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IMPROVING PUBLIC SAFETY COMMUNICATIONS: AN ANALYSIS OF ALTERNATIVE APPROACHES

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EXECUTIVE SUMMARY

There is a broad consensus that the communication capabilities of America's public safety agencies need to be improved. Public safety communications systems are not interoperable, making it difficult for agencies to communicate with one another. Moreover, these systems generally do not provide the broadband capabilities that are increasingly commonplace in commercial cell phones.

Congress, the Department of Homeland Security, the Federal Communications Commission (FCC) and public safety agencies themselves are all working towards implementing improvements. In early 2006, as part of legislation that set a "date certain" for the transition from analog to digital television (DTV), Congress set aside an additional 24 MHz of spectrum for public safety use. The same legislation provides $1 billion in funding to ensure the new spectrum is efficiently used to solve the interoperability problems. The new law is significant, as it responds directly to the 9/11 Commission's call for action in providing effective, interoperable communications for first responders.

In December 2006, the FCC proposed a "national, centralized approach to maximize public safety access to interoperable, broadband spectrum." The comprehensive plan proposed by the FCC would implement Congress' directive in a manner that ensures efficient and effective use of the spectrum provided to public safety, while promoting "the deployment of advanced broadband applications, related radio technologies, and modern, IP-based architectures."

A newly formed company called Cyren Call is lobbying Congress to approve a different approach. Cyren Call seeks an allocation of an additional 30 MHz of spectrum to construct a nationwide broadband network. Through a "Public Safety Broadband Trust," Cyren proposes to use the network for both commercial and public safety purposes. The FCC has already rejected Cyren Call's proposal, on the grounds that it is inconsistent with the 2006 DTV legislation.

This paper presents our analysis of the Cyren Call proposal. We find that Cyren Call's plan suffers from serious flaws, and that its adoption would not result in more effective communications solutions for public safety. In addition, we find that sufficient spectrum has already been allocated for public safety use, and that more efficient spectrum management and the adoption of modern wireless technology can provide the interoperability and advanced capabilities public safety agencies need. Specifically:

- The Cyren Call plan is likely to delay improvements in public safety communications.
  - It would disrupt the carefully crafted DTV transition, delaying indefinitely the availability of additional spectrum and funding to solve interoperability.
  - It would likely fail economically, as it assumes private industry would pay more to use the system than the competitive market would support.

- It would force public safety agencies and the Federal government to bear the entire risk of failure, including a government-backed loan guarantee of $5 billion;

- In addition to impeding the development of effective emergency communications systems, it would deprive consumers and taxpayers of other benefits of the DTV transition, including advanced wireless services made possible by the newly available spectrum, and $7 billion in deficit reduction.

- A new national model for managing public safety spectrum is necessary to ensure effective emergency communications.

  - Current interoperability problems and inefficiencies in public safety communications systems are the result of the traditional fragmented approach to managing public safety spectrum.

  - A national framework that leverages the use of modern technologies, such as that recently proposed by the FCC, would provide inherent interoperability and advanced capabilities, while maximizing spectrum and economic efficiency.

  - Public safety agencies themselves, including specifically agencies in the New York City area and in the National Capital Region, are demonstrating such an approach can work, as they are already cooperating to put in place highly capable broadband communications systems based on modern technologies – and doing so without additional spectrum allocations.

Overall, we conclude that the Cyren Call proposal is neither workable nor desirable. The steps needed for rapid improvements in public safety communications are already in motion, and Cyren Call's plan would do more to disrupt this progress than to promote it.

INTRODUCTION

The events of September 11, 2001 have heightened the public's awareness of the importance of effective communications for first responders and the inadequacies of current systems in providing police, fire, and other public safety officials with effective communications tools. Most significantly, today's systems typically are not interoperable - that is, they do not afford basic voice communications between agencies, either within a single jurisdiction (such as between local police and fire departments) or in different jurisdictions (such as between local and state police departments). In addition, most first responders do not have access to the latest advances in technology, such as broadband data and video capabilities that are now commonplace in wireless phones carried by U.S. consumers. There is no debate about the need to improve both the interoperability and the broadband capability of public safety communications systems.

In February 2006, Congress passed legislation that will provide public safety agencies with the spectrum and financial resources they need to address the interoperability problem.[1] The Digital Television Transition and Public Safety Act ("DTV Act") sets a firm date for transitioning existing television services to digital technology. In doing so, it ensures that public safety agencies will have access to an additional 24 MHz of spectrum in the 700 MHz band to provide critical interoperability and meet their future voice and data needs. In addition, the Act provides $1 billion in funding for interoperable communications systems through the auction of commercial spectrum. The Association of Public-Safety Communications Officials (APCO), applauded passage of the legislation, stating that it "will allow state and local public safety

1. Deficit Reduction Act of 2005, Pub. L. No. 109-171 (February 18, 2006).

agencies to move forward towards planning, funding, and deployment of new state of the art, interoperable communications systems."[2]

In April 2006, Cyren Call Communications Corporation, ("Cyren Call") proposed an alternative approach. It filed a petition with the Federal Communications Commission (FCC) asking that 30 MHz of commercial spectrum in the 700 MHz band be reallocated to public safety use, for the purpose of constructing a nationwide broadband emergency communications system for use by first responders.[3] Cyren Call proposes that the spectrum be deeded to a Public Safety Broadband Trust which would lease the spectrum to commercial operators in exchange for their commitment to construct a national broadband network.[4]

On November 3, 2006, the FCC dismissed Cyren Call's petition without prejudice, noting that it is inconsistent with the new law enacted by Congress.[5] However, it left the Cyren Call docket open to receive comments on the petition from the public safety community and other interested parties.[6]

In December 2006, the Commission issued a new Notice of Proposed Rulemaking that proposes a comprehensive plan designed to promote the rapid deployment of a nationwide, interoperable, broadband public safety network, and thereby improve emergency

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2. *See* Association of Public-Safety Communications Officials, "APCO Applauds Congress for the Establishment of a Hard Date," February 2, 2006 (www.apcointl.org/news/2006/20060202APCOApplaudsCongress_HardDate.html).

3. *In the Matter of Reallocation of 30 MHz of &00 MHz Spectrum (747-762/777-792 MHz) From Commercial Use Assignment of 30 MHz of 700 MHz Spectrum (747-762/777-792) to the Public Safety Broadband Trust for Deployment of a Shared Public Safety/Commercial Next Generation Wireless Network*, Petition for Rulemaking of Cyren Call Communications Corporation, RM Docket 11348 (rel. Apr. 27, 2006).

4. The Cyren Call proposal has won the support of many public safety agencies. See, for example, Association of Public-Safety Communications Officials, "Statement Of APCO Regarding Additional 700 Mhz Spectrum For Public Safety," August 10, 2006 (at http://www.apcointl.org/news/2006/20060810APCOStatementAddl700MHzSpectrum.html)

5. *In the Matter of Reallocation of 30 MHz of 700 MHz Spectrum (747-762/777-792) From Commercial Use, Assignment of 30 MHz of 700 MHz Spectrum (747-762/777-792) to the Public Safety Broadband Trust for Deployment of a Shared Public Safety/Commercial Next Generation Wireless Network*, Order, FCC 06-2278, RM Docket No. 11348, (rel. Nov. 3, 2006). The FCC noted, as Cyren Call admitted in its petition, that the FCC does not currently have the authority to approve Cyren Call's petition

responsiveness.[7] Unlike the Cyren Call proposal, the FCC's plan is consistent with existing law – that is, it would work within the 24 MHz of spectrum allocated by Congress. However, the Notice does have certain elements in common with the Cyren Call approach. For example, the FCC's proposal calls for formation of a national licensee to manage deployment of new broadband capabilities, and envisions that public safety and commercial entities could work together on the construction of broadband wireless networks.

Not deterred by the FCC's rejection, Cyren Call began in December to circulate draft legislation based on its original proposal. The draft bill would transfer 30 MHz of spectrum in the 700 MHz band to a Public Safety Broadband Trust at a price not to exceed $5 billion. It would also provide that repayment of the debt necessary to finance both the cost of the spectrum and the construction and maintenance of the shared network would be guaranteed by the United States government.

This paper analyzes the Cyren Call proposal from an economic perspective. It also provides an assessment of public safety's current spectrum holdings, and evaluates whether or not public safety has sufficient spectrum to construct a nationwide interoperable broadband emergency communications network.

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6. *Id.*

7. *In the Matter of Implementing a Nationwide, Broadband, Interoperable Public Safety Network in the 700 MHz Band; Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Communication Requirements Through the Year 2010*; Ninth Notice of Proposed Rulemaking, PS Docket No. 06-229; WT Docket No. 96-86 (rel. Dec. 20, 2006) [hereinafter *Ninth Notice*].

In Part I, we discuss the specific shortcomings of the Cyren Call proposal. First, and perhaps most importantly, the proposal would derail the plan that Congress put in place to facilitate the DTV transition, and as a result, place at risk the ability of public safety agencies to get the spectrum and funding they need for interoperability.

Next, we show that Cyren Call's proposal is significantly flawed on its own terms. Cyren Call's basic proposal is to deed the spectrum to the Public Safety Broadband Trust and allow the Trust to lease it to commercial operators, in exchange for their commitment to construct a nationwide broadband network for public safety use. This network would be designed to meet the more rigorous standards of an emergency communications network, and would be provided to public safety users for only a nominal maintenance fee. Commercial operators could sell service to others, as long as they do not preempt the provision of service to first responders.

