

**FCC REPORT TO CONGRESS**

**Vulnerability Assessment and  
Feasibility of Creating a Back-Up Emergency Communications System**

**Submitted Pursuant to  
Public Law No. 110-53**

Federal Communications Commission

Kevin J. Martin, Chairman

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## I. INTRODUCTION AND EXECUTIVE SUMMARY

1. This Report is submitted by the Chairman, Federal Communications Commission (FCC or Commission),<sup>1</sup> pursuant to Section 2201(b) of the Implementing Recommendations of the 9/11 Commission Act of 2007 (*9/11 Act*). This section mandates that, no later than 180 days from enactment of the statute (i.e., January 30, 2008), the Federal Communications Commission (Commission) “shall conduct a vulnerability assessment of the Nation’s critical communications and information systems infrastructure and shall evaluate the technical feasibility of creating a back-up emergency communications system that complements existing communications resources and takes into account next generation and advanced communications technologies.”<sup>2</sup> This Report reflects analysis undertaken by the Commission staff<sup>3</sup> as well as input from representatives of Federal, State and local government agencies, communications service providers and equipment manufacturers.<sup>4</sup>

2. As explained in further detail below, this Report sets forth the following findings regarding the vulnerability of critical communications and information technology infrastructure:

- **Existing Emergency Responder Communications Infrastructure Is Resilient**

It is built using hardened, fault-tolerant technologies and routinely supported by ample back-up power (e.g., 48 hours). Moreover, the infrastructure used by emergency responders for their primary communications is capable of surviving all but the most catastrophic disasters.

- **Commercial Communications Infrastructure Is Not Resilient to Large-Scale Disasters**

The commercial communications infrastructure is typically designed and deployed to reliability and resiliency specifications that are less rigorous than emergency responder infrastructure. Hence, commercial infrastructure is more likely to be compromised in a large-scale disaster. However, commercial service providers have the financial resources and business imperative to restore service rapidly as long as repair crews have access to the affected area. Access, which

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<sup>1</sup> See 47 U.S.C. §155(a) (stating that “[i]t shall be the [Chairman’s] duty . . . to represent the Commission in all matters relating to legislation and legislative reports . . .”).

<sup>2</sup> Implementing Recommendations of the 9/11 Commission Act of 2007, Pub. L. No. 110-53, § 2201(b), 121 Stat. 266, 539-540 (*9/11 Act*).

<sup>3</sup> See 47 C.F.R. §0.191(g) (providing authority to the Public Safety and Homeland Security Bureau (PSHSB) to conduct studies of public safety issues) and (k) (providing authority to PSHSB to develop responses to legislative inquiries).

<sup>4</sup> To fulfill this task, the Commission convened a task force comprised of subject matter experts from various units within the agency. To collect the information required for this evaluation, members of the task force conducted over 50 meetings, site visits and conference calls with emergency response agencies and organizations, vendors of emergency equipment and providers of commercial communications services. As required by the Paperwork Reduction Act, the information collection was approved by the Office of Management and Budget under OMB Control Number 3060-1109. See also “Public Information Collection Requirement Submitted to OMB for Emergency Review and Approval,” 72 Fed. Reg. 50,964 (Sept. 5, 2007). In addition, as required by the statute, the Commission consulted with the National Communications System. *9/11 Act*, § 2201(b)(1), 121 Stat. at 539.

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requires credentialing and physical security, is often the largest obstacle to rapid restoration of commercial communications systems.

- **Information Systems Supporting Emergency Communications Are Not Routinely Interoperable**

When the word “interoperability” is used in the context of emergency communications one thinks of radio communications interoperability. Emergency communications systems, however, are supported by a hierarchy of computer-based information systems that also should be interoperable. As discussed further below, this is often not the case, resulting in suboptimal emergency communications systems, particularly in large-scale disasters that require a response from widespread jurisdictions.

