Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Implementing a Nationwide, Broadband,	)	PS Docket No. 06-229
Development of Operational, Technical	)	
Interoperable Public Safety Network in	)	
The 700 MHz Band	)	
	)	
Development of Operational, Technical and	)	
Spectrum Requirements for Meeting Federal, State	)	WT Docket No. 96-86
and Local Public Safety Communications	)	
Requirements Through the Year 2010	)	

To: The Commission

COMMENTS

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EXECUTIVE SUMMARY

The Commission is to be commended for taking a bold and essential step in proposing to revamp its public safety regulatory framework to facilitate the implementation of a nationwide, interoperable, broadband public safety network at 700 MHz. In the Ninth NPR, the FCC has proposed to devote 12 MHz of public safety's existing 700 MHz spectrum to broadband use and to authorize this spectrum in a single block to a single, national public safety licensee for deployment of such a network. The FCC also has recognized the need for the national licensee to enter into arrangements with commercial entities, creating the types of public/private partnerships that will be the essential economic "fuel" for a network of this size and scope. Cyren fully supports the Commission's objective and believes the licensing concept outlined in the Ninth NPR has the potential to revolutionize public safety wireless communications.

Putting aside the fact that the public safety community has waited ten years for access to the 12 MHz of spectrum under consideration, and has developed detailed plans for, or has even begun implementing system deployment on, those channels, Cyren must advise the Commission that its proposal cannot succeed if the spectrum platform for the network is limited to 12 MHz. There are two interrelated elements that will cause the FCC's proposal to fail, elements that cannot be overcome by structural changes in the Commission's regulatory processes and that must not be ignored.

First, there are only two possible sources for financing the network the FCC has described as "consistent with national priorities focusing on homeland security and broadband and our commitment to ensure that emergency first responders have access to reliable and interoperable communications." The funds must come either from the government itself or from private investors. There is no suggestion in the Ninth NPR or elsewhere that the Federal

Government intends to underwrite the approximately Twenty Billion Dollar cost of network deployment, much less the additional billions of dollars required to finance its ongoing operations and future enhancements. Therefore, the Ninth NPR must assume that financing will come from the private investor community.

Yet, second, and contrary to that assumption, the private financing expected to fuel this national priority will not be available if only 12 MHz of spectrum is assigned for this purpose. In fact, a 12 MHz allocation would not even accommodate the expected broadband requirements of the public safety community itself. There would be no available "headroom" on which to serve the approximately Thirty Million commercial subscribers needed at network maturity to justify investing in the network's initial construction and its ongoing operation. An allocation of 12 MHz, built to public safety's technical specifications and coverage requirements, would result in a network cost that could never be recovered. In fact, since this network cannot and will not be deployed on 12 MHz of spectrum, if additional, sufficient 700 MHz spectrum is not allocated for this purpose, public safety would be better served by the FCC's abandoning its effort so that that capacity at least remains available for local, state and regional systems.

The public safety community has called upon the Commission to seek Congressional authority to reallocate 30 MHz from the upper 700 MHz band for the deployment of a nationwide, broadband, interoperable public safety network. Cyren joins with public safety in urging that the FCC take all possible steps to secure this spectrum for public safety use before it is auctioned for entirely commercial purpose and this singular, critical opportunity is lost forever.

Cyren Call Communications Corporation ("Cyren"), in accordance with Section 1.415 of the Federal Communications Commission ("FCC" or "Commission") Rules and Regulations, respectfully submits its comments in response to the Ninth Notice of Proposed Rulemaking in the above-entitled proceeding.[1] The Commission has taken a bold and critical step in the Ninth NPR in response to a matter of the greatest national urgency. This country's public safety community, users for whom robust, reliable, first-in-class wireless communications is a life-sustaining necessity, not a convenience, have been left behind in the advanced technology, broadband revolution. Their 20th century systems not only lack features needed to meet their 21st century responsibilities, but most offer only the most rudimentary, ad hoc interoperability capabilities.

Five and one-half years ago, this country learned the terrible price our first responders pay when they are sent into harm's way without the most advanced equipment available, including radios that enable them to communicate with one another easily and instantaneously during emergency situations. It is almost beyond belief that so little has happened in these intervening years to promote fundamental improvements in public safety communications capabilities – until now.

The Commission, the agency charged with promoting the highest and best use of the nation's communications resources, has proposed in the Ninth NPR to upend the traditional public safety licensing structure. It has proposed to devote 12 MHz of public safety's existing 700 MHz spectrum to broadband use and to authorize this spectrum in a single block to a single, national public safety licensee for deployment of a nationwide, interoperable public safety broadband network. The FCC has recognized the need for the national licensee to enter into

[1] *Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band, Ninth Notice of Proposed Rulemaking,* PS Docket No. 06-229, 21 FCC Rcd 14,837 (2006) ("Ninth NPR" or "NPR").

arrangements with commercial entities, creating the types of public/private partnerships that will be the essential economic "fuel" for a network of this size and scope. The Commission has explained that each of these regulatory innovations has been proposed to advance the overriding objective of "put[ting] into place a regulatory framework that would ensure the availability of effective spectrum in the 700 MHz band for interoperable, public safety use."[2]

The Commission is to be commended for its initiative in attempting to address this critical national problem. Its unwillingness to accept the status quo when faced with a crisis in public safety communications is consistent with the agency's historical commitment to this most vital of the FCC's constituency groups. Cyren fully supports the Commission's objective and believes the licensing concept outlined in the NPR has the potential to revolutionize public safety wireless communications.

But just as it would stop a firefighter rushing into a burning building without the equipment needed to quell the blaze, Cyren must warn the Commission that its proposal, as well-intentioned as it unquestionably is, cannot succeed given the spectrum tools available to the FCC. The nationwide, broadband public safety network described in the Ninth NPR is not financeable. As detailed below, 12 MHz cannot and will not support the many millions of commercial subscribers that are essential to funding deployment of a network built to more rigorous and costly public safety technical specifications and geographic scope. Worse, following the course laid out in the Ninth NPR without a sufficient spectrum/economic foundation threatens to cast this 12 MHz into spectrum limbo – unavailable for use by local, state or regional public safety entities, but not deployable for its intended nationwide purpose.

The unparalleled propagation characteristics of 700 MHz have prompted the public safety community to identify it as the only economically viable band in which a nationwide,

[2] *NPR* at ¶ 1.

interoperable, broadband network could be built. Because the 30 MHz of upper 700 MHz spectrum that is essential for this purpose has been scheduled for auction in less than a year,[3] the clock is ticking down relentlessly toward its unavailability for this critical national purpose. A failure to act promptly and decisively to preserve this 30 MHz for assignment to a national public safety licensee for use in a shared governmental/commercial broadband network will be a defeat for public safety by default – not by decision. Cyren urges the FCC to report this finding to Congress and recommend that the 30 MHz of upper 700 MHz spectrum be reallocated and assigned to the national public safety licensee for deployment of a shared public/private nationwide, interoperable, broadband network.

I. THE NINTH NPR PROPOSES IMPORTANT CHANGES IN THE COMMISSION'S PUBLIC SAFETY LICENSING MODEL

The Ninth NPR confirms the growing national consensus that public safety deserves a quantum improvement in its communications capabilities, an improvement that can be delivered only through deployment of an advanced broadband network. The Commission has described its objective in the NPR as follows:

> Particularly in light of the nation's current and anticipated public safety and homeland security needs, we propose a centralized and national approach to maximize public safety access to interoperable, broadband spectrum in the 700 MHz band, and, at the same time, foster and promote the development and deployment of advanced broadband applications, related radio technologies, and a modern, IP-based system architecture.[4]

This Commission initiative is a logical next step following the FCC's earlier alert to Congress of the vital need for this type of advanced technology, broadband public safety network.[5] The

[3] *See* 47 U.S.C. § 309(j)(15)(C)(v), (vi), as enacted by the Digital Television Transition and Public Safety Act of 2005, Title III of the Deficit Reduction Act of 2005, Pub. L. No. 109-171, 120 Stat. 4, 22 § 3003(a)(2)(2006).
[4] *NPR* at ¶ 4.
[5] *See* Report to Congress on the Study to Assess the Short-Term and Long-Term Needs for Allocations of Additional Portions of the Electromagnetic Spectrum for Federal, State, and Local Emergency Response Providers, WT Docket No. 05-157 at 13 ¶ 26 (Dec. 16, 2005).

Commission has concluded correctly that successful deployment of that network will require a significant departure from the traditional FCC licensing model for public safety systems.

The most critical need for the nation's emergency responders historically has been and will remain access to always on, always available voice communications. Even a millisecond delay in transmission could mean the difference between safety and harm – even death. Public safety users have zero tolerance for radio systems that might not ensure the immediate delivery of these types of mission critical transmissions since reliable communications can be as essential to the protection of police and fire personnel as the guns or hoses they carry. That is why public safety systems are built to deliver as close to guaranteed complete reliability as possible while commercial wireless systems, and their subscribers, accept levels of reliability well short of the public safety standard, aiming to achieve a 98% level of call completion reliability. The difference may appear insignificant unless the call is to a police officer, who is about to enter a residence, that the suspect located inside is armed.. In that situation, it is absolutely unacceptable for that call to be one of the two blocked calls out of every one hundred that does not get through on a commercial system -- the blocking standard to which commercial operators design their networks.