Under the Cyren Call plan, commercial operators would be required to build a nationwide broadband network at a considerable cost premium to one they would otherwise build, pay a substantial lease fee for the use of the spectrum, and agree to yield control of the network to public safety entities and Cyren Call. To cover the costs of doing so, they would need to price the services provided by the new network at a premium sufficient to cover the significant subsidies associated with providing service to public safety. This model is not sustainable in a competitive industry: it would place private carriers using the shared network at a significant competitive disadvantage and prevent them from earning an economic return on their investments – which is to say, they would be unwilling to make the investments in the first place.

In Part II, we first explain the needs of public safety agencies for interoperability and broadband communications. Next, we describe the spectrum already allocated to public safety uses. Nearly 100 MHz of spectrum has been allocated to public safety uses. Yet, less than 20 percent of this amount is currently used to support the vast majority of public safety's

communications systems. More than three-quarters of the allocated spectrum, including 24 MHz in the 700 MHz band and 50 MHz in the 4.9 GHz band, is largely unused today and is (or soon will be) available to meet the needs of public safety agencies, including the deployment of an interoperable broadband network.

We also compare the amount of spectrum allocated to public safety uses with the spectrum allocations of commercial wireless providers. We demonstrate that, on a per-subscriber basis, public safety agencies are allocated far more spectrum than *any* commercial operator in the United States. In fact, the spectrum assigned to public safety uses (99.7 MHz nationwide) exceeds the cellular spectrum holdings of any private sector wireless provider, including Cingular (which averages 52 MHz nationwide), Verizon (which averages 40 MHz nationwide), Sprint-Nextel (which averages 50 MHz of cellular/PCS spectrum),[8] and T-Mobile (which averages 25 MHz nationwide).

In Part III, we explain that lack of spectrum is not the key inhibitor to improving public safety communications. The challenges confronted by first responders (including a lack of interoperability) can be largely attributed to the current fragmented approach to designing emergency communications systems, in which thousands of agencies make independent decisions regarding public safety communications. In addition to the inherent lack of interoperability, such an approach – combined with the lack of incentives to economize on spectrum use – leads to inefficient use of spectrum and other resources.

We begin by showing how the current system leads to substantial spectrum inefficiencies. Professor Jon M. Peha of Carnegie Mellon has studied the effects of the current fragmented

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8. Sprint-Nextel also holds between approximately 70 and 80 MHz of BRS spectrum in the 2.5 GHz band. However, it is our understanding that this spectrum is not applicable to cellular service. If this spectrum is included along with Sprint-Nextel's cellular spectrum holdings, that company would have more spectrum (in total) than public safety, but less spectrum on a per subscriber (user) basis than public safety.

approach to public safety communications, and has concluded that this approach has resulted in a communications infrastructure that costs more and consumes more spectrum than it should. Moreover, he concludes that implementation of shared systems that utilize modern commercial technologies would substantially reduce public safety's spectrum needs – to approximately 8.3 MHz of spectrum in 2010. This amounts to only 8.3 percent of public safety's current spectrum allocation and 13.3 percent of the spectrum available to public safety for broadband communications. Dr. Peha's conclusions are supported by data from private industry which shows that nationwide wireless companies in the United States, on average, require just 1 MHz of spectrum to provide service to one million customers. After the 700 MHz spectrum is made available for use, public safety agencies will have 56 times more spectrum, per user, than the average nationwide wireless carrier does now.

Next, we provide examples demonstrating that the current spectrum allocation is sufficient to support interoperability and deploy broadband applications. Specifically, public safety agencies in New York City and Washington, DC have announced plans to implement modern communications systems that promise to make far more efficient and effective use of spectrum and other resources, while providing the interoperability and broadband capabilities that first responders require. We note that:

- In September 2006, New York City announced that it had awarded a five-year, $500 million contract to Northrop Grumman to provide a public-safety broadband wireless network. The announced network will utilize just *10 MHz of spectrum* in the 2.5 GHz band using Universal Mobile Telecommunications System (UMTS) technology. Northrop Grumman's network will cover the entire city of New York using spectrum leased from Sprint-Nextel and the Catholic Diocese of Brooklyn.

- The National Capital Region (NCR) has been granted a waiver covering the Washington, DC and surrounding areas. The NCR proposes to create a network that spans nearly 2,500 square miles and will provide 3.1 Megabits per seconds (Mbps) peak user data rates and NCR-wide throughput of over 352 Mbps, using only *2.5 MHz* of spectrum.

These examples show that interoperable broadband networks can be implemented in as little as 2.5 MHz of spectrum, and that current spectrum resources, if used efficiently, can adequately meet public safety communications needs. Other public safety agencies should follow these examples. We note that the FCC's Ninth Notice of Proposed Rulemaking provides a policy framework for implementing more efficient network models on a national scale.

Finally, we provide a simple economic framework that helps explain why public safety agencies have tended to make inefficient use of spectrum. In general, wireless communications services are produced using two primary inputs, spectrum and equipment. Public safety agencies pay for equipment out of their cash budgets. On the other hand, they are allocated spectrum "for free." Not surprisingly, they tend to overuse spectrum, while under-investing in equipment. Going forward, policymakers can best achieve improvements in public safety communications by encouraging more efficient use of the spectrum already allocated to public safety uses.

I. THE CYREN CALL PROPOSAL IS FUNDAMENTALLY FLAWED

Cyren Call proposes that 30 MHz of spectrum in the 700 MHz band be reallocated from commercial deployment and placed instead in a Public Safety Broadband Trust. To do so would destroy the carefully crafted compromise Congress reached in passing legislation to facilitate the DTV transition, including the provisions that would provide $1 billion in new funding to public safety agencies to promote interoperability.[9] Furthermore, the plan will not work in practice, as it depends on unrealistic assumptions about the willingness of commercial operators effectively to subsidize construction of a public safety communications network. Under Cyren Call's proposal, the risk of failure would be borne by public safety agencies and the U.S. government.

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9. As discussed further below, the Call Home Act of 2006 requires that the grants be awarded by September 30, 2007, but it is not clear it would be possible (or lawful) to do so if the DTV transition is thrown into turmoil, as the Cyren Call proposal would do.

A. Reallocating the 700 MHz Spectrum Would Disrupt the DTV Transition and Deprive Public Safety of Needed Funding for Interoperability

The transition to digital television broadcasting is a complex undertaking that is now well down the road to completion. In its second status report on the transition, the Commission noted:

> The transition to digital television is a massive and complex undertaking, affecting virtually every segment of the television industry and every American who watches television. The spectrum that will be recovered at the end of the transition will bring tremendous benefits to consumers and the United States economy. [Spectrum] will be returned and used for first responders and other critically important public safety needs. [Other spectrum] in the 700 MHz band... will be auctioned for use by new wireless services. The Commission has been continuously involved in the migration to digital television by, among other things, adopting a standard for digital broadcasting, creating a DTV Table of Allotments, awarding DTV licenses, establishing operating rules for the new service, and overseeing the physical build-out of digital broadcast stations.[10]

In February 2006, after years of consideration, Congress passed legislation setting a firm date for the full conversion to digital television broadcasting.[11] The DTV Act represents a carefully balanced set of provisions that will ensure the transition from analog to digital television on February 17, 2009.[12] The Act calls for 60 MHz of spectrum in the 700 MHz band to be released through a competitive auction, while 24 MHz will be made available for use by public safety agencies.[13] The Congressional Budget Office estimates that the auction of the 60 MHz will generate between $10 billion and $15 billion in revenue.[14] Of the proceeds, the DTV Act provides that $1.5 billion will be used to subsidize set-top boxes needed to convert digital TV signals to an analog format that will work with existing televisions, thus, facilitating the

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10. *Second Periodic Review of the Commission's Rules and Policies Affecting the Conversion to Digital Television*, MB Docket No. 03-15, FCC 04-192 (Sep. 7, 2004) at 6.

11. Deficit Reduction Act of 2005, Pub. L. No. 109-171 (2006). *See* Title III; "Digital Television Transition and Public Safety Act of 2005."

12. § 3002(a)(1)(B).

13. § 3003

14. *S. 1932: Deficit Reduction Act of 2005*, Congressional Budget Office Cost Estimate at 22 (Jan. 27, 2006), *available at* http://www.cbo.gov/ftpdocs/70xx/doc7028/s1932conf.pdf. [hereinafter *CBO Cost Estimate*].

clearance of the spectrum now used by incumbent television broadcasters.[15] Importantly, the spectrum that will be cleared through this process includes the 24 MHz of spectrum that is critical to satisfying public safety's future needs. An additional $1 billion will be allocated to public safety uses to support deployment of interoperable systems in the 24 MHz of new spectrum.[16] In addition, more than $300 million will be used for other important public safety programs, including the establishment of a unified national alert system and enhancements to existing 911 systems. Finally, more than $7.3 billion will be used for deficit reduction.[17] Thus, Congress has already allocated approximately $10 billion in proceeds from the auction of the 700 MHz spectrum.