3. This Report discusses, in detail, the following findings regarding the feasibility of a back-up emergency communications system:

- **A Single Back-Up Emergency Communication System Is Not Feasible in the Near-Term**

The emergency responder sector is a patchwork of semi-autonomous jurisdictions and agencies with a need to collaborate that varies inversely with geographic distance and functional alignment. Hence, there is no common set of emergency communications requirements that will satisfy the back-up needs of the entire emergency responder community. Technology evolution and a growing willingness of emergency responders to accept commercial solutions are creating the possibility of a unified solution over the long-term. The Commission’s recent Second Report and Order establishing the 700 MHz Public/Private Partnership lays the groundwork for this migration.<sup>5</sup>

- **Discrete Back-Up Emergency Communications Capabilities Are Feasible**

While a unified back-up emergency communications system is not a near-term option, there are a number of feasible technical capabilities in use today to enable back-up communications when primary emergency communications infrastructure is disrupted. These capabilities include back-up power for remote emergency communications assets, rapidly deployable radio systems used by emergency responders, and multiple commercial communications platforms like satellite and cellular.

- **Cooperative Region and State Emergency Communications Planning Is Increasing the Utility of Discrete Back-Up Capabilities**

One of the most important lessons learned from the emergency communications failures of 9/11 and the 2005 Gulf Coast hurricanes is the importance of planning for large-scale emergencies well in advance so that adequate preparations, including back-up asset acquisition and associated training, can be accomplished. A number of regions and states have embarked on such planning

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<sup>5</sup> See Service Rules for the 698–746, 747-762 and 777-792 MHz Bands, WT Docket No 06-150, *Second Report and Order*, 22 FCC Rcd 15,289 (2007) (“700 MHz *Second Report and Order*”).

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activities, some going so far as to design and deploy communications networks that can support back-up emergency communications.<sup>6</sup> These cross-jurisdictional planning efforts increase the utility of discrete back-up emergency communications capabilities that restore impaired infrastructure. More extensive regional and state planning is also a vital step in the journey toward the resilient, interoperable emergency communications system that Congress envisions in Section 2201(b) of the *9/11 Act*.

- **Evolution of Commercial Communications Technology and Emergency Responder Perception of Commercial Service Viability Should, Over Time, Create the Conditions for a Resilient, Interoperable Emergency Communications System**

Commercial communication technologies are undergoing a profound transformation based on the emergence of Internet Protocol as the next-generation multi-service network platform. These changes open new possibilities for an integrated resilient, interoperable emergency communications system and/or services that provide emergency responders with the priority access they need. The Commission's recent adoption of a Second Report and Order initiating a 700 MHz Public/Private Partnership will facilitate this evolution.<sup>7</sup>

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<sup>6</sup> For the purpose of this discussion, the term "region" refers to a collection of entities that are geographically near to each other (e.g., neighboring counties and municipalities) and from which there would likely be an emergency response to a large incident anywhere in the region. It is possible for a region to span several states.

<sup>7</sup> See 700 MHz *Second Report and Order*, *supra* note 2.



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## II. BACKGROUND

### A. Implementing Recommendations of the 9/11 Commission Act – Section 2201(b) Overview

4. On August 3, 2007, President George W. Bush signed into law the Implementing Recommendations of the 9/11 Commission Act of 2007 (*9/11 Act*), which requires that the Federal Communications Commission (Commission) “shall conduct a vulnerability assessment of the Nation’s critical communications and information systems infrastructure and shall evaluate the technical feasibility of creating a back-up emergency communications system that complements existing communications resources and takes into account next generation and advanced communications technologies.”<sup>8</sup> The Commission must submit a report to Congress that details the findings of this vulnerability assessment and feasibility evaluation not later than 180 days after the date of enactment of the *9/11 Act* (i.e., January 30, 2008).<sup>9</sup> This *Vulnerability Assessment and Feasibility of Creating a Back-Up Emergency Communications System* (Report) fulfills this task.

5. The task given to the Commission through Section 2201(b) of the *9/11 Act* uses public safety communications terminology not defined in the statute or in its legislative history.<sup>10</sup> In these instances, the Commission has, in its capacity as the expert agency on communications matters,<sup>11</sup> inferred what it understands is the scope of its charge pursuant to Section 2201(b) of the *9/11 Act*. As indicated below, however, the Commission also considered the expertise of various public safety and industry stakeholders.