Traditionally, the vital importance of communications prompted local jurisdictions and agencies to seek individually licensed radio systems tailored to their particular requirements and operating on the particular channel or channels assigned to them by the FCC. These needs were well-suited for the Commission's regulatory framework in the fragmented bands below 800 MHz where increasingly narrowband channels are assigned to specific licensees for use at designated transmitter locations.[6] It was not until the FCC made portions of the 800 MHz band available for

[6] As the primarily voice dispatch requirements of the public safety and Business/Industrial user communities continued to grow over the decades, the FCC has demanded that licensees in the shared bands below 512 MHz

public safety use that the rules and the FCC's allocation decisions permitted deployment of multi-channel trunked systems that could be shared by a number of public safety entities. For some members of the public safety community, the efficiencies of trunking (and the lack of channels available for assignment to individual licensees) outweighed the traditional insistence on controlling all aspects of their communications facilities, both the hardware itself and the operating parameters. Those entities now participate in citywide, countrywide and even regional trunking systems, although most also maintain individual, jurisdiction-specific, mission critical systems in other bands.

While these systems will remain integral parts of public safety communications facilities for the foreseeable future, the advent of broadband technology deployment on wireless mobile networks presents the first responder community with both an opportunity and a challenge. Consumers in more urban areas already enjoy the advanced services that commercial carriers are beginning to offer via broadband networks. Public safety entities likewise certainly need, deserve and now should have an opportunity to access these same features and even more on a system designed and built to their particular specifications.

However, it is not feasible for individual public safety organizations to create networks that can deliver these services, networks of the requisite scope and associated cost. Broadband technologies require a substantial swath of contiguous spectrum, spectrum that does not exist in

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migrate to increasingly narrower channel bandwidths. Most recently, the FCC determined that all such licensees must move to channels bandwidths of no greater than 12.5 kHz (or its data equivalent) by January 1, 2013, and has adopted rules providing for even more intensive utilizations of this spectrum on 6.25 kHz channels. *See* Implementation of Sections 309(j) and 337 of the Communications Act of 1934 as Amended; Promotion of Spectrum Efficient Technologies on Certain Part 90 Frequencies, WT Docket No. 99-87, *Third Memorandum Opinion and Order, Third Further Notice of Proposed Rule Making and Order*, 19 FCC Rcd 25045 (2004). Of course, since the Commission embarked on this "refarming" initiative, it has become apparent that wireless broadband technology provides superior spectrum utilization and service offerings *vis-à-vis* narrowband approaches. It may be prudent for the FCC to revisit this proceeding, at least with respect to public safety usage, in light of broadband technology advances in recent years.

the current, highly fragmented public safety allocations.[7] In exchange, broadband delivers significantly higher orders of capacity; more capacity than would be needed by any but the very largest federal governmental entities. The challenge for the public safety community is that effective deployment, economical operation and improved interoperability demands that the network be shared on a nationwide basis, a step beyond the traditional public safety licensing structure.

Thus, the Commission is correct to propose a new regulatory framework specifically suited to meeting advanced public safety communications requirements, a framework that also permits public safety users, like commercial subscribers, to enjoy upgrades as technology advances so that public safety remains at the forefront of innovation in the coming decades. The FCC's objectives detailed in the Ninth NPR capture essential elements that should characterize this 21st century public safety network:

> - **Broadband**: Broadband technologies hold the potential to provide public safety entities integrated access to voice and high-speed data capabilities, and thus may dramatically reduce the time it takes to access information during emergencies. We believe that we should maximize opportunities for broadband use of 700 MHz….[8]
> - **Network Interoperability**: All emergency personnel involved in an incident need to be able to communicate seamlessly. The availability of a nationwide, interoperable, broadband communications network for public safety substantially could enhance the ability of public safety entities to respond to emergency situation…and likely would save lives and preserve property.[9]

[7] A contiguous 50 MHz block in the 4.9 GHz band was allocated for public safety use on a nationwide basis in 2003. *See* 47 C.F.R. §§ 90.1201 *et seq.* While that spectrum may yet prove useful for mesh networking and similar applications during highly localized, contained events, the propagation characteristics of the 4.9 GHz band make it essentially unusable for the type of mobile communications network under consideration herein. Radio signals this high in the band have very limited coverage making the cost of network infrastructure deployment on the scale contemplated in the *NPR* economically prohibitive. Anyone who suggests that this spectrum could support high mobility operations over a typical public safety coverage area, the necessary operating environment for ambulances, police cars and fire trucks, is either technically unqualified or deliberately disingenuous.
[8] *NPR* at ¶ 12.
[9] *Id.* at ¶ 13.

- **Adequate Funding**: None of the other objectives of a public safety communications system can be met without adequate funding.[10]
- **Cost-Effectiveness**: Public safety services should be provided at the least cost given the characteristics…of services provided….Also of importance is the ability to continually evolve technologically and incorporate new capabilities, while preserving backward compatibility and interoperability with subscriber units in the field.[11]
- **Efficient Spectrum Use**: Public safety services should use spectrum efficient technologies that appropriately reflect the value of spectrum.[12]
- **Robustness**: Survivability is an important objective of the envisioned nationwide public safety broadband system.[13]
- **Flexible Modern Architecture**: A pubic safety communications network employing modern IP-based wireless system architecture may have many advantages in terms of flexibility, cost and compatibility with the existing IP-based networks.[14]

Cyren agrees that this ambitious agenda is appropriately designed to meet 21st century public safety communications requirements and that it is achievable on an appropriate spectrum platform. The FCC can have no more important objective.

The Commission's recommended regulatory structure is described in the NPR as including the following elements:

> (1) reallocate 12 MHz of wideband public safety spectrum to broadband use; (2) assign this 12 MHz to a single, national, broadband, public safety licensee; (3) permit the national broadband licensee to operate on the 12 MHz of narrowband public safety spectrum on a secondary basis; (4) permit the national broadband licensee to provide broadband service for a fee to public safety entities; (5) permit the national broadband licensee to lease its spectrum to commercial service providers on a secondary, unconditionally preemptible basis; (6) facilitate public safety shared use of commercial mobile radio service ("CMRS") infrastructure; and (7) establish performance requirements for the national broadband licensee for interoperability, build out, preemptibility of commercial use and system robustness.[15]

[10] *Id.* at ¶ 14.
[11] *Id.* at ¶ 15.
[12] *Id.* at ¶ 16.
[13] *Id.* at ¶ 17.
[14] *Id.* at ¶ 18.
[15] *NPR* at ¶ 4.

Cyren agrees that a nationwide broadband network designed to meet public safety requirements and intended to provide priority access to public safety users must be overseen by, and the associated license held by, a single licensee. The important rights and responsibilities associated with a nationwide system cannot be shared by a variety of individual public safety entities, but instead must reside within a single organization that is fully representative of the broad gamut of local, state and federal public safety entities as well as appropriate federal agencies such as the Commission.[16] This will ensure that decision making with respect to issues of national network significance, such as choice of a technology platform, establishment of overall network specifications and determinations regarding system upgrades, is handled on a national collaborative basis, while leaving to more localized public safety organizations decisions that require detailed knowledge of the individual requirements and priorities of users in particular areas. By designating a single national entity as accountable, the Commission can avoid the more heavy-handed regulatory command-and-control oversight the FCC often has felt necessary for bands where licensing is highly fragmented. The national licensee will have the same opportunities and incentives as a commercial wireless operator to maximize its spectrum utilization and to optimize its vendor relationships, both with an eye toward achieving economies of scale that will drive costs to the lowest possible levels consistent with the products and services required, while maintaining the flexibility needed to respond quickly to evolving technology advances.

[16] In its Petition for Rulemaking, Cyren recommended a Public Safety Broadband Trust ("PSBT" or "Trust") comprised of representatives of the broad public safety community as the national licensee for 30 MHz of upper 700 MHz spectrum to be reallocated from commercial use. *See* Petition for Rulemaking of Cyren Call Communications Corporation, RM 11348, filed April 27, 2006 ("Petition"). The Petition was placed on Public Notice on October 30, 2006, and assigned RM-11348. *Public Notice*, Report No. 2794 (rel. Oct. 30, 2006). The FCC dismissed the Petition on November 3, 2006, stating that because the Petition proposed the reallocation of 30 MHz of 700 MHz spectrum from commercial to public safety use it required Congressional action and was beyond the scope of the FCC's authority. RM 11348, *Order*, DA 06-2278 (rel. Nov. 3, 2006). However, the Commission left the proceeding seeking comment on the Petition open even after its dismissal. More than 1300 comments were filed, virtually all of which supported the principles of Cyren's proposal.

The Commission also has recognized that its new regulatory framework will require a new "business" model for public safety licensing. To that end it has recommended that the national licensee be permitted to assess a usage fee for broadband service on public safety entities that access the network. It also has proposed that the licensee have authority to enter into spectrum leases and other contractual arrangements it deems necessary to finance initial system deployment and ongoing maintenance, operations and improvements and to ensure competent network management.[17] The FCC also has specified that these spectrum leases, of course, must be predicated on the primacy of public safety communications needs on the network. The transmissions of commercial subscribers must be entirely preemptible during emergencies when public safety requires more than its normal capacity.

Cyren agrees with the Commission that these ingredients are essential for a nationwide, interoperable, broadband public safety network. It applauds the FCC's proposed innovations in public safety licensing. But, for the reasons detailed below, Cyren respectfully submits that these elements nonetheless are insufficient for the Commission's purpose. More alarming, adoption of the Ninth NPR as currently crafted would mean that one-half of the 700 MHz spectrum for which public safety has waited almost ten years would not be available for its use at all; precluded by FCC rule from being used at the local or state level and prevented by basic economics from being deployed as a nationwide broadband network. Since that would be the

[17] The *NPR* proposes that the national licensee have non-profit status, the ability to represent all public safety interests directly, and public safety frequency coordination experience. The *NPR* further proposes that no commercial interest may be held in the national license or licensee and that no commercial interest may participate in management of the national licensee. *NPR* at ¶ 27. Cyren agrees that the national licensee must represent and be entirely controlled by public safety entities. Its independence and authority must not be compromised by a commercial entity(s) having even a *de facto* or, worse, a *de jure* controlling interest in that licensee. However, it presumably is not the FCC's intent to circumscribe the national licensee's authority or flexibility to enter into normal contractual arrangements with entities qualified to fulfill a role in network management, deployment or operations. Such a restriction would go well beyond the Commission's typical licensee oversight and would create potentially insurmountable restrictions for a licensee that might not have internal expertise in advanced network systems or experience in operating a system of nationwide scope.

worst possible result for public safety providers and for the public they protect, Cyren urges the Commission to seek Congressional authority to reallocate sufficient 700 MHz spectrum to deploy the network described in the NPR.