As discussed further in Part II, interoperability is the highest priority issue for public safety communications, and the $1 billion provided by the DTV Act for this purpose is therefore especially important. As the 9/11 Commission Report notes, going forward our nation's security will depend on communication systems that "enable first responders to respond in a coordinated manner with the greatest possible awareness of the situation."[18] APCO recognizes the importance of the new funds: even as it has embraced the Cyren Call proposal, its web site continues to state that "APCO International opposes any action that would delay the allocation of the $1 billion from the spectrum auction proceeds for the grant program to assist public safety agencies in the acquisition of, deployment of, or training for use of interoperable communications systems."[19]

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15. § 3005(a)(2); § 3005(c)(3)(A)(ii); *see also CBO Cost Estimate, supra* note 14, at 23.
16. § 3006.
17. *CBO Cost Estimate, supra* note 14, at 21, table 10.
18. NATIONAL COMMISSION ON TERRORIST ATTACKS ON THE UNITED STATES, 9/11 COMMISSION REPORT, July 22, 2004 at 315 (hereafter *9/11 Commission Report*).
19. *See* Association of Public-Safety Communications Officials, "Additional 700 MHz Spectrum for Public Safety," at http://www.apcointl.org/government/positions/APCO_position_statements.htm#Additional700.

The DTV Act, then, solves several problems at once. It ensures the successful transition to DTV broadcasting, bolsters our nation's commitment to interoperable public safety communications and, in addition, provides for the auction of 60 MHz of badly needed new spectrum for new commercial wireless services. And, it does all of these things while reducing the Federal deficit by more than $7 billion.

The reallocation of spectrum in the 700 MHz band – as Cyren Call proposes – would endanger all of these goals, disrupting the carefully legislated DTV transition and depriving public safety of funding needed to achieve interoperable voice communications. Clearing spectrum used by incumbent television operators has been a lengthy process that has already been delayed several times.[20] Furthermore, both the funding needed to clear the spectrum of incumbent broadcasters and the funding for a public safety network in the 700 MHz band rely on the auction of the full 60 MHz of spectrum in the 700 MHz band. Although Cyren Call proposes that the Public Safety Broadband Trust raise up to $5 billion for the spectrum, the burden of that debt (and the debt from the construction and maintenance of the network) would be borne by the U.S. Government. Therefore, Cyren Call's proposal effectively holds the improvements in interoperability that would result from the $1 billion in new funding hostage to the success of the Public Safety Broadband Trust.[21]

There is no debate that public safety agencies need funding to build out their spectrum in the 700 MHz band. The National Telecommunications and Information Administration, which is

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20. For example, the FCC sought comment on mechanisms to promote voluntary clearing of the 700 MHz band and accelerate the transition to DTV in June 2000. *Memorandum Opinion and Order and Further Notice of Proposed Rulemaking*, WT Dkt. No. 99-168 (FCC 00-224), adopted June 22, 2000.

21. As noted above, the Call Home Act of 2006 (Public Law 109-459) requires the NTIA to "award" at least $1 billion in interoperability grants by September 30, 2007. Furthermore, the Deficit Reduction Act permits the NTIA to borrow funds from the Treasury, so that the grants could in theory be funded prior to the receipt of revenues from the auction. (§ 3006 (b)) However, the law only permits use of the funds for "the acquisition of, deployment of, or training for the use of interoperable communications systems that utilize, or enable

charged with administration of the $1 billion fund for public safety,[22] has begun the process of establishing requirements and procedures affecting these grants.[23] As interoperability and lack of funding are key inhibitors to enhanced public safety communications, policy makers and the public safety community should be focused on prompt implementation of the DTV Act and the establishment of an expeditious process for allocating the funds already appropriated by Congress for the deployment of 700 MHz spectrum. They should not allow themselves to be distracted by a proposal that threatens to deprive them of funds they critically need.

B. Cyren Call's Proposal Cannot Be Effectively Implemented Because it Assumes Private Industry Will Subsidize the Project

Cyren Call proposes that the 30 MHz of spectrum in the 700 MHz band currently slated for auction be shared by public safety and commercial operators. Although it acknowledges that the vast majority of the spectrum would be used for commercial purposes, it proposes that the spectrum be under the control of public safety, deeded to a Public Safety Broadband Trust comprised of state and local public safety representatives. Public safety control would be necessary, Cyren Call argues, to ensure that the broadband network is built in accordance with the more rigorous standards of public safety users, and that first responders have priority use of the spectrum in times of emergency.

Under the Cyren Call plan, commercial operators would agree to lease the spectrum from the Trust and to build a nationwide broadband network that is designed by Cyren Call to meet

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interoperability with communications systems that can utilize" the 24 MHz of spectrum the Act makes available (see § 3006 (d)(3)). Without the DTV transition, the 24 MHz of spectrum will not become available.

22. *See* DTV Act, *supra* note 11.

23. *See, for example, Testimony of John M. R. Kneuer Acting Assistant Secretary for Communications and Information National Telecommunications and Information Administration U.S. Department of Commerce before the Committee on Homeland Security's Subcommittee on Emergency Preparedness, Science and Technology U.S. House of Representatives* (April 25, 2006) (available at http://www.ntia.doc.gov/ntiahome/congress/2006/Kneuer_interoperable_042506.htm) and *Opening Statement of John M.R. Kneuer, Nominee, Assistant Secretary for Communications and Information, National Telecommunications and Information Administration, Before the United States Senate Committee on Commerce,*

public safety's specifications. The network would have to provide extensive coverage, including sparsely populated areas, and it would have to provide the necessary mechanisms to enable public safety to preempt commercial use of the network when necessary. Cyren Call recognizes that commercial operators would be less willing to fund construction of networks in less dense areas, and thus proposes that fees collected from operators for leasing spectrum in metropolitan areas be used to subsidize deployment in rural areas.[24]

Cyren Call's proposal is fundamentally flawed because it assumes private sector companies would be willing to pay above-market prices for a key input, something they cannot and would not do in a competitive market. Under the Cyren Call plan, commercial operators would be required to build a nationwide broadband network that Cyren Call admits would require substantially greater investments than would otherwise be required given public safety's more rigorous requirements.[25] In addition to these costs, operators would have to pay a substantial spectrum lease fee (significant enough to fund construction of broadband networks in rural areas) and pay for the development of a "priority access" system that would ensure uninterrupted access for public safety when additional capacity is needed. Cyren Call's proposal to pay the U.S. Treasury up to $5 billion[26] for the spectrum further exacerbates this problem, because the lease fees that operators would pay to the Trust would have to enable the Trust and/or Cyren Call and its investors to fully recoup this investment as well.[27] All of these

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Science, and Transportation, 104th Cong. (September 12, 2006) (available at http://commerce.senate.gov/public/_files/KneuerOpeningStatementFinal.doc).

24. Cyren Call Petition at 13-14.

25. *Id.* at 11-12.

26. *APCO Backs Proposal for Additional 700 MHz Spectrum*, RADIO RESOURCE, Aug. 10, 2006, *available at:* http://www.radioresourcemag.com/news.cfm.

27. The Congressional Budget Office has estimated that the 30 MHz of spectrum sought by Cyren Call is worth more than the $5B it proposes to pay. The sale of spectrum for below market value is another reason why the Cyren Call proposal is not in the public interest.

considerable costs would have to be borne by the commercial operators, while control over the design and operation of the network is yielded to public safety agencies and Cyren Call.

While Cyren Call proposes that public safety users would pay some amount (as yet not specified) to cover ongoing operations and maintenance of the network, the cost of network construction would have to be borne entirely by the operators' commercial customers. Consequently, commercial services would have to be priced at a premium to cover what is effectively a subsidy associated with providing service to public safety agencies. This would place any commercial operator who participated in funding the Cyren Call network at a substantial disadvantage relative to other service providers that do not have to support such subsidies. In a highly competitive environment, like the wireless market, operators could not expect to earn a market rate of return on such investments, and hence would not make them in the first place.

C. Public Safety Agencies and the U.S. Government Would Bear the Risk for Cyren Call's Plan

While Cyren Call is a private company which presumably expects to profit from this proposal, the plan calls for the public safety agencies and the U.S. government to assume virtually all the risk. Because the proposal incorrectly assumes private industry would subsidize construction of the network, this risk is substantial.

The price of spectrum is extremely volatile, and it is therefore uncertain how much the 30 MHz of spectrum the Public Safety Broadband Trust would hold will be worth at the eventual 700 MHz auction. If the spectrum turned out to be worth more than $5 billion, Cyren Call would have received a windfall, and U.S. taxpayers would have suffered a loss.[28] If, on the other hand,

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28. The CBO's $10-$15 billion estimate of auction revenues from the 60 MHz of spectrum is based on an average valuation of all 60 MHz. For a variety of reasons having to do with the suitability of the spectrum for commercial mobile radio applications, the spectrum at the upper end of the band (746-806 MHz) is likely to be more

the value of the spectrum turned out to be less than $5 billion, the Public Safety Broadband Trust would find itself $5 billion in debt to the U.S. Treasury, holding an asset worth substantially less than $5 billion, and without a viable means of recouping the difference. In particular, commercial wireless carriers, which would already be unwilling to subsidize the construction of a network with technical standards in excess of their needs, would also be unwilling to compensate the Public Safety Broadband Trust for effectively overpaying for its spectrum. The result could well be public safety's version of the NextWave debacle – valuable spectrum could remain unused for years, because the lessee is financially incapable of building out the network.[29] As the NextWave experience showed, "repatriating" the spectrum so that it could be put back out for auction, or to some other better use, would almost surely be a lengthy and litigious process.

II. PUBLIC SAFETY SPECTRUM NEEDS AND CURRENT SPECTRUM ALLOCATIONS

Public safety authorities have two main priorities for improving and upgrading communications systems: interoperability and broadband capability.