### B. Overview of Emergency Communication Systems

6. For purposes of this Report, an overview of emergency communication systems and their principal elements is presented. At a high conceptual level, communication systems used by emergency responders can be grouped into two general categories: emergency mobile radio and emergency enterprise communications.<sup>12</sup>

7. Emergency mobile radio communication systems support the needs of public

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<sup>8</sup> *9/11 Act*, § 2201(b), 121 Stat. at 539-540.

<sup>9</sup> *Id.*, § 2201(b)(1), 121 Stat. at 539.

<sup>10</sup> H. Rep. No. 101-259 (2007), as reprinted in, 2007 U.S.C.C.A.N. 119, 230-232 (H.R. 1 Conference Rpt.).

<sup>11</sup> See, e.g., *Qwest v. FCC*, 258 F.3d 1191, 1195 (10th Cir. 2001) (“We review and uphold the FCC’s computer model . . . . Several technical aspects of the model have been challenged, but we find that these fall squarely within the FCC’s discretion as an expert agency.”); *Chisholm v. FCC*, 538 F.2d 349, 357 (D.C. Cir. 1976), cert. denied 429 U.S. 890 (1976) (“The Congress created the Federal Communications Commission as an expert agency to administer the Communications Act of 1934 (quoting S. Rep. No. 562, 86<sup>th</sup> Cong., 1<sup>st</sup> Sess. 12 (1959)).

<sup>12</sup> Mike Alagna, Vice President, Integrated Solutions, Motorola, Inc. (Motorola), interview with FCC staff preparing 9/11 Act Report (Sept. 27, 2007). See also Sukumar Dwarkanath, COMCARE, *Emergency Services Enterprise Framework: A Service Oriented Approach*, 2006 Proceedings of the 3rd International Information Systems for Crisis Response and Management (ISCRAM) Conference 298, available at <http://www.comcare.org/uploads/DwarkanathPositionPaperISCRAM2006.pdf> (last visited Jan. 16, 2008).

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safety personnel who need to respond to the site of an emergency, the “first responders.”<sup>13</sup> These radio systems are generically called Land Mobile Radio (LMR)<sup>14</sup> systems and are owned and operated by emergency responder communities. While there are many varieties of such systems supporting different capacities and features, all systems share some common elements:

- A heavy-duty grade handset or “handy-talkie” that can be switched among a number of channels. Emergency responders typically assign channels to specific communication functions, e.g., one channel may be assigned for communications among emergency responders at the site of an incident, a second channel may be reserved for use by supervisory personnel only, a third channel may be reserved for communication with an adjoining jurisdiction, and so forth. Each channel functions in a “push to talk” mode enabling the channel to be efficiently shared among all users of that channel.<sup>15</sup>
- A radio tower providing the air link connecting all handsets and also connecting with a dispatch center. Radio towers are critical assets and therefore are typically designed to withstand the harshest conditions expected to be found within a region.<sup>16</sup>
- A power back-up system to protect against loss of commercial power. This usually consists of a battery reserve together with a generator that often provides days of power reserve. By way of comparison, commercial wireless systems often have just battery reserve protecting against commercial power loss.<sup>17</sup>
- A dispatch center, often located at the Public Safety Answering Point (PSAP).<sup>18</sup> The dispatch center communicates with emergency responders over the LMR system and with other emergency officials using wireline communications such as the Public

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<sup>13</sup> The term “first responder” refers to those individuals who in the early stages of an incident are responsible for the protection and preservation of life, property, evidence, and the environment, including emergency response providers as defined in Section 2 of the Homeland Security Act of 2002. 6 U.S.C. § 101.

<sup>14</sup> See *infra* Appendix A for more details on LMR systems.

<sup>15</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, teleconference with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>16</sup> M/A-COM presentation to FCC staff preparing 9/11 Act Report (Oct. 26, 2007).

<sup>17</sup> Jim Bugel, Vice President, AT&T, interview with FCC staff preparing 9/11 Act Report (Sept. 27, 2007); Dave Buchanan, Chairman, Southern California Regional Planning Committee, teleconference with FCC staff preparing 9/11 Act Report (Oct. 12, 2007). Recognizing the vulnerability of commercial communication systems to loss of commercial power as demonstrated during the Katrina disaster and other events, and the important role played by commercial communications for the public and emergency responders during such events, the Commission has ordered that back-up power be provided for assets of certain wireless and wireline communications service providers. Recommendations of the Independent Panel Reviewing the Impact of Hurricane Katrina on Communications Networks, *Order*, 22 FCC Rcd 10541 (“*Katrina Panel Order*”), *Order on Reconsideration*, 22 FCC Rcd 18013 (2007) (“*Katrina Panel Recon Order*”).