II. THE PROPOSAL IN THE NINTH NPR WILL NOT SUPPORT DEPLOYMENT OF A NATIONWIDE, INTEROPERABLE, BROADBAND PUBLIC SAFETY NETWORK

Cyren is confident that broadband technology will be available to support the advanced network endorsed by the FCC. Cyren is confident that the public safety community will embrace this opportunity to secure mobile communications capabilities equal or even superior to those available on commercial networks and will pay appropriately priced usage fees for system access.[18] Cyren is confident that public safety users will cooperate with one another and with other relevant constituency groups in creating a national licensee, representative of all of public safety, to safeguard the spectrum deployed in the network.

Nonetheless, there are two interrelated elements that will cause the FCC's proposal to fail, elements that cannot be overcome by structural changes in the Commission's regulatory processes and that cannot be ignored in the FCC's decision making process.[19] First, there are only two possible sources for financing the network the FCC has described as "consistent with national priorities focusing on homeland security and broadband and our commitment to ensure

[18] Public safety's enthusiastic support for a nationwide, broadband, shared public/private network is amply evidenced in the more than 1300 comments filed in support of the Cyren Petition.

[19] It is clear that the Commission has a statutory obligation to consider the economic feasibility of the rules it proposes, an obligation that has been affirmed consistently by the Courts. "Contrary to petitioners' assertions, no general principle of administrative law forces all agencies to conduct exhaustive economic impact studies before taking action. Such a requirement would hamstring administration at every juncture of the policy making and implementation process….We would be remiss, however, if we permitted the FCC to implement a registration program that would have major effects on rates paid by telephone subscribers without even considering that potential economic impact. The purpose of the Communications Act – to establish 'a rapid, efficient, Nationwide and world-wide wire and radio communication service with adequate facilities at reasonable charges,' – would be undercut if the Commission could adopt 'technical' requirements without making a preliminary reasoned assessment of their economic impact." *North Carolina Utilities Comm'n v. FCC*, 552 F.2d 1036, 1055 (4th Cir. 1977).

that emergency first responders have access to reliable and interoperable communications."[20] The funds must come either from the government itself or from private investors. As there is no suggestion in the Ninth NPR or from any other credible source that the Federal Government intends to underwrite the approximately Twenty Billion Dollar cost of network deployment, much less the additional billions of dollars required to finance its ongoing operations and future enhancements, the Ninth NPR must assume that financing will come from the private investor community. Second, contrary to that assumption, the private financing expected to fuel this national priority will not be available if only 12 MHz of spectrum is assigned for this purpose. An allocation of that size built to public safety's technical specifications and coverage requirements would result in a network cost that could never be recovered. 12 MHz would not support the approximately Thirty Million commercial subscribers needed at network maturity to justify investing in the network's initial construction and its ongoing operation. Since rational investors do not invest without expecting some reasonable rate of return in some reasonable time period, they will not invest in the network proposed in the Ninth NPR.

This is an issue of mathematics, not politics or policy. Although the Ninth NPR recommends a more flexible regulatory environment for a broadband public safety network, it does not propose an effective mechanism for financing that network, either initially or over time. The public safety user population that Cyren has estimated at approximately 2.7 million persons is simply too small to serve as the primary revenue source for this network. 12 MHz will not provide adequate capacity to both provide services that the public safety user base will need (given its superior reliability and priority usage requirements) and still support a commercial

[20] *See* Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communications Requirements Through the Year 2010, WT Docket No. 96-86, *Eighth Notice of Proposed Rulemaking*, 21 FCC Rcd 3668 (2006).

subscriber base (even with its lower, commercial-grade service expectations) large enough to attract the necessary private investment. The center simply will not hold for a nationwide, broadband, interoperable public safety network that is allocated less than 30 MHz of spectrum.

A. 12 MHz of 700 MHz Spectrum is Not Adequate Even to Satisfy Public Safety Broadband Requirements and Cannot Support Meaningful Commercial Usage

In the Ninth NPR, the FCC identified several likely public safety broadband uses:

> For example, police officers could exchange mug shots, fingerprints, photographic identification and enforcement records; firefighters could have access to floor and building plans and real-time medical information; forensic experts could provide high resolution photographs of crime scenes and real-time video monitoring transmitted to incident command centers.[21]

The FCC also described other broadband capabilities that could enhance emergency responders' ability to do their jobs even more efficiently and effectively: "video surveillance, real-time text messaging and email, high resolution digital images and the ability to obtain location and status information of personnel and equipment in the field."[22] Additional broadband applications such as collaborative white boarding, video conferencing and 3D GIS capabilities for personnel, asset and incident management, have been cited by the public safety community as key features that will be needed to meet their growing responsibilities. In particular, the ability to have real-time situational awareness of events as they unfold will provide public safety with an invaluable tool to complement its mission critical voice communications.

There is no question that the advanced technology broadband network contemplated by the FCC would be used for these and myriad other purposes, some of which have not yet been imagined. One of the truths of wireless technology, proven over the past two and one-half decades, is that expanded capacity inevitably is absorbed by increased usage fueled by new

[21] *NPR* at ¶ 12.
[22] *Id.* at ¶ 2.

applications and by cost reductions attributable to marketplace efficiencies. It could not have been anticipated in 1983 when the first analog cellular system was activated that subscribers in 2007 would be using their "phones" to take pictures, watch movies, read emails and maintain calendars. The same will be true for public safety broadband usage once the emergency responder community has access to broadband capabilities on a shared governmental/commercial network that delivers the same economies of scale that have driven consumer wireless subscriber equipment costs down dramatically .

Cyren anticipates that equipment manufacturers and application developers would seize the opportunity to provide the emergency responder market segment with a broad variety of products tailored specifically to rigorous public safety requirements at prices that approach those achieved at consumer-based volumes[23]. The ability to develop broadband applications and user devices geared to a common, open standards technology platform would permit volume-driven cost economies to an extent rarely seen before in this market segment. The Commission already has recognized that these products will enhance the safety of the nation's emergency response providers, as well as the safety of the public they are charged to protect. However, they also will require bandwidth to a degree heretofore unseen within a public safety community that traditionally has had access only to extremely narrowband transmissions.

Yet the Commission has proposed that this advanced broadband network, a network expected to accommodate all of the expanded usage requirements described by the FCC, be deployed on public safety's existing 12 MHz of wideband 700 MHz spectrum. Putting aside the fact that the public safety community has waited ten years for access to that spectrum and has

[23] One of the unfortunate consequences of the anti-competitive pressure exerted by certain dominant CMRS operators opposed to elevating public safety requirements over corporate profits is the absence of significant vendor input on these important matters. This lack of public vendor involvement should not be misinterpreted by the Commission as a lack of vendor interest.

developed detailed plans for, or has even begun implementing system deployment on, these channels, the 12 MHz of 700 MHz spectrum proposed by the FCC does not offer adequate capacity even to meet the broadband requirements of local, state and regional governmental entities. It assuredly will not also accommodate federal government users, an essential element of meaningful interoperability. Even more critically, the broadband requirements of public safety users will not leave sufficient capacity on a 12 MHz network to accommodate the approximately Thirty Million commercial subscriber units required to attract entrepreneurs whose investments are essential to fund initial network deployment, plus ongoing operations, maintenance and system upgrades.

Appendix 1, Public Safety Broadband Capacity Analysis, compares the capacity that would be available to serve the public safety community on a 12 MHz versus a 30 MHz advanced technology broadband network. It concludes that a 12 MHz network would be able to support only approximately 1.2 Million public safety users. This is not surprising since streaming video, the very essence of real-time situational awareness, is, by far, the broadband application of greatest interest to the nation's first responders. The capability that they need more urgently is also the most spectrum-intensive and will place substantial capacity demands on the network. Moreover, this network, like all public safety systems, must be built to assure as close to guaranteed complete reliability, rather than the 2% blocking rate that is considered acceptable for commercial users and that would be used for commercial traffic on this network as well. (Those who might argue that public safety should learn to tolerate a higher blocking rate in a misguided attempt to satisfy an arbitrary "spectrum efficiency" standard undoubtedly have not held a finger on a trigger while waiting for the "Shoot/Don't Shoot" command.)

That public safety access to broadband technology will lead to significant consumption of available broadband network capacity should not be a surprise to the Commission. The FCC forecast increased public safety spectrum requirement more than ten years ago when it adopted the spectrum needs findings of the FCC-sponsored PSWAC Final Report[24] and again just over a year ago when the agency submitted its own needs report to Congress.[25] Unfortunately, the now decade-old 700 MHz allocation did not assign enough spectrum to public safety to meet even its own broadband requirements, let alone the increased demand that would arise by reason of sharing network capacity with an appropriately sized commercial user base.

If the Commission is committed to addressing future public safety requirements that the FCC itself has identified, then the proposal in the Ninth NPR will not suffice. The 12 MHz of existing public safety spectrum that the FCC has proposed to dedicate to broadband use is not adequate even for public safety utilization.[26] It cannot provide the excess capacity needed to attract commercial lessees, the only financial engine that can drive deployment of a nationwide broadband network.