Interoperability is defined as "an essential communications link within public safety and public service wireless communication systems, which permits units from two or more different entities to interact with one another, exchanging information according to a prescribed method, in order to achieve predictable results."[30] To fully serve the public interest, public safety communications must be interoperable. That is, distinct public safety agencies must be able to communicate with one another in the event of an emergency that requires cooperation between

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valuable than the spectrum at the lower end (698-746MHz). The 30 MHz that would be removed from auction under the Cyren Call proposal is at the upper end of the band, and is thus likely to be worth more (possibly considerably more) than half of the total. Put differently, the Cyren Call proposal is likely to reduce auction revenues by more than $5 billion.

29. *See, e.g.*, FCC v. NextWave Personal Communications, Inc., 537 U.S. 293, 296 (2003). There was and still is much written about NextWave.

them. Interoperability must be provided for communications between agencies within a single jurisdiction (for example, local police and fire departments) and between agencies in different jurisdictions (for example, local and state police departments).

Broadband capability would give public safety agencies the ability to utilize new applications that demand higher bandwidth, including sharing documents such as maps, blueprints and photographs. For example, one possible public safety application of broadband communication would be "the ability to download schematics of a building to a fire truck over a wireless network before it leaves for a fire."[31]

A. The Need for Interoperable Voice Communications

The need for interoperable voice communications is especially significant in the face of terrorist attacks, natural disasters, and similar major disasters that require coordinated emergency responses. Terrorist attacks in the United States have demonstrated repeatedly the need for improved interoperability among local, state, and federal public safety authorities.[32] The 1993 World Trade Center bombing demonstrated the New York Fire Department's inability to communicate after a large terrorist attack,[33] and the lack of interoperability among New York safety services was further exposed after the attacks on September 11, 2001. The 9/11 Commission cited numerous examples in which interoperability difficulties hampered rescue operations after the attack. For example, New York Police Department helicopters quickly discovered that rooftop rescue operations were not possible. However, their inability to

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30. 47 C.F.R. § 90.7.4.9.

31. Kathleen Q. Abernathy, *Public Safety and Sound Spectrum Management Go Hand in Hand,* National Forum on Public Safety Spectrum Management (Feb. 10, 2004) (*available at:* http://www.fcc.gov/commissioners/previous/abernathy/speeches.html).

32. *See, e.g.,* Jerry Brito, *Public Safety Interoperability*, MERCATUS REPORTS: COMMENTARY, Fall 2006, at 6-7 (discussing the need for interoperability and the structural problems with public safety that cannot be cured by spectrum and funding); Philip Weiser, Dale N. Hatfield & Brad Bernthal, *Toward a Next Generation Architecture for Public Safety*, University of Colorado Boulder Working Paper, at 2-4.

33. *See* Eric Lipton, *Fire Dept. Gets Better Radio, but Needs Much More*, N.Y. TIMES, May 30, 2004, at A27.

communicate this to the New York Fire Department resulted in some victims attempting to climb to the roof for possible rescue.[34] Although the different circumstances of the Pentagon attack (that is, not a high-rise building, but a more isolated location) made coordination of local and federal authorities somewhat more manageable, there were still severe communication problems. The Arlington County After-Action Report noted that:

> Almost all aspects of communications continue to be problematic, from initial notification to tactical operations. Cellular telephones were of little value . . . . Radio channels were initially oversaturated . . . . Pagers seemed to be the most reliable means of notification when available and used, but most firefighters are not issued pagers.[35]

Natural disasters have also exposed public safety officials' inability to communicate regardless of agency. The most recent example was the communication difficulties after Hurricane Katrina devastated the Gulf Coast in September 2005. First responders had to resort to "runners" to communicate due to a combination of communication failures and a lack of interoperability.[36] A dramatic example was provided by New Orleans' police officers "who called Senator Landrieu's Washington office because they could not reach commanders on the ground in New Orleans."[37]

Responding to routine emergencies also necessitates communications across various public safety agencies. This need to communicate with various departments, combined with a lack of national standards, often strains the resources of local public safety agencies. For example, one local agency in Pennsylvania was forced to install seven radios in a single ambulance so that it could communicate with other public safety departments in the area.[38] In

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34. *See 9/11 Commission Report* at 292.
35. *Id.* at 315.
36. *Emergency Communications Bill Gets First Post-Katrina Markup*, COMM. TODAY, Sept. 23, 2005.
37. Scott Shane, *Storm and Crisis: The Fallout*, N.Y. TIMES, Sept. 5, 2005, at A1.
38. *See* Patrick O'Driscoll, *SOS: Emergency Agencies Often Unable to Talk to Each Other; Non-Compatibility Contributed to Loss of Lives on Sept. 11*, USA TODAY, Nov. 20, 2002, at A1.

Portland, Oregon, a local Portland police officer cannot communicate by radio with a state trooper parked just across the street.[39]

These examples demonstrate the clear need for improved interoperability. The 9/11 Commission Report best summarized this need: "[T]he problems in command, control, and communications that occurred at both sites will likely recur in any emergency of similar scale. The task looking forward is to enable first responders to respond in a coordinated manner with the greatest possible awareness of the situation."[40] This awareness demands that first responders be provided with an emergency communications system that provides interoperability across all agencies and all jurisdictions.

The FCC has not ignored this need for interoperability. Since 2001, the agency has been continuously reviewing interoperability standards and responding to public commentary on the issue.[41] There is no debate, therefore, that interoperability is an essential element of any public safety communications solution. Congress' plan to provide more spectrum and financial resources addresses this interoperability problem. Cyren Call's proposal does not.

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39. *Id.*

40. NATIONAL 9/11 COMMISSION REPORT, at 315.

41. In 2001, the FCC issued its Fourth Report and Order, which adopted Project 25 as the narrowband digital standard for the interoperability channels. *See The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Agency Communications Requirements Through the Year 2010*, WT Docket No. 96-86, Fourth Report and Order and Fifth Notice of Proposed Rulemaking, 16 FCC Rcd 2020 (2001). In 2004, the FCC issued its Seventh Notice of Proposal Rulemaking, which sought comment on its tentative conclusion to adopt the Scalable Adaptive Modulation (SAM) standard as the interoperability standard for the 700 MHz wideband interoperability channels and to require all wideband radios be capable of operating on the wideband interoperability channels using SAM. *See Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Agency Communications Requirements Through the Year 2010*, WT Docket 96-86, Fifth Memorandum Opinion and Order, and Sixth Report and Order, and Seventh Notice of Proposed Rulemaking, 20 FCC Rcd 831 (2005). In 2006, the FCC issued an Eighth Notice of Proposed Rulemaking to determine whether it should modify the public safety portion of the 700 MHz band to accommodate broadband communications. *The 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) [hereinafter *Eighth Notice*].

B. The Need for Broadband Capability

In addition to voice communications, broadband communications are becoming increasingly important for first responders and emergency workers. The Department of Homeland Security's Safecom Program concluded in its 2004 report that "[b]ecause of advances in technology, public safety operations are increasingly dependent on the sharing of data, images and video."[42] In defining public safety communications functions, Safecom defined two categories of non-voice communications for public safety: (1) interactive data communications and (2) non-interactive data communications.[43]

Examples of interactive data communications are the provision of images, such as maps, architectural designs of a structure, or video images that are provided in response to a query that is initiated by public safety personnel.[44] The provision of such data can improve the efficiency of first responders by increasing the quantity and level of sophistication of data at their disposal. For example, first responders entering a burning building could better perform their duties with knowledge of the building's floor-plan.[45]

Non-interactive data communications involve the one-way transfer of information involving public safety personnel.[46] An example of non-interactive data communications for public safety is real-time monitoring by a supervisor or commander of first-responders' biometrics and the environment in which first-responders are operating.[47] By increasing awareness of first-responder's health status and the changing conditions of their surroundings,

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42. STATEMENT OF REQUIREMENTS FOR PUBLIC SAFETY WIRELESS COMMUNICATIONS & INTEROPERABILITY, The Safecom Program, Dept. of Homeland Security V.1, Mar. 10, 2004 at 76.
43. *Id.* at 3.
44. *Id.*
45. *Id.*
46. *Id.*
47. *Id.*

the command group is better able to manage first responders and, if needed, can more quickly alert medical staff to the need for their services.

Given the descriptions above, it is clear that the response to the attacks on 9/11 would have benefited from the use of broadband communications. The recent decisions in New York and Washington, DC to build-out broadband networks for public safety (discussed further below) further highlight the importance of broadband communications, as two major metropolitan areas have decided to invest hundreds of millions of dollars toward the deployment of spectrum for those services. Going forward, broadband communications for public safety is a vital component of any effective array of public safety wireless communications services.

C. Current Spectrum Allocations for Public Safety Use

The federal government has allocated 99.7 MHz of spectrum for use by state and local public safety agencies. Of this total, less than 17 MHz of spectrum (in the frequency bands between 150 and 869 MHz) is currently used to support the vast majority of public safety's current communications systems (See Table 1A). More than three-quarters (76.5 MHz) of the spectrum allocated to public safety has been allocated since 1996 and is not yet widely used (see Table 1B). To use the spectrum allocated to public safety, a licensee must: (1) have as its sole purpose the protection of life, health, or property, (2) be a state or local government entity or non-government entity authorized by a local or state public safety entity, and (3) provide services that are not commercially available to the public.[48]

48. Safecom, *Public Safety's New Allocation – Answering Users' Questions on the 4.9 Gigahertz Band*, 2003.

TABLE 1A: STATE AND LOCAL PUBLIC SAFETY SPECTRUM
AS LISTED IN THE 1996 PSWAC FINAL REPORT

Band (MHz)	MHz (est.)	Comments
25-50	6.3	VHF Low Band. Used for conventional non-trunked dispatch voice communications. The band is in use by state highway patrols for wide-area coverage. Future use is questionable as equipment availability is limited.
150-174	3.6	VHF High Band. Generally used for conventional non-trunked dispatch voice communications.
220-222	0.1	220 MHz SMR Band. This allocation is fairly recent and requires very narrow (5 kHz) channelization. Equipment availability is limited.
450-470	3.7	UHF Band. Generally used for conventional non-trunked dispatch voice communications.
470-512	*	UHF TV-Sharing. Various bandwidths have been made available in 11 metropolitan areas for private land mobile use, including public safety use.[49]
806-821 851-866	3.5	800 MHz band. Used for both conventional and trunked systems.
821-824 866-869	6.0	800 MHz band. Used for both conventional and trunked systems.
	23.2	**TOTAL**[50]

Source: Public Safety Wireless Advisory Committee (PSWAC), Final Report, Sept. 1996 (*available at:* http://ntiacsd.ntia.doc.gov/pubsafe/publications/PSWAC_AL.PDF).