<sup>18</sup> A PSAP is a E-911 call center housing the personnel and systems used to support E-911 calls. E-911 calls may be routed to a dispatch center for assignment and “dispatch” of emergency responders to an emergency. See Billy Ragsdale, et al., National Emergency Numbering Ass’n (NENA), *9-1-1 Tutorial*, available at <http://www.nena.org/florida/Directory/911Tutorial%20Study%20Guide.pdf> (last visited Jan. 4, 2008).

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Switched Telephone Network (PSTN).<sup>19</sup>

8. LMR systems typically use one of four primary frequency bands: Very High Frequency (VHF), Ultra High Frequency (UHF), 700 MHz, or 800 MHz. The VHF band, the earliest used by emergency responders, has the longest effective transmission range but limited capacity (e.g., ability to only support simplex voice communications). As such, VHF bands are often favored where emergency responders need to cover large territories as might be the case for a state trooper or wildlife agent. The 800 MHz systems,<sup>20</sup> which have more recently been allocated to public safety, are often used for the provision of higher capacity or trunked LMR systems, which can support more simultaneous voice communications than lower frequency systems.<sup>21</sup>

9. An “enterprise” is a term generalized by the commercial communications and IT sectors to describe an organization of people supporting a common set of goals as often represented by a business.<sup>22</sup> Emergency responders are supported by groups of emergency services personnel, which this Report refers to as emergency responder enterprises. These can include the PSAP and dispatch groups, fire and police organizations, city, county or state emergency operations centers, and federal law enforcement agencies, among others.<sup>23</sup> In addition to LMR systems, a specific enterprise may commonly use voice PBX equipment, public telephone services, commercial data services, satellite voice and data services, as well as other communication capabilities.<sup>24</sup> Emergency responder enterprises, due to the range of the tasks they perform, are dependent on a larger set of communication services than that for the typical on-scene emergency responder, whose primary communication link is a LMR handset. Furthermore, since the emergency responder enterprises are based in fixed building locations, their communication needs can be more easily satisfied by wireline voice and data services. Critical communication assets in an emergency responder enterprise are typically protected against loss of commercial power by the use of battery and generator power systems.<sup>25</sup> These emergency communication elements are depicted in Figure 1 below.

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<sup>19</sup> M/A-COM presentation to FCC staff preparing 9/11 Act Report (Oct. 26, 2007).

<sup>20</sup> The Commission has also made spectrum in the 700 MHz band available to first responders, with characteristics similar to the 800 MHz band. *See* Service Rules for the 698-746, 747-762 and 777-792 MHz Bands, *Second Report and Order*, 22 FCC Rcd 15289 (2007).

<sup>21</sup> *See, e.g.*, Improving Public Safety Communications in the 800 MHz Public Safety Band, *Report and Order*, 19 FCC Rcd 14969 (2004).

<sup>22</sup> *See, e.g.*, Luis M. Camarinha-Matos and Hamideh Afsarmanesh, *Collaborative Networked Organizations, A Research Agenda for Emerging Business Models* (2004) (discussing enterprise concepts).

<sup>23</sup> Roger Hixson, Technical Issues Director, NENA, Presentation to FCC staff preparing 9/11 Act Report (Nov. 9, 2007). *See also* David Alyward, COMCARE and Patrick Halley, NENA, *Emergency Communications and Interoperability: An Update and Action Plan*, presentation to NSTAC, (June 7, 2007).

<sup>24</sup> Steve Souder, Director, Dep’t of Public Safety Communications, Fairfax County, VA, interview with FCC staff preparing 9/11 Act Report (Nov. 7, 2007).

<sup>25</sup> Roger Hixson, Technical Issues Director, National Emergency Numbering Ass’n (NENA), presentation to FCC staff preparing 9/11 Act Report (Nov. 9, 2007).