Therefore, Cyren joins the public safety community in urging the Commission to seek Congressional approval for the reallocation of the 30 MHz of upper 700 MHz spectrum to be dedicated to deployment of a shared governmental/commercial nationwide broadband network as proposed in Cyren's April 27, 2006 Petition for Rulemaking.[27]

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[24] *Final Report of the Public Safety Wireless Advisory Committee to the Federal Communications Commission and National Telecommunications and Information Administration,* dated September 11, 1996.
[25] *See* n. 5 *supra.*
[26] The *NPR* suggests that this broadband network would have access to additional capacity by utilizing the 12 MHz of public safety narrowband spectrum on a secondary basis. *NPR* at ¶¶ 38-40. The public safety community that continues to struggle to rectify the interference problem caused at 800 MHz by the intermingling of systems with different, incompatible network architectures is not likely to look favorably on that proposal. Moreover, if the FCC anticipates that adding the possibility of entirely secondary access to encumbered narrowband public safety spectrum in an environment that is rife with interference potential would nonetheless enhance the financeability of a 12 MHz network, Cyren must advise the Commission that its optimism is surely misplaced.
[27] *See* n. 16 *supra*.

B. Deployment of a Nationwide, Broadband, Interoperable Public Safety Network is Entirely Dependent on Private Financing That Must be Attracted by a Meaningful Commercial Service Opportunity

No one disagrees that our public safety users deserve a first-in-class, nationwide, broadband network. There is no dispute that the cost of such a network, both the initial capital expenditure for construction and the ongoing operational expenses, will total an amount that dwarfs other public safety communications projects in this nation. But, to date, no one has shown public safety the money.[28] It is not enough to wish for, hope for, or even pray for this network to be built. If there is no available government funding, as there is not, and if there is no viable private financial model, which Cyren submits the NPR does not provide, then in another ten years, after who knows how many more events like Katrina, Columbine and 9/11, we still will be decrying public safety's lack of appropriate communications tools and its interoperability failures.

The Ninth NPR expressly acknowledges the need for "adequate funding," but provides scant detail about either its likely origins or its sufficiency.[29] Indeed, the NPR does not discuss the cost of the network it has proposed or identify any of the factors that will contribute to that cost, although surely those facts are essential to the viability – and therefore the reasonableness – of the Commission's proposal.[30]

The FCC does suggest that the national licensee be permitted to charge fees for the use of the network, fees which are described as a potential funding source for system build-out, maintenance and continued operation.[31] The Commission also notes that these fees could serve

[28] As discussed below, Cyren believes that its Petition provides a roadmap for a financially viable, sustainable nationwide, broadband public safety network.
[29] *NPR* at ¶¶ 28-30.
[30] *See* n. 19 *supra.*
[31] *NPR* at ¶ 28.

to allocate network capacity to the highest value uses and could help to decentralize certain decisions with respect to more localized usage.

Cyren certainly agrees that public safety users who choose to have access to this nationwide broadband network must be assessed a usage fee. That concept is an integral part of the Cyren Petition, as is the expectation that these users would fund their own subscriber equipment, albeit at price levels more closely approaching those associated with product volumes in a commercial consumer marketplace. Cyren also agrees with the FCC that usage fees "may pose less of a financial burden for local jurisdictions, especially smaller ones, which may find it easier to budget for annual usage fees than to raise large amounts of upfront capital to construct individual systems."[32]

But that revenue source, however useful in helping to defray some portion of future operational expenses, will be too little and too late to support the massive investment required to finance initial network deployment. Cyren estimates that it will cost approximately Twenty Billion Dollars to build an IP-based, next generation, nationwide, broadband public safety system that satisfies the demanding specifications of emergency response providers. These more rigorous requirements dictate terrestrial coverage of ninety-nine percent (99%) of the nation's population and sixty-five percent (65%) of its land mass with an integrated satellite component for the remaining coverage and for robust redundancy in the event of catastrophic terrestrial failure as occurred during Hurricane Katrina.

The 37,000 sites Cyren has calculated will be needed to provide this level of terrestrial coverage each will have to be "hardened" to provide the robust reliability and redundancy that are essential characteristics of a network intended for public safety operations. They will require more rigorous construction standards and materials for certain network elements, greater life

[32] *Id*. at ¶ 30.

stand-by power arrangements and superior heating and cooling features. The network also will need more diverse, redundant traffic back-haul arrangements than would be required in a typical commercial wireless network build.

Surely the Commission cannot believe that a public safety community of fewer than Three Million will generate sufficient usage fees to finance a network build-out of this magnitude or to maintain it into the future, even in the entirely unrealistic event that all of public safety immediately became network users. Therefore, the money can only come from one of two sources: either the government itself is prepared to finance initial network construction and ongoing operational expenses in the billions of dollars annually, which it is not, or the network must be built with private funds that demand an acceptable rate of return on investment.

It appears that the Commission has recognized the gap between network deployment costs and public safety airtime fees. Mirroring an approach proposed in the Cyren Petition, the Ninth NPR recommends that the national licensee be permitted to lease the use of this 12 MHz of spectrum to commercial operators on a secondary, unconditionally preemptible basis, and suggests that those lease fees would help support network construction.

Cyren fully endorses the public safety spectrum leasing concept. Its Petition proposed a public/private partnership in which governmental and commercial users share a broadband network. It is the cornerstone of that Petition that the network infrastructure would be built by commercial operators in exchange for spectrum rights leased from the national public safety licensee on which the commercial providers would offer preemptible commercial service. But the concept is viable only if there will be sufficient excess capacity on a day-to-day basis to accommodate some Thirty Million commercial subscribers, subscribers whose fees over the long-term will justify private investment in the network at the outset and into the future.

Appendix 1 explained that 12 MHz would not be adequate even for public safety's own broadband requirements. It would provide no "headroom" for a complementary for-profit service. As detailed in Appendix 2, a minimum of 30 MHz is required to generate the substantial network capacity needed to achieve the economic metrics that would attract the necessary commercial funding for a shared network and to ensure that public safety could routinely claim enough network capacity for day-to-day operations with more available immediately and unconditionally during emergency situations. Thus, the 12 MHz proposed in the Ninth NPR as the spectrum foundation for this broadband network is demonstrably inadequate to provide a financeable commercial opportunity.

III. THE CYREN ALTERNATIVE

By contrast, the proposal described in the Cyren Petition would permit implementation of the nation's first economically self-sustaining model for advanced public safety communications capabilities. The Cyren proposal works for the very reason that the Ninth NPR cannot: while the NPR proposes to use only 12 MHz of spectrum, the Cyren Petition is based on a 30 MHz allocation -- adequate capacity to support a financially viable public/private shared network.

The Cyren Petition endorsed the following principles:

- **Upper 700 MHz C and D Block Spectrum** – It is in the public interest for the Federal Government to assign the uniquely appropriate 30 MHz of upper 700 MHz spectrum to a public safety licensee to facilitate deployment of a single nationwide, broadband, all IP network.

- **Public Safety Broadband Trust** – The license granting the right to utilize the spectrum should be held perpetually in trust for the American public. Public safety should be encouraged to propose and the FCC to approve representatives of local, state and federal entities to act as trustees for the entity that will hold the license for this 30 MHz broadband network with all the rights and responsibilities that status entails. All levels of government, for the first time, will share a single network with coverage throughout the nation.

- **Commercial Host** – Public safety cannot finance a network of this scope, nor could it afford future upgrades to keep the system "evergreen" as technology advances. The national public safety licensee must structure lease arrangements with commercial providers capable of building this advanced network. In exchange, these commercial operators will have the right to use network capacity to deliver commercial broadband service to urban and rural communities, as long as doing so does not impede public safety communications.

- **Public Safety Interoperability Bridge/Network Specifications** – The national licensee must establish technical parameters that include as a core design element the capability of acting as an interoperability bridge that can tie together legacy local, state and federal systems, as well as those operated by members of critical infrastructure industries whose participation can be vital in emergency situations. It also must develop specifications that ensure a robust, redundant, reliable, and secure network built to public safety specifications, including capacity, coverage and application requirements, yet still consistent with the need to attract ongoing participation by commercial providers.

- **Network Management** – The national licensee must have the right to engage a qualified third party such as, but not necessarily, Cyren to manage the deployment and ongoing operation of this network under the direction and control of that national licensee, to coordinate public safety and commercial usage, and to obtain for public safety users the benefits of scale economies.

While the Ninth NPR incorporates virtually all of these elements, it omits the most critical: the FCC's proposal does not provide enough spectrum to make the network financeable.

Cyren submits that the 30 MHz it proposed represents the only model that will ensure public safety access to the features and functionalities that are essential to fulfilling its responsibilities in the decades to come. At the same time, because the network would be built to public safety specifications, including coverage based on people and property needing protection, not wireless profit centers, it would have the corollary benefit of extending commercial wireless broadband coverage to the nation's more rural areas that remain unserved by current commercial broadband networks. There would be tangible benefits to the public through improved security for first responders and the citizens they protect, as well as to consumers nationwide who would have access to a commercial broadband network.

The math is simple. 30 MHz creates the commercial capacity that validates the business opportunity which, in turn, will attract the private investment that will permit this very high cost, but publicly essential, network to be implemented. 12 MHz does not and so should be abandoned as insufficient for that purpose.