49. Eleven "markets" (defined as 50 miles radius around center-city coordinates) have access to spectrum in the 470-512 MHz band (*i.e.*, TV channels 14-20) for land mobile uses: Boston, Chicago, Cleveland, Dallas, Detroit, Houston, LA, Miami, New York, Philadelphia, Pittsburgh, San Francisco, and Washington. In most of these markets, one or two 6 MHz spectrum blocks are available for both common carrier and private land mobile, including public safety, shared use. However, New York and LA have three 6 MHz blocks available, one of which is reserved for public safety use exclusively.

50. This total does not include spectrum in the 470-512 MHz band, *See* n. 45 *supra*..

TABLE 1B: NATIONWIDE PUBLIC SAFETY SPECTRUM ALLOCATIONS ENACTED SINCE 1996

Band (MHz)	MHz (est.)	Comments
764-776 794-806	24	700 MHz Band. To be used for conventional and trunked voice systems and wideband data systems. Further proceedings now underway to better promote broadband deployment.
806-824 851-869	2.5	800 MHz Band Reconfiguration. The FCC estimates that Public Safety should have access to a "running average" of 2.5 MHz of additional 800 MHz spectrum as a result of Sprint Nextel relocating from the interleaved portion of the band. Public safety entities will have exclusive access to this spectrum for 3 years.
4940-4990	50	4.9 GHz. Available for exclusive public safety use for localized fixed and portable broadband applications. Commonly referred to as the public safety Wi-Fi band.
	76.5	**SUBTOTAL**
	99.7	**TOTAL (includes 1996 total)**

Source: *The 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); *Improving Public Safety Communications in the 800 MHz Band*, WT Docket 02-55, 19 FCC Rcd 15056 (2004); *In the Matter of the 4.9 GHz Band Transferred From Federal Government Use*, WT Docket No. 00-32, Second Report and Order and Further Notice of Proposed Rulemaking, 17 FCC Rcd 3955 and 3956 (2002).

To put this information in perspective, public safety has been allocated spectrum (99.7 MHz nationwide) that exceeds the spectrum holdings of any U.S. wireless operator, including Cingular (which averages 52 MHz nationwide),[51] Verizon (which averages 40 MHz nationwide),[52] Sprint Nextel (which averages 50 MHz of cellular/PCS spectrum and approximately 70-80 MHz of BRS spectrum in the 2.5 GHz band), and T-Mobile (which averages 25 MHz nationwide).[53] Yet, it currently uses 20 percent or less of this spectrum for the operation of emergency communications systems.

The additional allocations at 700 MHz and 4.9 GHz provide important spectrum for meeting public safety's future communications needs. In accordance with Congress' directive, the FCC allocated 24 MHz of spectrum at 700 MHz for public safety use (see Table 1B). This

51. CINGULAR WIRELESS LLC, 2005 SEC FORM 10-K at 10 (released Feb. 24, 2006). This does not include the spectrum that Cingular purchased in FCC auction 66. Including that spectrum allotment, Cingular Wireless has the ability to operate on approximately 55 MHz of spectrum nationwide.

52. CELLCO PARTNERSHIP, 2005 SEC FORM 10-K at 11 (released March 14, 2006). This does not include the 20 MHz of spectrum that Cellco Partnership purchased in FCC auction 66. Including that spectrum allotment, Verizon wireless has the ability to operate on approximately 50 MHz of spectrum nationwide.

includes 12 MHz designated for narrowband (voice) communications, and 12 MHz for wideband (data) communications.[54] Within both channel segments, the FCC provided for general use, interoperability, and reserve spectrum.[55]

The FCC's Ninth Notice[56] specifically addresses how to use the 24 MHz of spectrum allocated to public safety at 700 MHz, and contains several key components that should dramatically improve public safety communications. First, the FCC proposes that the 12 MHz of 700 MHz spectrum designated for "wideband" communications be used solely for broadband applications.[57] Second, to promote interoperability, the FCC proposes that a single licensee be awarded this spectrum on a nationwide basis, and that this licensee also be permitted to use the 12 MHz of 700 MHz spectrum designated for "narrowband" communications for broadband use on a secondary basis.[58] Therefore, provided that it does not interfere with the primary users of the narrowband spectrum (or accepts whatever interference primary users cause), the national licensee would have 24 MHz of 700 MHz band spectrum available to it for broadband applications.[59] The FCC posits that its "secondary use" proposal would promote more efficient use of the public safety spectrum, and might facilitate the long term migration of 700 MHz narrowband systems to broadband technology. Third, to promote greater coordination and cooperation among various public safety agencies, the FCC proposes to allow the national

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53. This does not include the 20 MHz of spectrum that T-Mobile purchased in FCC Auction 66. Including that spectrum allotment, T-Mobile has the ability to operate on approximately 45 MHz of spectrum nationwide.

54. In 1997, the FCC reallocated 24 MHz of the 700 MHz band from television broadcast services to public safety communications services. *See Reallocation of Television Channels 60-69, the 746-806 MHz Band*, ET Docket No. 97-157, Report and Order, 12 FCC Rcd 22953 (1997). In many parts of the nation, this spectrum remains unavailable for public safety use. *See Eighth Notice, supra* note 41, at 3668. The current band plan for the public safety portion of the 700 MHz band provides narrowband and wideband communications channels. The four narrowband segments are 764-767 MHz (Channels 1-480), 773-776 MHz (Channels 481-960), 794-797 MHz (Channels 961-1440) and 803-806 MHz (Channels 1441-1920). *Id.* The two wideband segments are 767-773 MHz (Channels 1-120) and 797-803 MHz (Channels 121-240). *Id.*

55. *Id.*

56. *Ninth Notice*, *supra* note 7.

57. *Id.* at 7.

58. *Id.*

licensee to use its assigned spectrum to provide public safety agencies with broadband service on a fee for service basis. Fourth, to promote efficient use of the spectrum and to potentially aid in the build-out costs of the network, the FCC proposes to allow the licensee to enter into arrangements with commercial wireless carriers.[60] This could include the shared use of commercial infrastructure, such as towers, for the efficient provision of public safety broadband service, or providing commercial operators with unconditionally preemptible access to the spectrum for commercial purposes.[61] Thus, the FCC's Ninth Order already incorporates the most positive aspect of the Cyren Call proposal – the ability to efficiently share scarce spectrum resources, as well as the costs of deploying new systems, with private sector users.

The 4.9 GHz band also represents important spectrum for the use of public safety agencies, especially in high density urban areas where spectrum needs are greatest. In 1999, this band was transferred from federal government use to non-federal government use.[62] In 2000, the FCC released a Notice of Proposed Rulemaking that proposed to allocate the 4.9 GHz band to non-government fixed and mobile services, and to allow flexible use of this band.[63] In 2002, the FCC allocated the 50 MHz of contiguous spectrum in the 4.9 GHz band for fixed and mobile services (except aeronautical mobile service), and designated the band for public safety use.[64] In the Third Report and Order, the FCC adopted service rules for use of the 4.9 GHz band,

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59. *Id.*
60. *Id.*
61. *Id.*
62. Omnibus Budget Reconciliation Act of 1993, Pub. L. No. 103-66, 107 Stat. 312 (OBRA-93).
63. *The 4.9 GHz Band Transferred from Federal Government Use*, Notice of Proposed Rulemaking, 15 FCC Rcd 4778 (2000).
64. *The 4.9 GHz Band Transferred from Federal Government Use, Second Report and Order and Further Notice of Proposed Rule Making*, 17 FCC Rcd 3955 (2002).

providing public safety agencies with contiguous spectrum specifically allocated to broadband communications.[65]

Any assessment of public safety agencies' current allocation of spectrum must recognize that the amount of spectrum available for public safety uses has increased significantly in recent years. The FCC has been responsive to the need for additional spectrum, and continues to adopt policies designed to ensure the continuing and uninterrupted availability of spectrum for the use of public safety personnel. The FCC has also sought to promote more efficient spectrum use by adopting technical standards, such as digital compression, that allow for reductions in channel size.[66] However, the FCC has stopped short of mandating the use of commercial technologies that dramatically increase efficiency. Because public safety agencies receive spectrum "for free," and thus do not face appropriate economic incentives to use it efficiently, the FCC (and other policymakers) need to encourage efficient spectrum use through the adoption of appropriate policies.

