide additional wireless capacity.

In addition to using the 700 MHz spectrum currently dedicated for broadband use, other public safety 700 MHz spectrum can be rationally converted for broadband operations in the future to create an integrated voice and data network. At present, public safety has a total of 24 megahertz in the 700 MHz band. Twelve megahertz is dedicated to narrowband voice and 10 megahertz is dedicated to broadband, with a two megahertz guard band in-between the narrowband and broadband operations to avoid public safety interfering with itself. Sound spectrum stewardship suggests that portions of this 12 megahertz of narrowband voice spectrum can be transitioned, over time, to accommodate voice on the broadband network. Our study indicates that if an additional ten megahertz of today's twelve megahertz of narrowband spectrum is rationally transitioned to broadband in the future, leaving 2 megahertz for narrowband voice operations, there would still be sufficient capacity at 700 MHz to create 160 traditional narrowband voice communications channels. Therefore, a combination of the 10 megahertz of 700 MHz broadband spectrum with a portion of the currently allocated 700 MHz narrowband spectrum, as already requested by some public safety agencies, would allow a seamlessly integrated voice, data, and video public safety broadband network to be deployed, and would increase the maximum per user throughput and overall capacity achievable within the dedicated public safety network. Integrating narrowband voice capabilities on the broadband

network using the ten megahertz we recommend would also avoid the construction and deployment of two networks at 700 MHz – one for LTE broadband operations and one for narrowband voice. Even assuming funding availability, the implementation of two networks is wasteful, expensive and inefficient and undermines the goal of interoperability.

Finally with respect to public safety capacity, it is critical to recall that 700 MHz is far from the only source of spectrum for public safety narrowband voice capacity. The nearby 800 MHz band can provide 280 narrowband voice channels and the public safety spectrum in the band 450-470 MHz offers over 70 voice channels. Over time, the spectrum in the band 450-470 MHz will be required to be converted to 6.25 kHz bandwidth (narrowbanding), providing a total of almost 600 traditional narrowband voice channels. Therefore, if public safety leverages the full complement of spectrum they are allocated in multiple bands, it is evident that there is sufficient broadband and narrowband capacity for public safety operations well into the future without reallocated D-Block spectrum. Multiple bands are already being used by nearly everyone in this room and some public safety equipment manufacturers are already offering multi-band radios. Commercial wireless devices in your pocket already employ spectrum from the 800 MHz cellular bands, the 1.8/1.9 GHz personal communications service bands and the 1.7/2.1 GHz advanced wireless service bands, and will soon use commercial 700 MHz spectrum. There is no reason why public safety systems cannot leverage its spectrum holdings in the same efficient manner to create a nationwide interoperable public safety network.

Use of Commercial 700 MHz D-Block Networks by Public Safety

The *National Broadband Plan*'s proposal for a public/private partnership will provide first responders substantial technical benefits that a stand-alone public safety system cannot. Primary among these benefits is the priority access to, and roaming on, what will be higher

capacity commercial networks. As I noted, commercial networks are typically constructed with significantly more base station sites than public safety networks -- even a public safety network with a cellularized buildout. In a public/private partnership, first responders will have priority access and roaming rights on these more fully developed private networks -- not using only D-Block spectrum but potentially spectrum throughout the 700 MHz band.

The public safety network and the commercial networks at 700 MHz are all expected to use LTE technology. Critically, the packet nature of LTE allows public safety information to be prioritized over commercial traffic in a manner not possible on today's circuit-mode communications systems. LTE technology allows public safety information to be added to already-busy channels, so the concept of channel unavailability is not relevant. When priority packets are added to a data stream, they can effectively slow down other traffic and be delivered faster than lower priority users' data. The LTE architecture can also inhibit lower-priority users from transmitting during periods of high-priority congestion. This assures that access for public safety users is always available. In addition, the 15 priority classes and 9 bit rate levels of LTE allow provisioning of commercial D-Block networks so that public safety users can achieve any desired priority level.