IV. CONCLUSION

The 12 MHz spectrum foundation proposed in the Ninth NPR is entirely inadequate to the task of supporting an economically viable, sustainable nationwide, broadband, interoperable public safety network. It is a foundation made of sand and would collapse under the weight of public safety usage alone. It will not support the public/private partnership required to build, maintain, operate and upgrade a nationwide, advanced technology broadband network shared by public safety and commercial subscribers, including those in rural areas that have been bypassed by the nation's communications revolution. **In fact, since this network cannot and will not be deployed on 12 MHz of spectrum for the reasons detailed herein, if additional, sufficient 700 MHz spectrum is not allocated for this purpose, public safety would be better served by the FCC's abandoning its effort so that this capacity at least remains available for local, state and regional systems.**

The public safety community has called upon the Commission, the expert federal agency with responsibility for ensuring that spectrum is used to promote the welfare of the entire American public, to seek Congressional authority to reallocate 30 MHz from the upper 700 MHz band for the deployment of a nationwide, broadband, interoperable public safety network. Cyren joins with public safety in urging that the FCC take all possible steps to secure this spectrum for public safety use before it is auctioned for entirely commercial purpose and this singular, critical opportunity is lost forever.

APPENDIX 1

Public Safety
Broadband Capacity Analysis

Introduction

The future of telecommunications is moving towards the ubiquitous carriage of information via IP based telecommunications systems. Wireless services are part of this evolution as all voice, data, and video will soon be sent and received via IP based radio access that is an integral portion of this future all IP network environment.

To fully understand the radio spectrum requirements of this future network, Cyren Call performed an analysis of the capacities a public safety grade wide area wireless broadband network will have to support to ensure that public safety can leverage and utilize the advanced capabilities required to meet its mission of providing protection and safety for the citizens of the United States.

Background

Public Safety has recognized that the specific spectrum allotments that will support wireless broadband technology for its needs must be identified and set aside now to ensure that it is available for future. It is generally agreed by the Congress of the United States, FCC, NTIA, Commercial Industry, and the scientific community that spectrum is a finite resource. To ensure the many competing interests for this resource have sufficient allocations for their specific requirements, Congress and the FCC agree that each need be weighed against the benefits a specific allocation can provide for overall common good of the United States.

To this end a determination of what is sufficient spectrum for a given entity or services provider becomes an exercise of peering into the future and using the best available information to assess what impacts technology change will have on its needs.

What is known is that as wireless services have evolved to incorporate services beyond basic voice, spectrum with increasingly larger channel sizes are required to deliver advanced capabilities and provide the level of performance demanded by these services. This has caused a competition for spectrum to arise with many entities vying for its share of the spectrum pool.

Public Safety is no exception, it is in competition with the wireless commercial operators for spectrum to support its mission. This has raised the debate not only as to how much spectrum public safety will require to implement broadband services but in an era of fiscal constraints, how it will be able to sustain and keep evergreen the technology base required to have services available now and into the future.

Scope

As outlined above there are many facets to the current debate over public safety's broadband requirements and what will be required to ensure these capabilities are available for its use. This analysis was undertaken to determine not only the sufficiency of current spectrum allotments to support wireless broadband technologies for public safety but also what would be required for a public private partnership that enables public safety to evolve and maintain a desired level of service now and into the future.

This focus provides the boundaries for this analysis and the underlying assumptions used in the capacity calculations. Two spectrum positions were analyzed to determine the requirements of public safety and also a public – private partnership. These were:

- 12 MHz 6 MHz by 6 MHz paired
- 30 MHz 15 MHz by 15 MHz paired

Assumptions

In this section the major assumptions used in the analysis are outlined. Specific assumptions that are critical to the methodology of the analysis are highlighted in context with the use of the assumption.

General –

This study assumed a national network view. The national network assumed 37,000 cell sites required to provide coverage and capacity to meet the requirements of the baseline user population, their profiles, and offered services. Due to the scope, magnitude, make-up and varying sizes of public safety jurisdictional entities within the U.S. specific case by case sample studies for jurisdictions in large dense urban, suburban, rural, and highway corridor environments will be the basis for future studies to assess individual jurisdictional needs. Incidents/events of various scales were a key component of this study to assess capacity and performance requirements for these types of occurrences.

Analysis Period –

A period of 10 years was used in this analysis, from 2008 to 2018. By using a full 10 year study period considerations such as technology and applications evolution and maturity, services adoption, gains in spectral efficiency, convergence and concurrent use of services, and increasing demands for mobility could be employed to assess the demands that would be placed on the network.

Network Technology –
Today there are three major wireless technologies considered to be on migratory and evolutionary paths to what is envisioned will be the technology deployed for the 3G+ or 4th wide area mobile next generation networks in the study period. These are:
GSM > UMTS > HSPA > LTE
WiMax > LTE
EVDO Rev A/B > LTE

Long Term Evolution or LTE is a term used to describe the envisioned technical characteristics that will be required for these next generation wide area mobile networks. This analysis blended and used common technical stated evolutionary characteristics across all three technology tracks such as OFDM-MA and MIMO [1], flat IP core network architectures, mature IMS/SAE services delivery and management, VoIP based push to talk, and other attributes to normalize the capacity and performance assumptions that will be available to provide broadband services.

Radio Access Layer –
The radio link for a given sector was characterized using the following design assumptions from HSPA+ as this provides a conservative estimate for modeling rather than using the stated objectives for 3GPP LTE:

Channel Size:	5 MHz
Reuse Factor:	3/1
Uplink Capacity:	11.5 Mbps
Downlink Capacity:	28 Mbps

Broadband Network User Population –
It is estimated that by 2018 there will be less than 3 million public safety personnel and that the U.S. population will be 300+ million. A conservative and high estimate of 3 million public safety users and 32 million critical infrastructure and enterprise users was assumed as the user population for this network in 2018.

[1] OFDM-MA: Orthogonal Frequency Division Multiplexing – Multiple Access, MIMO: Multiple Input / Multiple Output

Services –

The following table depicts the services that were characterized would be provided by the network for this study:

Type	Category	Sub-Category [where applicable]	Capacity Mgmt Ref ID	Service Description	Example	Service Level Designator	RAN Service Rqmt Throughput Rate [Kbps]	[Mbps]	E-E / 1-Way Delay [ms]
Voice	PS Tele-Services	PTT	TSP-1	Individual-Direct	1:1 or Walkie Talkie	Guaranteed	24	0.024	<150
	[P25]		TSP-2	Group	Talk Groups	Guaranteed	24	0.024	< 150
			TSP-3	Broadcast	1:N or 1:1 for Dispatch	Guaranteed	24	0.024	< 150
			TSP-4	Un-addressed	1: All Devices on Channel	Guaranteed	24	0.024	< 150
				Open Channel	All Devices on Channel	Guaranteed	24	0.024	< 150
		Monitoring	TSM-1	Individual-Direct	Unit/Device level	Guaranteed	24	0.024	< 150
			TSM-2	Group	All Units/Device assigned to grp	Guaranteed	24	0.024	< 150
			TSM-3	Channel	All Units/Device on channel	Guaranteed	24	0.024	< 150
			TSM-4	Scanning	All Units/Devices on selected channels	Guaranteed	24	0.024	< 150
		Alerting	TSA-1	Individual-Direct	Unit/Device level	Guaranteed	24	0.024	< 150
			TSA-2	Group	All Units/Devices assigned to grp	Guaranteed	24	0.024	< 150
			TSA-3	Audible Emergency	Individual device / assigned units to a group	Guaranteed	24	0.024	< 150
			TSA-4	Silent Emergency	Unit/Device level	Guaranteed	24	0.024	
	CMRS	Network Based	CMR-1	Local	Local M-M / M-PSTN	Predictive	24	0.024	< 150
			CMR-2	Long Distance	Long Distance M-M / M-PSTN	Predictive	24	0.024	< 150
			CMR-3	Conferencing	Voice	Predictive	24	0.024	< 150
			CMR-4	CLASS Features	Call Forward, Call Wait, Trace, etc	Predictive	24	0.024	< 150
			CMR-5	Voice Mail	Traditional Voice Mail Services	Predictive	24	0.024	< 150
Data	Media	Photo	DMP-1	Image Transfer	Stills, Slide Show	Best Effort	144	0.144	1000
	Messaging	SMS	DMT-1	Text	Both basic and enhanced (rich text) SMS	Best Effort	14.4	0.0144	4000
		E-Mail	DMT-2	Enhanced Text	Text w/attachments - various includes MMedia	Best Effort	14.4	0.0144	4000
	FTP	Bulk Data	DFT-1	Reporting	Form based data transfer	Best Effort	64	0.064	1000
			DFT-2	File Transfer	Various file type / sizes	Best Effort	64	0.064	2000
	Sensor	Telemetry	DSR-1	Bio-Metrics	Personnel physiology reporting / mgmt	Guaranteed	28.8	0.0288	< 50
			DSR-2	Environmental	Temperature, Moisture, etc	Predictive	14.4	0.0144	4000
			DSR-3	Situational Awarness	Intrusion Detection, Wireless Fence, alarm	Guaranteed	28.8	0.0288	< 500
			DSR-4	Vehicle Telemetry	Vehicle Sensors - Speed, Crash, Engine, etc	Predictive	64	0.064	1000
	Location Based	Reporting	DLB-1	Person	Individual location tracking	Guaranteed	14.4	0.0144	< 250
		Reporting	DLB-2	Vehicle	Vehicle location tracking	Guaranteed	14.4	0.0144	1000
		Bulk Data	DLB-3	GIS Thematic	Thematic Maps (e.g. Hurricane Track, Flooding)	Best Effort	64	0.064	4000
		Reporting	DLB-4	Sensor	Location of Sensor both fixed and temporary	Best Effort	14.4	0.0144	4000
		Reporting	DLB-5	Robotic	Location of Robotic elements / devices / machines	Best Effort	14.4	0.0144	< 500
	Work Force Mgmt	Personnel Mgmt	DFM-1	Normal / Daily	Daily Assignment via form based data	Best Effort	64	0.064	1000
		Personnel Mgmt	DFM-2	Incident / Event	Event personnel assignments, accounting, etc - Interactive form	Predictive	64	0.064	1000
	Asset Mgmt		DAM-1	Normal / Daily	Daily mgmt & tracking of assets - assignment / status form based	Best Effort	64	0.064	4000
			DAM-2	Incident / Event	Event / Incident mgmt and tracking of assets-assignment/status form ba	Best Effort	64	0.064	4000
	Robotics		DRS-1	Control	Remote control / mgmt of robotic devices	Guaranteed	64	0.064	< 250
			DRS-2	Data	Robotic gathered/assembled data	Predictive	varies on type		varies
Video	Media	Video	DMV-1	Real-Time	Broadcast Quality - Uni-Directional - 24-30 fps	Guaranteed	1000	1	< 500
			DMV-2	Real-Time	Basic Quality - Uni-Directional - 15 fps	Predictive	500	0.5	1000
			DMV-3	Streaming	Store and Forward - Uni-Directional - 8-10 fps	Predictive	300	0.3	1000
			DMV-4	Conferencing	Multi-participant Video + Voice + Media - Bi-Directional - 15 fps	Guaranteed	770	0.77	< 150