III. PAST POLICIES HAVE RESULTED IN INEFFICIENT SPECTRUM USE

In its Statement of Requirements for Public Safety, the Department of Homeland Security's Safecom Program repeatedly stresses the need for public-safety communications systems to work efficiently, stating (for example) that "The Radio Frequency (RF) system must be spectrally efficient to a minimum quantifiable degree,"[67] and listing both "Spectrum *and network efficiency*" in its list of necessary network requirements.[68]

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65. The 4.9 GHz Band Transferred from Federal Government Use, Memorandum Opinion and Order and Third Report and Order, 18 FCC Rcd 9152 (2003).

66. *In the matter of Review of the Emergency Alert System*, EB Docket No. 04-296, 20 FCC Rcd 18625 and 18639 (2005).

67. *Id.* at 76.

68. *Id.* at 51 (emphasis added).

In this section, we show that the current system for managing public safety spectrum is inefficient. We show that, if used more efficiently, public safety agencies currently have sufficient radio spectrum to build out a broadband network. Finally, we provide an economic framework that helps to explain why public safety agencies have tended to make inefficient use of spectrum in the past.

A. Existing Systems Use Spectrum Inefficiently

One reason public safety agencies have traditionally used spectrum inefficiently is that they have relied on systems that use call assigned-slot networks, where availability is limited to the number of "slots" available for communication. This architecture greatly limits both the capacity of public safety systems and the ability of these systems to support high data rates. Commercial wireless networks, whose owners pay for their spectrum and thus have incentives to use it wisely, have taken a different approach.

1. Modern System Architectures Allow Spectrum to be Used More Efficiently

In general, the capacity of a multiple access network, such as Code Division Multiple Access (CDMA) and Orthogonal Frequency Division Multiple Access (OFDMA) networks, is measured by the average number of users receiving service at a given time with a given level of quality. The availability and capacity of advanced commercial wireless systems is dictated not only by total bandwidth and the data rate per user, but also by the extent to which frequency is reused across multiple geographic areas or "cells."

In a commercial wireless network, subscriber density is inversely proportional to the square of the cell radius. This means that as the service radius of cells in a wireless network is made smaller, the number of subscribers that can be served grows exponentially. Typical public safety systems, designed with as few tower sites as possible and large service radii, do not have sufficient subscriber density limits to handle capacity bursts. Commercial systems, with their

use of micro and picocells, have much greater subscriber densities available to handle a greater number of calls or higher data rates in the same spectrum bandwidth.

For example, with subscriber density levels that typically exceed 250 simultaneous subscribers per square kilometer (with a 1 kilometer service radius), a 10 MHz CDMA-based network with three sector reuse is capable of serving millions of subscribers within a typical city's limits.[69] Furthermore, this architecture permits capacity to be increased substantially simply by continuing to shrink service radii. Such flexibility is simply not possible with the architecture of existing public safety systems. However, there is no reason that new broadband networks for public safety cannot be built using modern architectures (as in the New York and Washington, DC examples described below), thus allowing public safety communications networks to take advantage of similar capacity and efficiency gains.

2. Lack of Coordination Has Led to Inefficient Spectrum Use and Lack of Interoperability

Research by Professor Jon M. Peha of Carnegie Mellon University shows that a policy that requires each local public safety organization to make independent decisions about its communications system without effective coordination "will produce an infrastructure that is more expensive than necessary, requires more spectrum than necessary, and is more prone to interoperability problems than necessary."[70] To demonstrate why the current regime is more expensive than necessary, Peha uses regression analysis to estimate the relationship between the number of antenna structures deployed by public safety agencies in a given region and a host of explanatory variables including population, terrain, and the size of the covered territory.[71] He

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69. Theoretically, OFDMA-based networks could provide even greater spectral efficiency, however, commercial OFDMA systems are not yet widely deployed.

70. Jon M. Peha, *How America's Fragmented Approach to Public Safety Wastes Spectrum and Funding*, 33rd Telecommunications Policy Research Conference, Sept. 2005.

71. *Id.* at 5.

finds that information on the number of municipalities in a region increases the predictive power of the regression model by 50 percent – that is, it increases the R^2 from 0.4 to 0.6. He explains the significance of this result as follows:

> The reason that counties with more municipalities tend to have more antennas is that many municipal agencies operate communications systems specifically designed to cover the area where their emergency responders might someday operate (and perhaps additional area as well), with little or no regard for the communications systems used by their neighbors. Without national or regional planning, local agencies are far less likely to consider sharing their transmission towers or equipment, which leads to unnecessary duplication.[72]

According to Peha, the common "solution" to the interoperability problem is patching – that is, connecting disparate public safety communications systems through a switch. But that approach is plagued with inefficiency for several reasons. In particular, patching wastes spectrum because it "has the effect of creating one communications channel, but it consumes twice the bandwidth throughout a greater area than a normal channel."[73] Addressing interoperability problems by patching also involves "extending coverage even further beyond city limits so responders can communicate with the switch that does the patching even further from home," which consumes even more spectrum.[74]

Peha also notes that public safety's current call for more spectrum is based on findings from a 1996 report to Congress by the Public Safety Wireless Advisory Committee (PSWAC), which claimed that an *additional* 95.3 MHz of spectrum beyond public safety's 1995 allocation of 23.4 MHz – a total of 118.7 MHz – would be needed to meet public safety requirements in the year 2010.[75] PSWAC arrived at its result by extrapolating spectrum reuse patterns from Southern California in 1995. Peha points out that PSWAC's extrapolation from Southern

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72. *Id.* at 6.
73. *Id.* at 9.
74. *Id.*

California to the United States is flawed because it assumes that the inefficiencies present in Southern California in 1995 would only be addressed through incremental changes in technology, not through fundamental changes in technology or policy.[76]

Peha considers what could be achieved if public safety reused spectrum the way commercial cellular networks and microcellular Wi-Fi networks do as they use large spectral bandwidths to spread information much more efficiently. Peha demonstrates that if one replaces just two assumptions in the PSWAC model with more realistic ones (i.e., a more realistic load factor of 10.75, and spectrum reuse consistent with modern systems (increased from a range of 2.5 to 4 to 620)), the model would show that public safety agencies would need about 8.3 MHz of spectrum in 2010 – about one-third of the public safety allocation in 1995 (23.4 MHz) and less than 10 percent of the current allocation (99.7 MHz).[77] Peha explains that even this estimate is conservative, as it assumes a frequency reuse factor of 3,[78] which means that no more than one third of the licensed spectrum can be used at any given base station, Advanced technologies like CDMA and OFDMA can use a frequency reuse factor of 1, which means that all licensed spectrum can be used at every base station.[79] Had Peha's analysis used the frequency reuse factor available with current commercial technologies, he would have concluded that public safety's spectrum needs in 2010 would be even less than 8.3 MHz.

As discussed in detail above, public safety agencies have received almost all of the 95.3 MHz of additional spectrum that the PSWAC report recommended, as the Commission has already reallocated and dedicated an additional 76.5 MHz of spectrum for public safety use in the

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75. Public Safety Wireless Advisory Committee (PSWAC), Final Report, Sept. 1996. http://ntiacsd.ntia.doc.gov/pubsafe/publications/PSWAC_AL.PDF

76. Peha, *supra* note 70, at 10.

77. *Id.* at 12.

78. *Id.* at 12.

79. *See, e.g.,* http://www.cdg.org/technology/cdma_technology/a_ross/cdmarevolution.asp.

intervening ten years. With the advent of new technology, and public safety's embrace of such advances, public safety has more than enough spectrum to meet its needs for deployment of a broadband network.

3. The Private Sector Uses Spectrum Much More Efficiently Than the Public Sector

The most frequent users of public safety communications are first responders -- that is, police, fire fighters, and paramedics. Approximately 1.9 million first responders work in the United States, including 665,000 police officers, 1.1 million fire fighters, and 155,000 registered Emergency Medical Technicians (EMTs).[80]

When the 700 MHz spectrum is vacated by its current occupants, public safety will have 99.7 MHz of spectrum with which to provide communications services to approximately 1.9 million first-responders. Therefore, the ratio of first-responders to bandwidth allocated to first responders is 19,057 users per 1 MHz. Furthermore, the ratio of first-responders to the 62 MHz of bandwidth allocated for broadband applications is 30,645 per 1 MHz.

Table 2 provides rates of spectrum usage per subscriber for several nationwide wireless carriers in the United States.

TABLE 2: SUBSCRIBERS AND SPECTRUM HOLDINGS FOR NATIONWIDE U.S. CARRIERS

Wireless Carrier	2005 Subscribers (Millions)	Nationwide Spectrum (MHz)	Subscribers per MHz
Cingular	54.1	52	1,040,385
Verizon Wireless	51.3	40	1,282,500
T-Mobile	21.7	25	867,600
		Average	*1,063,495*

The data in Table 2 indicate that nationwide wireless carriers in the United States, on average, provide wireless services to over one million customers per 1 MHz of spectrum. By

80. Cyren Call estimates there are 3 million "core first responders." *See* Cyren Call Petition at 7.

contrast, after the 700 MHz spectrum is vacated, public safety will have 56 times more spectrum, per user, than the average nationwide wireless carrier does now (equal to 1,063,495/(1.9 million public safety subs/99.7 MHz of spectrum)). Considering only the 62 MHz of spectrum allocated to broadband applications, public safety will have nearly 35 times the spectrum, on a per user basis, than the average nationwide wireless carrier does now (equal to 1,063,495/(1.9 million public safety subs/62 MHz of spectrum)).