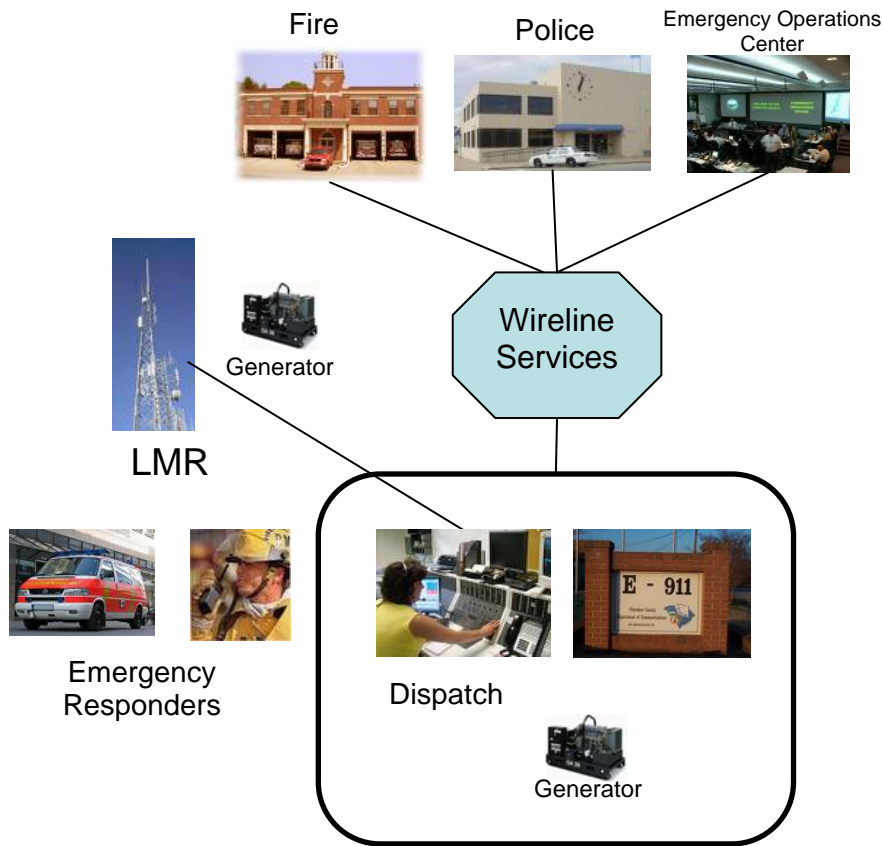


Figure 1

**C. Vulnerability Assessment of the Nation’s Critical Communications and Information Infrastructure**

10. The *9/11 Act* requires the Commission to “conduct a vulnerability assessment of the Nation’s critical communications and information systems infrastructure.” For purposes of this task, the term “critical communications and information infrastructure” is defined as that which is typically used by emergency responders.<sup>26</sup> This definition is consistent with Section 2201(b) of the *9/11 Act*, particularly given the overriding objective of this provision to ensure “a resilient interoperable communications system for emergency responders in an emergency.”<sup>27</sup> For purposes of this analysis, this definition includes mobile radio services such as LMR, private

<sup>26</sup> The terms “emergency” and “emergency responder” are addressed below in the context of a discussion of the technical feasibility evaluation that the Commission is also charged with by the *9/11 Act*. If necessary, Section 2201(b) also makes provision for a “classified annex” regarding the provision of information in the Report concerning “critical infrastructure.” *9/11 Act*, § 2201(b)(3), 121 Stat. at 540. The Report does not include a classified annex.

<sup>27</sup> See *9/11 Act*, § 2201(b)(1), 121 Stat. at 539. See also *9/11 Act*, 121 Stat. at 266; National Commission on Terrorist Attacks Upon the United States, *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States* 396-397 (Official Government ed. 2004) (*The 9/11 Commission Report*).

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networks dedicated to use by emergency responders and public networks to the extent these networks and the services they enable are used by emergency responders in an emergency. This term also includes communications facilities that are used by emergency responders but that are owned and/or controlled by private sector communications service providers.