Services Note:
It was assumed that all services have a failure point based on excessive delay. For example:

- It may be acceptable to wait a minute for a file transfer, but it may not be acceptable for that file transfer to take 30 minutes
- Service Throughput is determined by the most demanding aspect of the service which is generally session initiation and set-up.
- Utilizing strict average throughput would underestimate usage especially with concurrent sessions (voice with video).

Methodology

The high level methodology used to determine the number of subscribers supported for various spectrum positions was as follows:

- Characterize the Services
- Define Subscriber Types
- Assign Service Usage to Subscriber Types
- Determine the Available Throughput
- Capacity Calculations
    - Public Safety
    - Critical Infrastructure
    - Commercial

Each step is further explained in the subsequent sections.

Characterize the Individual Services -
For the purposes of this analysis it was assumed that subscribers would utilize services in three broad categories, namely: Real Time Services, Best Effort Services, and Streaming Services. Within each category, specific services were assigned, as follows:

Real Time Services
- Push-to-Talk (PTT)
- Telephony (Voice)
- Monitoring – ability to listen to ongoing group communications
- Alerting – ability to alert other users that communication is desired

Best Effort Services
- File Transfer – Transfer of large files to or from some data repository
- Messaging – Ability to send multi-media messages to one or more users
- Location – Transmission to or from the network containing information about the physical location of the user.
- Sensor based data

Streaming Services
- Streaming Video – The ability to transmit or receive continuous video.

Define Subscriber Types -
The following user profiles were developed and incorporated as the subscriber types for this study:

Public Safety:	Blended profiles for police, fire, and EMS personnel
Critical Infrastructure:	Medical, Energy/Power, Water, Food, Transportation
Enterprise:	Large enterprise [business] entities

Assign Service Usage to Subscriber Types -
Independent Service Usage
For each subscriber type, a service profile was assigned that specified how much of each service that subscriber type would utilize on average. It was assumed for this analysis that Public Safety would not be using this service for its primary voice system, and would instead rely on it for mission-critical and routine broadband applications. Critical Infrastructure and Commercial users would use the system for voice, and this was factored into the model. Usage was assigned for uplink and downlink separately.

Aggregate Service Usage -
Once each subscriber type had the individual service profiles assigned, an aggregate service profile was created. This aggregate service profile was used to characterize the average network utilization of that particular type of subscriber (Public Safety, Critical Infrastructure, or Commercial).

The specific usage assumptions and aggregate service profile for each subscriber type are listed in the appendix.

Determine Available Throughput -
This analysis uses a generic, technology independent, throughput to determine available capacity. The throughput values are correlated to available radio spectrum. Although the available throughput is technology independent, the quantitative initial estimate is based on stated LTE standards for spectrum positions of 30 MHz (paired 15 MHz) and 12 MHz (paired 6 MHz).

The effect of radio propagation over distance on the effective throughput -

- As the radio channel deteriorates, the throughput decreases.
- The radio channel deteriorates as the distance increases from the cell center (a function of radius)
- It is assumed that the user distribution in a cell site is random (evenly spread out within the area of the cell)
- The diagram below shows the calculations for the average effective data rate for an omni-directional cell divided into three regions: inner, middle and outer rings. An ideal user distribution model would utilize a continuous distribution model, rather than the discrete 3 section model shown below. However, the radio modulation schemes do not adjust continuously, but rather discretely in a finite number of steps. It is clear that the average effective throughput is significantly less than the peak throughput and this is an initial estimate at quantifying the de-rated throughput.

	Entire Cell	Outer	Middle	Inner
Radius	1.000	1.000	0.660	0.330
User Distribution	100.00%	55.56%	33.33%	11.11%
Users	100.0	55.6	33.3	11.1
Throughput Rate Modifier	-	15%	40%	100%
Avg Effective Data Rate	**32.78%**	of peak throughput		

Estimate the impact of other system effects that impact throughput:

- Packet Loss (radio and otherwise)
- Retransmissions due to Packet Loss
- Lower Layer Packetization Efficiencies (Layer 2 Framing, etc)
- Computational Delays and Inefficiencies
- The cumulative effect of these inefficiencies is estimated to reduce the available throughput by 20%.

Result: The effective available throughput for the average user. Below are the analysis results for the throughput at 30 MHz. The same process would be used for other spectrum positions.

	Uplink Throughput (kbps)	Downlink Throughput (kbps)
RF Efficiency	33%	33%
Packetization Efficiency	80%	80%

Capacity Calculations

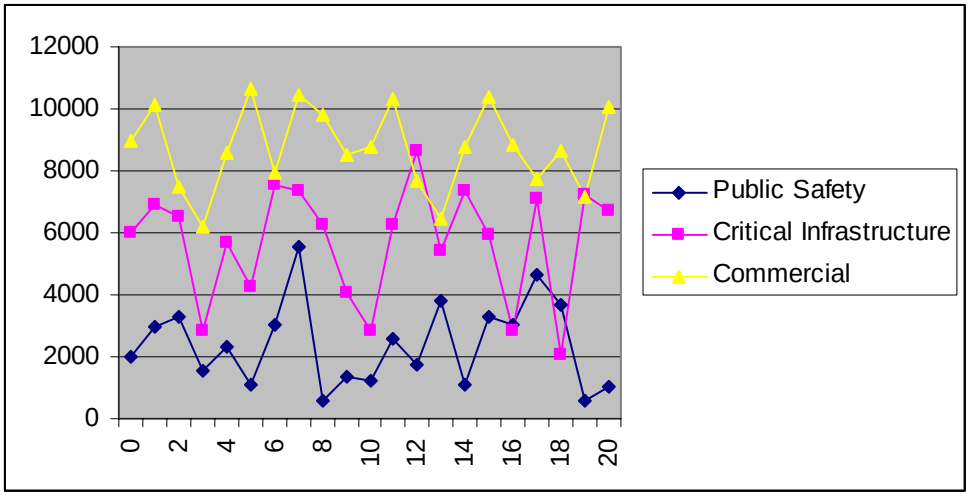
Sharing Spectrum

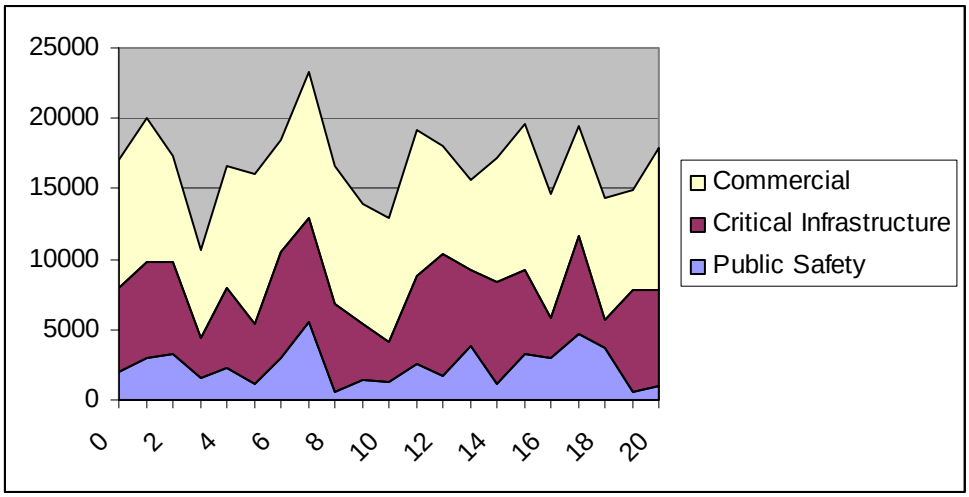
The system being modeled is one with the ability to prioritize traffic and in this system Public Safety has priority access to all capacity. If Critical Infrastructure or Commercial users are utilizing capacity that is needed to serve Public Safety, the system will throttle the capacity available to Critical Infrastructure and Enterprise users, and make it available to Public Safety on an immediate, as needed basis.

Critical Infrastructure users will also have priority. However it is lower than Public Safety, but it is higher than commercial users. Thus after Public Safety capacity needs are met, Critical Infrastructure users are served.

Enterprise users utilize the remaining capacity. Note that capacity that has been set aside to ensure Public Safety and Critical Infrastructure usage experiences less blocking but also provides service for the enterprise users. Enterprise users are only

affected by capacity in use, and would only be blocked from having access to additional capacity if Public Safety and Critical Infrastructures are generating a high demand on the system. The diagrams below illustrate the concept.