Those who advocate more spectrum for public safety agencies point out, correctly, that public safety users have special needs, and that public safety systems cannot therefore be compared directly with Commercial Mobile Radio Service (CMRS) systems. The point of the above analysis, however, is that, even recognizing that there are differences between public safety and CMRS systems, CMRS systems are dramatically more efficient in their use of spectrum than public safety systems. Before giving public safety agencies additional spectrum to use inefficiently, policymakers should consider providing the guidance, funding, and incentives necessary for them to make more efficient use of the spectrum they have.

If the 24 MHz of 700 MHz spectrum made available for public safety use by the DTV Act is used efficiently, it would enable the provision of both interoperable voice and broadband data applications for public safety entities throughout the country. In addition, public safety agencies have not yet begun to use the additional 50 MHz of *contiguous* spectrum recently allocated in the 4.9 GHz band. Efficient use of this spectrum would ensure public safety broadband and other needs are met for the indefinite future. Clearly, the appropriate focus for policymakers is to ensure that public safety resources are concentrated on efforts to quickly and efficiently deploy recently allocated spectrum for interoperability and broadband services.

B. New Public Safety Systems Demonstrate the Current Allocation of Radio Spectrum Is Sufficient to Build Out a Broadband Network

The FCC has recognized that 10 MHz is sufficient for traditional commercial wireless networks to operate over an extensive population of users,[81] and that a network only requires 2.5 MHz of paired spectrum to provide broadband data rates.[82] Two recent examples, involving the New York City and Washington, DC regions, demonstrate that interoperable broadband networks can in fact be deployed using relatively little spectrum; in fact, using even less than the 24 MHz already being made available.

In September 2006, New York City announced that it had awarded a five-year, $500 million contract to Northrop Grumman to provide a public-safety broadband wireless network. The announced network will utilize 10 MHz of spectrum in the 2.5 GHz band, and is designed to enhance public safety by facilitating communication between emergency responders. Northrop Grumman chose Universal Mobile Telecommunications System (UMTS) technology because of its inherent spectral efficiency, which reduces the network's need for spectrum[83] while providing New York with a technology sufficient for its public-safety broadband wireless requirements.[84]

Northrop Grumman's network will cover the entire city of New York using 10 MHz of spectrum through spectrum leases with Sprint Nextel and the Catholic Diocese of Brooklyn. Northrop Grumman will install approximately 400 cell sites in the area.[85] Each cell site will

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81. *See e.g.,* Service Rules for Advanced Wireless Services in the 1.7 and 2.1 GHz Bands; WT Docket No. 02-353; 20 FCC Rcd 14058 at ¶ 12.

82. *See* Amendment of Part 22 of the Commission's Rules to Benefit the Consumers of Air-Ground Telecommunications Services; Biennial Regulatory Review – Amendment of Parts 1, 22, and 90 of the Commission's Rules; Amendment of Parts 1 and 22 of the Commission's Rules to Adopt Competitive Bidding Rules for Commercial and General Aviation Air-Ground Radiotelephone Service; Application of Verizon Airfone Inc. for Renewal of 800 MHz Air-Ground Radiotelephone License Call Sign KNKG804; WT Docket No. 03-103;70 FR 19293, 19377 at ¶ 31.

83. Donny Jackson, *New York City Awards $500 million Wireless Contract to Northrop Grumman*, PRISM INSIGHT, Sept. 15, 2006.

84 Joni Morse, *IPWireless Technology Chosen for NYC Public-Safety Network*, RCR WIRELESS NEWS VOL. 25 NO. 38, Sept. 18, 2006.

85. *Id.*

provide 7.5 Mbps of data in a three-sector arc. There are plans to upgrade the network to achieve 35 Mbps of throughput within two to three years, all within 10 MHz of spectrum.[86]

Similarly, the National Capital Region (NCR), which covers the Washington, DC and surrounding areas, has been granted a waiver by the FCC for a broadband network that will utilize only 2.5 MHz of spectrum.[87] The proposed network will span nearly 2,500 square miles and provide 3.1 Mbps peak user data rates and average NCR-wide throughput of over 352 Mbps.[88] NCR argued that the deployment of wideband technology in accordance with existing FCC rules would have limited the average throughput for each public safety licensee to a little over 100 kbps, while "a single broadband channel used throughout the NCR will provide over 10 times this throughput per sector (using the average speed) and the NCR intends to deploy nearly 300 sectors – delivering over 400 times the throughput while using less spectrum."[89] The single broadband channel that NCR refers to is made up of two 1.25 MHz channels.

These examples demonstrate that systems using modern technologies can meet the needs of public safety agencies for broadband communications while using far less than 24 (or even 12) MHz of spectrum.

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86. Bob Brewin, *Catholic Diocese of Brooklyn to Supply NYC Safety Net Spectrum*, FEDERAL COMPUTER WEEK, Sept. 13, 2006.

87. *Request by National Capital Region for Waiver of the Commission's Rules to Allow Establishment of a 700 MHz Interoperable Broadband Data Network*, WT Docket No. 96-86, DA 07-454, (Jan. 31, 2007). *See also* Letter from Robert LeGrande, Deputy Chief Technology Officer, District of Columbia, filed with the FCC on July 3, 2006 ("LeGrande Letter").

88. LeGrande Letter at 4.

89. LeGrande Letter at 11.

C. Current Policies Give Public Safety Agencies Incentives to Use Spectrum Inefficiently

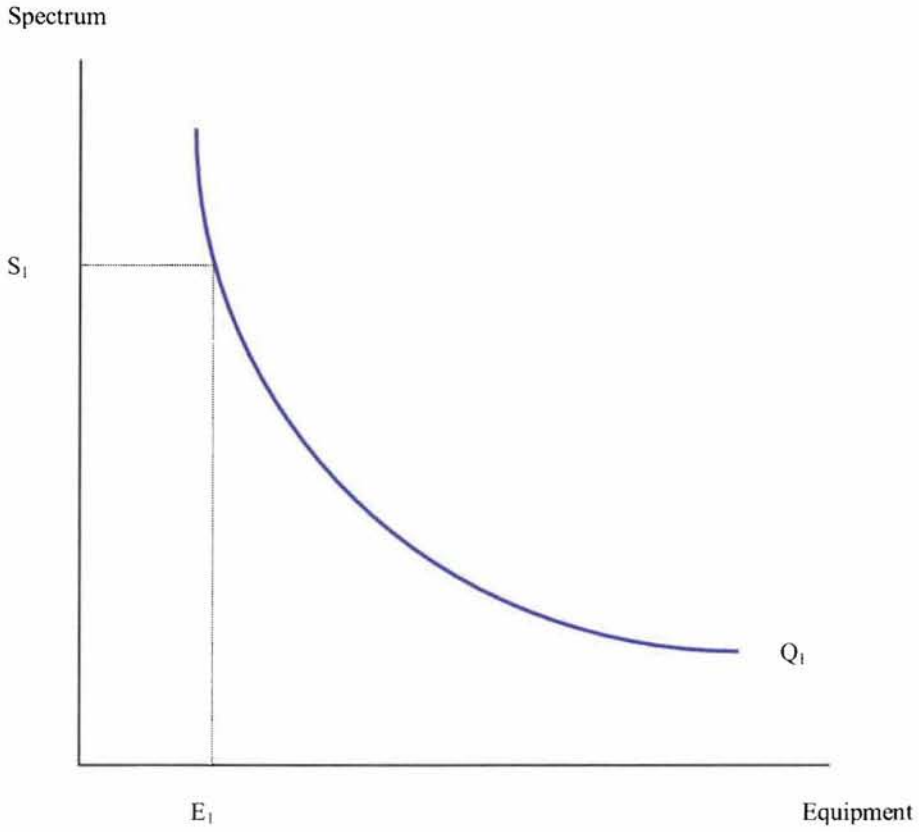
Economic principles provide a framework for understanding why public safety has tended to use spectrum inefficiently in the past, and perhaps help explain why additional spectrum is not the solution for today's public safety communications challenges.[90]

The two primary inputs used to provide wireless communications services are spectrum and equipment. In layman's terms, these two inputs are both complements and substitutes: that is, they are complements in the sense that both inputs are needed to produce the desired output (mobile communications services), but substitutes in that the same amount of output can be obtained utilizing different mixes. Historically, public safety agencies' strategy for the provision of communications services has been to rely heavily on the procurement of additional spectrum (which, from their perspective, is "free"), and to under-invest in more efficient equipment, which would allow the more efficient use of spectrum (but which, from the perspective of public safety agencies, costs money).

The tradeoff facing public safety in this regard is portrayed graphically in Figure 1.

90. The graphical analysis below is intended to be illustrative. To fully analyze the complementarities between spectrum and equipment for certain public safety applications, a more detailed analysis would be necessary.