**D. Evaluation of the Technical Feasibility of a Back-Up Emergency Communications System**

11. The *9/11 Act* also requires the Commission to “evaluate the technical feasibility of creating a back-up emergency communications system that complements existing communications resources and takes into account next generation and advanced communications technologies.” As noted above, the *9/11 Act* provides that the “overriding objective” for this evaluation “shall be providing a framework for the development of a resilient interoperable communications system for emergency responders in an emergency.”<sup>28</sup> In conducting its evaluation, the Commission focused on those events that by their nature disrupt or degrade the primary communications systems relied upon by emergency responders. Such events are referred to as “large-scale disasters” in the Report. This approach is consistent with the *9/11 Act*, particularly in light of the fact that large-scale disasters were the focus of the recommendations of the *9/11 Commission Report*, which served as the impetus for Congress to direct the Commission to prepare this Report.<sup>29</sup> The 9/11 Commission’s recommendations regarding “command, control, and communications” address situations such as the “attacks on 9/11 [that] demonstrated that even the most robust emergency capabilities can be overwhelmed if an attack is *large* enough.”<sup>30</sup> (emphasis added)

12. Large-scale disasters consist of events affecting significant areas of a region and may be caused by regional flooding or fires, earthquakes, or other disruptive forces of nature or man. While major events such as the attacks on 9/11 and such natural disasters as Hurricane Katrina capture the Nation’s attention, less catastrophic disasters of large-scale occur frequently throughout the Nation, often without high visibility. Specific regions of the country may be more susceptible to certain types of risks, e.g., the western states frequently suffer the effects of forest fires, tornados strike throughout the Plains states and other areas, while the southern and mid-Atlantic states suffer from hurricanes. In conducting this evaluation, the Commission considered emergencies that require a regional response, such as those that cover a large geographic area and involve too much damage to be addressed through emergency response by a single agency or even a single jurisdiction. Sometimes the emergency itself covers a region that is multi-jurisdictional in nature, like recent California wildfires that occurred simultaneously in or rapidly spread among adjacent counties with parched forests. Other times an emergency can be like the 9/11 attacks, which were local but very large — large enough to make response from multiple non-local agencies necessary. Response to such emergencies may require cooperation among emergency response agencies that do not normally work with each other or even communicate with each other. Large-scale disasters highlight the need for planning and

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<sup>28</sup> *9/11 Act*, § 2201(b)(1), 121 Stat. at 539.

<sup>29</sup> *Id.*, 121 Stat. at 266.

<sup>30</sup> *The 9/11 Commission Report* at 396.

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coordination among emergency responder communities. The 9/11 Commission recognized this in its recommendation that “[w]hen multiple agencies or multiple jurisdictions are involved, they should adopt a unified command. Both are proven frameworks for emergency response.”<sup>31</sup>

13. The *9/11 Act* includes a number of terms that are germane to the Commission’s evaluation. These terms are discussed in turn.

- “Emergency responders” include Federal, tribal, state, and local emergency public safety, law enforcement, emergency response, emergency medical (including hospital emergency facilities), and related personnel.<sup>32</sup>
- “Emergency communications system” includes equipment (often from multiple vendors) and procedures integrated into a system to serve the communications needs of emergency responders.<sup>33</sup>
- “Back-up” means equipment and procedures that exist as part of an emergency communications system to provide continuity of service if the primary communications system is disabled or degraded.<sup>34</sup>

14. The *9/11 Act* directs the Commission to evaluate the technical feasibility of a back-up emergency communications system that “complements existing communication resources,” which includes both private and commercial technologies that are now available, and to take “into account next generation and advanced communications technologies.”<sup>35</sup> For purposes of this Report, the Commission defines “next generation” and “advanced communications technologies” as encompassing packet-based technologies such as Internet Protocol (IP) and broadband multimedia and communication concepts and plans advanced by industry representatives regarding capabilities currently in development or planned. Section 2201(b) of the *9/11 Act* also sets as its objective a “framework for the development of a resilient

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<sup>31</sup> *Id.* at 397.