The first diagram shows a hypothetical level of traffic for the three types of users. The second diagram is the additive capacity of that usage. In this hypothetical example, there would have been no blocking if the capacity of the system was at least 25,000 kbps. It is illustrative to look at the blocking effects as the capacity of the system is constrained.

Capacity Level	PS Blocking	Crit Inf Blocking	Comm Blocking
25,000	None	None	None
20,000	None	None	Minor
15,000	None	None	Moderate
10,000	None	Minor	Major*
5,000	Minor	Major**	Total**

* Note that even though Critical Infrastructure is blocking, some commercial traffic can still get through.
** Note that a substantial amount of Critical Infrastructure traffic still is passed by the network, and that there may be cases where some commercial traffic can squeeze in as well. None of this traffic impacts the service levels of Public Safety

It is clear from the diagram that Public Safety users would benefit with an extremely high availability system (from a congestion/capacity stand point), and that sizing of the system is dependent more upon the enterprise user base, and to a lesser extent, critical infrastructure grade of service.

Per Cell Capacity Calculation -
To determine the number of subscribers supported for a given throughput, the number of concurrent average services for the available capacity was calculated. Once the number of concurrent simultaneous sessions is known, one can apply statistical modeling with the desired grade of service calculations. In this analysis, Erlang B and Poisson distribution modeling was used with various grades of service, depending on the subscriber type. The result is the effective number of simultaneous sessions (users) that provides the desired grade of service. The average effective load or the average subscriber was calculated previously, and the effective number of sessions, with effective load per user can be used to determine the total number of users that could be supported within a cell.

Network-wide Capacity Calculation
In order to extrapolate a per cell calculation to the entire network, usage modeling assumptions need to be made. Specifically the distribution of the subscribers/users across the cells needs to be taken into account. For this analysis the business modeling assumptions were taken from the Cyren Call business model using an even distribution of users across the network. The following depicts analysis of a 30 MHz (15x15 paired) spectrum position.

Public Safety Calculation

The capacity to support Public Safety is limited only by the average available throughput of the system. Therefore by using the services and usage levels of a typical Public Safety subscriber the total number of Public Safety subscribers can be determined. The table below summarizes the calculation for Public Safety

Public Safety			Max Subs	
	Blocking	Limited by	Sector	Nationwide
Full Spectrum Utilization	0.001%		164.66	6,977,092
	1.000%	Uplink	237.61	10,068,249
	2.000%		252.11	10,682,864
		Throughput Required (kbps)		
# of PS Users	Blocking	Uplink	Downlink	
3,000,000	0.001%	3243	3189	
	1.000%	2161	2186	
	2.000%	2053	2095	

From the table one can see that the model predicts that the network with 30 MHz could support between nearly 7 million to nearly 11 million Public Safety users for varying grades of service (blocking). However, the maximum number of Public Safety users that would be expected to be supported would be 3 Million. Note that, by the nature of giving Public Safety priority, that this network at 30 MHz would provide essentially Public Safety with non-blocking service.

Having calculated the Public Safety utilization one can then determine the amount of capacity that is left over for other users. For the purposes of this model, it was assumed that 3 million Public Safety users were utilizing the network, and any remaining capacity unused by them would form the basis of subsequent calculations.

Critical Infrastructure Calculation

For this analysis, it was assumed that Critical Infrastructure would require a better grade of service than Commercial users, but that it would not need to be as robust as for Public Safety, and that planning for 1% blocking was reasonable. To determine the available capacity for Critical Infrastructure, it was first necessary to determine the Public Safety capacity requirements at 1% blocking. Note that this is not the grade of service Public Safety has, but that the amount of capacity needed to maintain Public Safety at 1% blocking can not be utilized by Critical Infrastructure users. One must account for the fact that unused Public Safety capacity is available to Critical Infrastructure users, and that it is the actual usage of Public Safety that impacts the remaining capacity, not the capacity set aside to maintain high grades of service (as discussed in the Capacity Overview section). For this model it was assumed to be a reasonable approximation that Public Safety capacity usage at 1% blocking would be

capacity that was unusable by Critical Infrastructure. The analysis is summarized in the table below.

Critical Infrastructure				
Critical Infrastructure Blocking	1.00%			
	Blocking	Limited by	Max Subs Sector	Nationwide
Filling Left Over Spectrum	1.000%	Uplink	281.70	11,936,510
	2.000%		297.86	12,621,535
		Throughput Required (kbps)		
# of Crit Inf Users	Blocking	Uplink	Downlink	
6,000,000	1.000%	1978	2672	
	2.000%	1862	2567	

As shown in the table, the analysis showed that nearly 12 million Critical Infrastructure users could be supported in 30 MHz (15 MHz paired). However, the Cyren Call business analysis expects the Critical Infrastructure users to number approximately 6 million subscribers.

Commercial Calculation

The commercial capacity is calculated in a similar manner. It is assumed that Commercial users would receive the nominal blocking of most other cellular systems, namely 2%. Thus the capacity available for Commercial users would be that which is left over from Public Safety and Critical Infrastructure usage also at 2%. The analysis results are below.

Commercial				
Commercial Blocking	2.00%			
	Blocking	Limited by	Sector	Nationwide
Filling Left Over Spectrum	2.000%	Uplink	620.01	**26,272,059**

The analysis shows that with 3 Million Public Safety users, and 6 Million Critical Infrastructure users, there is enough network capacity to serve about 26 Million commercial users at typical cellular service levels with a 30 MHz (15x15 paired) spectrum position.

Summary of Results

Using the methodology described above, the following spectrum positions were analyzed. It was found that a 12 MHz (6x6) allotment would not care for a 2.9 million public safety user base using an even distribution national network model.

[I would delete this, at least until one of our opponents raises it. A 20 MHz (10x10) spectrum allotment for a public private partnership would not provide the capacities required to enable a business model as developed by Cyren Call.]

As was shown in the more detailed overview of the analysis, a 30 MHz (15x15) would meet the criteria to offer public safety grade prioritized service and still enable sufficient capacity to be provided to critical infrastructure and enterprise subscribers.

Spectrum Allocation	Supported Population Public Safety	Support Population Critical Infrastructure	Supported Population Commercial
12 MHz paired [6 x 6]	1.2M	N/A	N/A
30 MHz paired [15 x 15]	3.0M	6.0M	26.3M

APPENDIX A

The following tables provide user individual and aggregated service assumptions used in the analysis

Table A.1 Public Safety

	Uplink Service Mix		Number of Calls	per Unit of Time (peak time)	Calls/Hour	Duration (seconds)
Real Time	PTT	Voice - PTT	0	hours	0	36
	Telephony	Voice - Telephony	0	hours	0	90
	Monitoring	Voice - Monitoring	0	hours	0	90
	Alerting	Voice - Alerting	0	hours	0	90
Best Effort	File Transfer	Data - File Transfer	2	hours	2	90
	Messaging	Data - Messaging	4	hours	4	20
	Location	Data - Location	4	hours	4	1
Streaming		Streaming - Video	1	days	0.04166667	8100

	Downlink Service Mix		Number of Calls	per Unit of Time	Calls/Hour	Duration (seconds)
Real Time	PTT	Voice - PTT	0	hours	0	36
	Telephony	Voice - Telephony	0	hours	0	90
	Monitoring	Voice - Monitoring	0	hours	0	90
	Alerting	Voice - Alerting	0	hours	0	90
Best Effort	File Transfer	Data - File Transfer	3	hours	3	90
	Messaging	Data - Messaging	8	hours	8	20
	Location	Data - Location	4	hours	4	1
Streaming		Streaming - Video	1	days	0.04166667	8100
			numbers reflect multicast			

Table A.2 Critical Infrastructure

	Uplink Service Mix		Number of Calls	per Unit of Time (peak time)	Calls/Hour	Duration (seconds)
Real Time	PTT	Voice - PTT	2	hours	2	36
	Telephony	Voice - Telephony	2	hours	2	90
	Monitoring	Voice - Monitoring	0	hours	0	90
	Alerting	Voice - Alerting	0.5	hours	0.5	90
Best Effort	File Transfer	Data - File Transfer	1	hours	1	90
	Messaging	Data - Messaging	3	hours	3	20
	Location	Data - Location	3	hours	3	1
Streaming		Streaming - Video	1	days	0.04166667	3600

	Downlink Service Mix		Number of Calls	per Unit of Time	Calls/Hour	Duration (seconds)
Real Time	PTT	Voice - PTT	1	hours	1	36
	Telephony	Voice - Telephony	1.5	hours	1.5	90
	Monitoring	Voice - Monitoring	4	hours	4	90
	Alerting	Voice - Alerting	2	hours	2	90
Best Effort	File Transfer	Data - File Transfer	0.25	hours	0.25	90
	Messaging	Data - Messaging	3	hours	3	20
	Location	Data - Location	1	hours	1	1
Streaming		Streaming - Video	3	days	0.125	1800
			numbers reflect multicast			

Table A.3 User Services - Commercial

	Uplink Service Mix		Number of Calls	per Unit of Time (peak time)	Calls/Hour	Duration (seconds)
Real Time	PTT	Voice – PTT	1	hours	1	36
	Telephony	Voice – Telephony	1.5	hours	1.5	90
	Monitoring	Voice – Monitoring	0	hours	0	90
	Alerting	Voice – Alerting	0.25	hours	0.25	90
Best Effort	File Transfer	Data - File Transfer	1	days	0.04166667	90
	Messaging	Data – Messaging	3	hours	3	20
	Location	Data – Location	1	hours	1	1
Streaming		Streaming – Video	3	days	0.125	1800