A good way to think about this LTE feature is its similarity to highway traffic management. Using old technology, when the highway was bumper-to-bumper, no additional cars could easily use it. LTE technology has the ability to monitor access to the on-ramps to the highway *and* regulate the traffic in each lane. It can create lanes with no traffic -- for public safety -- while leaving more congested lanes for commercial use. Therefore, even on a fully utilized commercial network, capacity can always be created for priority public safety communications. Importantly, if public safety has access to a densely deployed commercial D-

Block and other 700 MHz commercial systems, it will get priority access and roaming on more highways, with more lanes, than it could with a 20 megahertz less densely deployed public safety network.

The fact that first responders could have priority access to, and roaming rights on, densely deployed networks is particularly critical in natural or man-made disasters. One of the reasons that public safety entities relied on commercial systems during the September 11 terrorist attacks is because the significantly greater number of commercial base stations available on commercial systems that remained operational. As I mentioned before, even if public safety systems adopt a cellularized infrastructure, they will not have the same number of sites as commercial systems. Priority access to, and roaming on, more densely developed commercial networks will help ensure that public safety always has a communications system on which it can rely -- even when its own more limited infrastructure is not available. The public interest is therefore not well served by simply making sure that public safety has ownership of a limited highway but by giving it access to more roads than it could own by itself. A public/private partnership will give first responders significantly more access to more densely deployed networks than they would have if they relied solely a public safety network.

Limited Interference Risks

In the past, public safety systems have experienced interference from adjacent commercial systems. First responders are still engaged in relocation of their 800 MHz band spectrum because of interference from nearby commercial operations. However, because of the projected use of LTE technology by both the commercial and public safety networks, there should be little concern about interference between the two using adjacent 700 MHz spectrum bands.

Previous interference analyses of D-Block and public safety networks in adjacent spectrum have employed the worst of the worst case scenarios whereby D-Block sites are systematically placed where signals from public safety sites are weakest and most vulnerable to interference. While examining a worse-case scenario is useful from a theoretical perspective, it does not reflect realistic system configuration. The LTE air interface has been designed for adjacent networks in adjacent bands without causing harmful interference. The best situation, as described in the *National Broadband Plan* and other sources, is for the dedicated public safety network base sites to share infrastructure and co-locate when possible with the commercial D-Block sites. Such co-location of public safety and commercial base site equipment is not uncommon today and would expedite public safety network deployment. Still, co-location is not a prerequisite to avoiding harmful interference between D-Block and public safety networks. Any issues can be addressed during system design.

Finally, analysis of the potential interference generated by user device transceivers with integral GPS receivers in the same device shows that any potentially harmful interference can be avoided with a number of well-known methods, including transmit filtering. Moreover, from an interference standpoint, there is little difference between a separate D-Block and a combined D- and public safety block. Both band edges are in the same place relative to GPS signals.

Conclusion

Taking all of the above factors into consideration, our study shows that the *National Broadband Plan* recommendation to auction the 700 MHz D-Block and share facilities between commercial and public safety users is the best way that America can achieve a nationwide interoperable broadband public safety network. The Commission's plan for allowing first responders to roam on, and have priority access to, commercial networks in the 700 MHz band is

highly desirable because of the uniform adoption of LTE technology that will enable them to benefit from cutting-edge technology. Roaming with priority access on commercial networks would best serve our country during emergencies and disasters when a less densely built standalone public safety network might otherwise become overloaded or unavailable. A commercial auction of the D-Block would unlock the value of the spectrum for the delivery of commercial mobile broadband services while supporting the concurrent development of public safety broadband capability through many of the same equipment developments, roaming, and priority access requirements identified in the Public Safety Spectrum and Wireless Innovation Act.

Thank you again for the opportunity to share my views with you today. I look forward to continuing to work with you going forward.