FIGURE 1: PUBLIC SAFETY'S USE OF SPECTRUM AND EQUIPMENT TO PROVIDE WIRELESS COMMUNICATIONS



The curved line in Figure 1 represents the "isoquant"[91] for a quantity of wireless communications services equal to Q_1. This means that any combination of spectrum (S) and equipment (E) that lies along the line could be used to provide Q_1 of communications services[92] The fact that the isoquant is convex, or curved inwards towards the origin of the horizontal and vertical axes, indicates that as the amount of either input is increased, the additional value of another unit of that input falls relative to the value of the other input. In a system that is "spectrum rich" but "equipment poor," for example (like the point shown in Figure 1, which indicates a relatively large quantity of spectrum, S_1 and a relatively small amount of equipment,

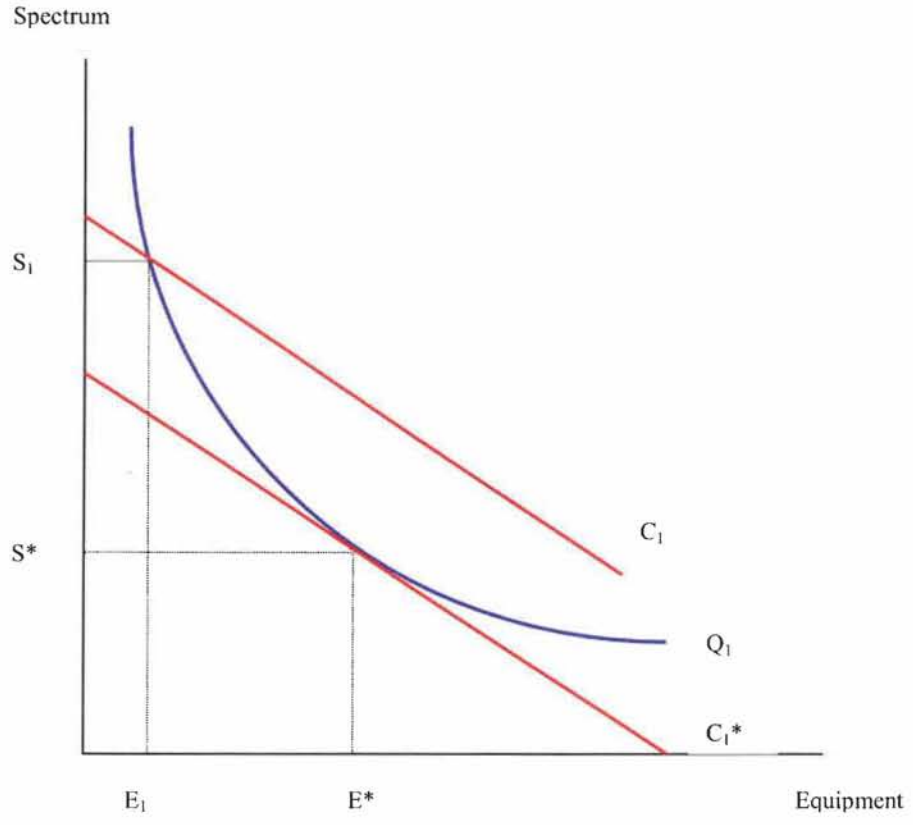
91. *See, e.g.*, ROBERT S. PINDYCK & DANIEL L. RUBINFELD, MICROECONOMICS 202-208 (Pearson Prentice Hall 6th ed, 1995).

92. *Id.* at 202.

E_1) a relatively small amount of equipment could substitute for a relatively large amount of spectrum while still maintaining output at Q_1 (i.e., staying on the isoquant).

The optimal mix of spectrum and equipment for any given output of communications depends on the price of equipment relative to the price of spectrum. For any given set of relative prices, one can draw an "isocost" curve (or price line). Figure 2 analyzes both the current and optimal mix of spectrum and equipment given the price of equipment relative to the price of spectrum.

FIGURE 2: INVESTING IN SPECTRUM OR EQUIPMENT TO OFFER BROADBAND COMMUNICATIONS SERVICES



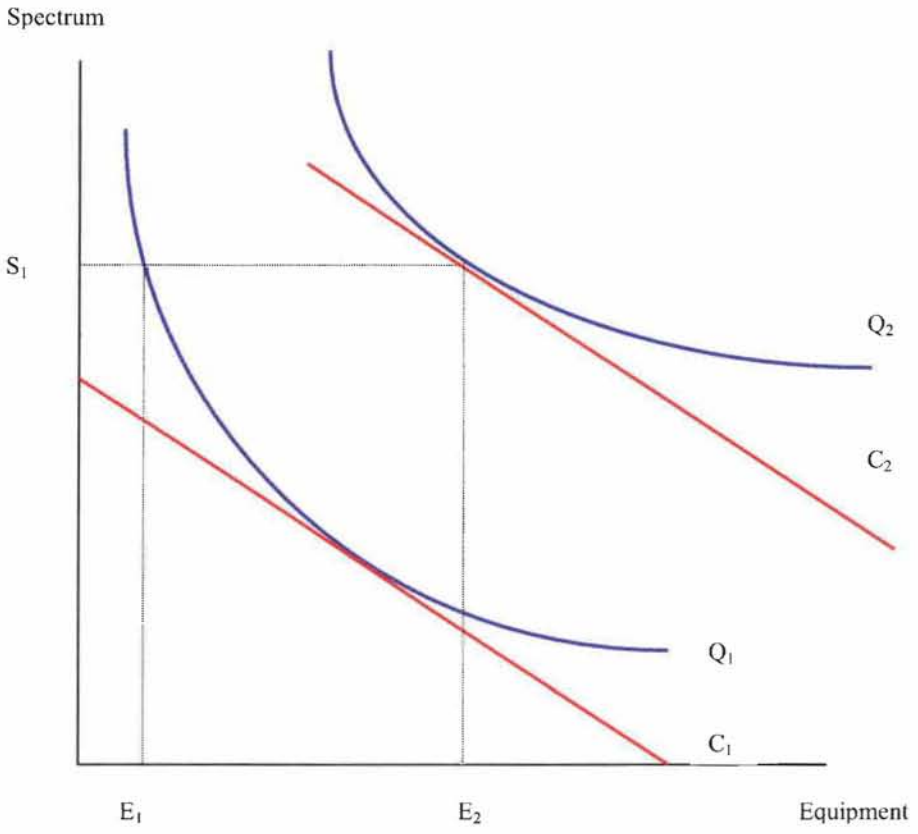
In Figure 2, we add two "price lines" (or "isocost lines"), C_1 and C_1*. Each line represents the amount of equipment and/or spectrum that can be purchased for a given cost, given the relative prices of spectrum and equipment, which are represented by the slope. (As the line moves further from the origin, the cost goes up, and the amount of spectrum and/or

equipment that can be purchased goes up commensurately. Thus, C_1 represents a higher cost than does C_1*). As Figure 2 illustrates, if public safety agencies had been faced with the actual relative prices of spectrum and equipment, and if their goal had been to achieve the current level of output (Q_1) for the lowest possible cost, they would have chosen to use less spectrum (S*) and more equipment (E*). In this manner, public safety could achieve the same amount of communications services while using fewer resources.[93] Because public safety agencies (unlike commercial providers) do not face the actual price of spectrum, they (quite rationally) have chosen to overuse spectrum and under-invest in equipment.

This analysis also illuminates the choice faced by public safety agencies going forward. They now seek to achieve a greater quality of output, both in terms of interoperability and broadband capability, as represented by the isoquant Q_2 in Figure 3. One approach to achieving Q_2 is to flood the system with still more spectrum, while keeping expenditures on equipment relatively low (for example, achieving greater interoperability by retaining existing equipment and using more "patches"). Another approach is to use the current amount of spectrum more efficiently, even though this might require, in the short run at least, a greater expenditure on equipment. As Figure 3 illustrates, the efficient approach is to change the mix of inputs.

93. *Id.* at 228-29.

FIGURE 3: INVESTING IN SPECTRUM OR EQUIPMENT TO OFFER BROADBAND COMMUNICATIONS SERVICES



Holding the spectrum allocation constant at S_1, a cost minimizing solution exists for an equipment investment of E_2 and at a quantity of communications services Q_2. The question is whether or not Q_2, the maximum amount of mobile communications services that can *efficiently* be achieved with the current spectrum allocation, is sufficient for public safety needs. The examples and analysis above demonstrate that, for the foreseeable future, the current allocation is sufficient.

It should also be noted that this analysis takes as given the current level of fragmented decision making and other managerial problems discussed in Section II above. To the extent policymakers, including the FCC, are able to address these problems (for example, by putting in

place a sound framework for the use of the 24 MHz spectrum about to be made available to public safety agencies), the result would be to increase the quantity of communications services that would be produced with any given combination of spectrum and equipment. The plan proposed by the FCC in its *Ninth Notice* could provide such a framework. While we have not fully analyzed the specifics of the FCC's proposal, it clearly represents a step in the direction of more efficient use of public safety spectrum, and thus improved communications for first responders.

CONCLUSION

Through the DTV Act, Congress has provided both the funding and the additional spectrum needed to improve interoperability of public safety communications systems and to deploy needed broadband capabilities. Cyren Call's proposal threatens both outcomes. By forcing Congress to pass new legislation, it threatens to upset the delicate balance upon which the DTV transition is based. Funding for interoperability would be threatened, and the process of making new spectrum available would be (at best) delayed by many months or, more likely, years. Moreover, the Cyren Call plan rests on unrealistic assumptions about the willingness of commercial network operators to subsidize the deployment of a public safety network. In a competitive market, no network operator – no matter how patriotic or public-spirited – would be allowed by its shareholders to do so. The fact that the plan is risky is demonstrated by Cyren Call itself, which demands a government guarantee as a condition for moving forward. If, as is likely, the plan proves unworkable, U.S. taxpayers will bear the financial risk. Public safety agencies, however, would bear an even greater cost, as the spectrum they so desperately need to improve interoperability and deploy broadband could be left unusable and ultimately tied up in litigation for years to come.

Cyren Call's proposal comes at a time when policymakers legitimately are concerned about the need to improve public safety communications capabilities. The DTV Act, however, has already provided the framework needed to achieve these goals. Policymakers today should focus on providing public safety agencies with the means, and the guidance, necessary to ensure that current spectrum allocations are efficiently and effectively used.