	Downlink Service Mix		Number of Calls	per Unit of Time	Calls/Hour	Duration (seconds)
Real Time	PTT	Voice - PTT	1	hours	1	36
	Telephony	Voice - Telephony	2	hours	2	90
	Monitoring	Voice - Monitoring	1	hours	1	90
	Alerting	Voice - Alerting	1	hours	1	90
Best Effort	File Transfer	Data - File Transfer	1	days	0.04166667	90
	Messaging	Data - Messaging	3	hours	3	20
	Location	Data - Location	0.25	hours	0.25	1
Streaming		Streaming - Video	0.25	hours	0.25	1200
			numbers reflect multicast			

Table **B.1 - Public Safety Aggregation**

Public Safety

	Uplink Service Mix		Arrivals (per sec)	Intensity (Arrivals*Duration) (Erlangs)	Service Usage (kbps)	Service Throughput (kbps)
Real Time	PTT	Voice - PTT	0	0	0	19.07
	Telephony	Voice - Telephony	0	0	0	11.85
	Monitoring	Voice - Monitoring	0	0	0	10.54
	Alerting	Voice - Alerting	0	0	0	42.40
Best Effort	File Transfer	Data - File Transfer	0.000556	0.05	2.906667	58.13
	Messaging	Data - Messaging	0.001111	0.022222	0.018673	16.81
	Location	Data - Location	0.001111	0.001111	0.008933	8.04
Streaming		Streaming - Video	1.16E-05	0.09375	15.12594	161.34
	Aggregate	**per carrier**		**0.167083**	**18.06021**	
	Downlink Service Mix					
Real Time	PTT	Voice - PTT	0	0	0	19.07
	Telephony	Voice - Telephony	0	0	0	11.85
	Monitoring	Voice - Monitoring	0	0	0	10.54
	Alerting	Voice - Alerting	0	0	0	42.40
Best Effort	File Transfer	Data - File Transfer	0.000833	0.075	4.36	58.13
	Messaging	Data - Messaging	0.002222	0.044444	0.037347	16.81
	Location	Data - Location	0.001111	0.001111	0.008933	8.04
Streaming		Streaming - Video	1.16E-05	0.09375	15.12594	161.34
	Aggregate	**per carrier**		**0.214306**	**19.53222**	

Table B.2 Critical Infrastructure Service Aggregation

Crit Infra

	Uplink Service Mix		Arrivals (per sec)	Intensity (Arrivals*Duration) (Erlangs)	Service Usage (kbps)	Service Throughput (kbps)
Real Time	PTT	Voice - PTT	0.000556	0.02	0.381333	19.07
	Telephony	Voice - Telephony	0.000556	0.05	0.5925	11.85
	Monitoring	Voice - Monitoring	0	0	0	10.54
	Alerting	Voice - Alerting	0.000139	0.0125	0.53	42.40
Best Effort	File Transfer	Data - File Transfer	0.000278	0.025	1.453333	58.13
	Messaging	Data - Messaging	0.000833	0.016667	0.014005	16.81
	Location	Data - Location	0.000833	0.000833	0.0067	8.04
Streaming		Streaming - Video	1.16E-05	0.041667	6.722639	161.34
	Aggregate	**per carrier**		**0.166667**	**9.700511**	
	Downlink Service Mix					
Real Time	PTT	Voice - PTT	0.000278	0.01	0.190667	19.07
	Telephony	Voice - Telephony	0.000417	0.0375	0.444375	11.85
	Monitoring	Voice - Monitoring	0.001111	0.1	1.054	10.54
	Alerting	Voice - Alerting	0.000556	0.05	2.12	42.40
Best Effort	File Transfer	Data - File Transfer	6.94E-05	0.00625	0.363333	58.13
	Messaging	Data - Messaging	0.000278	0.005556	0.004668	16.81
	Location	Data - Location	0.000278	0.000278	0.002233	8.04
Streaming		Streaming - Video	3.47E-05	0.0625	10.08396	161.34
	Aggregate	**per carrier**		**0.272083**	**14.26324**	

Table B.3 Commercial Service Aggregation

Commercial

	Uplink Service Mix		Arrivals (per sec)	Intensity (Arrivals*Duration) (Erlangs)	Service Usage (kbps)	Service Throughput (kbps)
Real Time	PTT	Voice - PTT	0.000278	0.01	0.190667	19.07
	Telephony	Voice - Telephony	0.000417	0.0375	0.444375	11.85
	Monitoring	Voice - Monitoring	0	0	0	10.54
	Alerting	Voice - Alerting	6.94E-05	0.00625	0.265	42.40
Best Effort	File Transfer	Data - File Transfer	1.16E-05	0.001042	0.060556	58.13
	Messaging	Data - Messaging	0.000833	0.016667	0.014005	16.81
	Location	Data - Location	0.000278	0.000278	0.002233	8.04
Streaming		Streaming - Video	2.78E-05	0.008333	1.344528	161.34
	Aggregate	**per carrier**		**0.080069**	**2.321363**	
	Downlink Service Mix					
Real Time	PTT	Voice - PTT	0.000278	0.01	0.190667	19.07
	Telephony	Voice - Telephony	0.000556	0.05	0.5925	11.85
	Monitoring	Voice - Monitoring	0.000278	0.025	0.2635	10.54
	Alerting	Voice - Alerting	0.000278	0.025	1.06	42.40
Best Effort	File Transfer	Data - File Transfer	1.16E-05	0.001042	0.060556	58.13
	Messaging	Data - Messaging	0.000833	0.016667	0.014005	16.81
	Location	Data - Location	6.94E-05	6.94E-05	0.000558	8.04
Streaming		Streaming - Video	6.94E-05	0.083333	13.44528	161.34
	Aggregate	**per carrier**		**0.211111**	**15.62706**	

APPENDIX 2

Cyren Call Communications

Public Safety Wireless Broadband Network
Why 12 MHz is Inadequate

February 26, 2007

Only 1.2 Million Public Safety Wireless Broadband Users Can Be Supported With 12 MHz of Spectrum

Spectrum	*Public Safety*	*Critical Infrastructure*	*Commercial*
12 MHz Paired [6 x 6]	*1.2M*	*Insufficient Capacity*	*Insufficient Capacity*
30 MHz Paired [15 x 15]	*2.1M*	*6.2M*	*34.3M*

Key Assumptions

- Spectrum Band: Upper 700 MHz
- 37,000 cell sites nationwide to provide 99% population coverage
- Technology Performance: Average of estimated performance of 4G technologies CDMA-EVDO, HS_PA, WiMAX and Flarion
- Blocking: 0.001% for Public Safety, 1% for Critical Infrastructure, 2% for Commercial
- Average Monthly Subscriber Usage: 1,800 minutes, 3,100 Megabytes
- Source: 4DK Technologies, Inc.

However, there is No Viable Business Case for a Nationwide Broadband Network With Only 1.2 Million Subscribers…

(In $Billions Except Where Noted)

	2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
Cell Sites (Thousands)	1.9	8.9	15.9	22.9	29.5	33.4	34.7	35.3	35.8	36.4	37.0
Subscribers (Millions)	-	0.0	0.1	0.5	0.9	1.1	1.2	1.2	1.2	1.2	1.2
Service Revenue *	-	0.0	0.1	0.3	0.8	1.1	1.2	1.2	1.2	1.1	1.1
EBITDA	(0.1)	(0.4)	(0.8)	(1.1)	(1.2)	(1.1)	(1.0)	(1.0)	(1.0)	(1.0)	(1.0)
Capital Expenditures	0.5	1.5	1.5	1.5	1.5	0.9	0.8	0.6	0.6	0.6	0.6
Cumulative CAPEX	0.5	2.0	3.6	5.1	6.5	7.4	8.2	8.8	9.4	10.0	10.7
Free Cash Flow	**(0.6)**	**(2.0)**	**(2.4)**	**(2.6)**	**(2.7)**	**(2.4)**	**(2.2)**	**(2.0)**	**(2.0)**	**(2.0)**	**(2.2)**
Cumulative FCF	**(0.6)**	**(2.6)**	**(5.0)**	**(7.6)**	**(10.3)**	**(12.7)**	**(14.8)**	**(16.8)**	**(18.8)**	**(20.8)**	**(23.0)**

* Estimated monthly per subscriber revenue from high-usage commercial segment

Assumes <u>NO</u> sharing with existing commercial infrastructure.

... Even With Aggressive Assumptions About Network Infrastructure Sharing

(In $Billions Except Where Noted)

	2008	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
Cell Sites (Thousands)	2	9	16	23	30	33	35	35	36	36	37
Subscribers (Millions)	-	0.0	0.1	0.5	0.9	1.1	1.2	1.2	1.2	1.2	1.2
Service Revenue	-	0.0	0.1	0.3	0.8	1.1	1.2	1.2	1.2	1.1	1.1
EBITDA	(0.1)	(0.2)	(0.4)	(0.5)	(0.4)	(0.1)	0.1	0.1	0.1	0.0	0.0
Capital Expenditures	0.2	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.2	0.2	0.2
Cumulative CAPEX	0.2	0.6	1.0	1.4	1.8	2.1	2.3	2.5	2.7	2.9	3.1
Free Cash Flow	**(0.3)**	**(0.6)**	**(0.9)**	**(0.9)**	**(0.8)**	**(0.7)**	**(0.6)**	**(0.5)**	**(0.5)**	**(0.6)**	**(0.8)**
Cumulative FCF	**(0.3)**	**(0.9)**	**(1.8)**	**(2.7)**	**(3.5)**	**(4.3)**	**(4.8)**	**(5.3)**	**(5.9)**	**(6.5)**	**(7.2)**

Levering existing commercial infrastructure assumptions—75% sharing of:

- Site rent, utilities, maintenance and engineering
- Billing
- G&A
- Site construction CapEx
- RF network equipment CapEx
- Switching center and network operating center CapEx