<sup>32</sup> As noted above, none of these terms are defined in the statute or in its legislative history. The *9/11 Act* does not define “emergency responder.” The definition used for this Report was obtained from the Homeland Security Act of 2002. 6 U.S.C. § 101. This is a widely accepted definition of the term. *See, e.g.,* Warren B. Rudman, et al., *Emergency Responders: Drastically Underfunded, Dangerously Unprepared, Report of an Independent Task Force Sponsored by the Council on Foreign Relations* 12 (2003).

<sup>33</sup> The 9/11 Commission recommends that Congress “establish signal corps units to ensure communications connectivity between and among civilian authorities, local first responders, and the National Guard. Federal funding of such units should be given high priority by Congress.” *The 9/11 Commission Report* at 397. Such “communications connectivity” entails an “emergency communications system.”

<sup>34</sup> The 9/11 Commission discusses back-up in the context of there not having been a back-up for the New York City Emergency Operations Center located at the World Trade Center, and concluded in its recommendations regarding “command, control and communications” that “[p]reparedness in the private sector and public sector ... should include ... a plan for continuity of operations.” *Id.* at 284, 398. Continuity of operations entails back-up communications whether it is in the form or resiliency of primary facilities or redundancy in the form of secondary facilities.

<sup>35</sup> *9/11 Act*, § 2201(b)(1), 121 Stat. at 539.

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interoperable communications system for emergency responders in an emergency.”<sup>36</sup> For purposes of this Report, the Commission defines as “resilient” a communications system configured to readily adapt to and recover from the failure of elements of the overall system.

15. Section 2201(b) of the *9/11 Act* also enumerates “factors to be evaluated” as part of the technical feasibility analysis. Several of these factors use the term “public safety entity” (PSE), which, for purposes of this Report, the Commission interprets to mean any agency or authority to which emergency responders report.<sup>37</sup> The factors enumerated in Section 2201(b) are:

- A survey of all Federal agencies that use terrestrial or satellite technology for communications security and an evaluation of the feasibility of using existing systems for the purpose of creating such an emergency back-up public safety communications system;
- The feasibility of using private satellite, wireless, or terrestrial networks for emergency communications;
- The technical options, cost, and deployment methods of software, equipment, handsets or desktop communications devices for public safety entities in major urban areas, and nationwide; and
- The feasibility and cost of necessary changes to the network operations center of terrestrial-based or satellite systems to enable the centers to serve as emergency back-up communications systems.<sup>38</sup>

The Commission considered all of these factors in its work and addressed them in this Report.

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<sup>36</sup> *Id.*

<sup>37</sup> The 9/11 Commission points to the problem of the “inability” of “public safety organizations” to communicate during the 9/11 attacks. *The 9/11 Commission Report* at 397.

<sup>38</sup> *9/11 Act*, § 2201(b)(2), 121 Stat. at 540.

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### III. DISCUSSION OF KEY FINDINGS

#### A. Vulnerability Assessment of Critical Infrastructure

16. In conducting this assessment, the Commission considered the effect of the terrorist attacks of 9/11 and from the devastation that Hurricane Katrina brought to the Gulf Coast. In addition to lessons learned from these events, the Commission considered information from the Power Blackout of 2003, the California Wildfires of 2007, and other events and incidents in this Report. The study of these manmade and natural disasters reveals that vulnerabilities still exist for the Nation's critical communications and information technology infrastructure and for those who both operate and rely on its proper functioning.

17. The Federal government, partnering with states, tribes, and local government entities, along with the private sector and non-governmental organizations (NGO), is actively identifying and addressing vulnerabilities, collaborating to streamline response efforts, and exercising emergency plans and procedures. Specifically, under the Department of Homeland Security's (DHS) leadership, the Federal government has published sector specific plans for all seventeen critical infrastructure and key resources sectors, including communications and energy,<sup>39</sup> redrafted the National Incident Management System (NIMS),<sup>40</sup> is drafting a new all hazards National Response Framework (NRF), which is slated to replace the National Response Plan (NRP),<sup>41</sup> is working on several planning scenarios,<sup>42</sup> and will conduct a National Level Exercise (NLE 2-08) this May.<sup>43</sup>

18. A probable worst-case disaster scenario is a wide-area power disruption coupled with significant terrestrial damage, a scenario for which Hurricane Katrina is the prime example. According to the Commission's Independent Panel Reviewing the Impact of Hurricane Katrina on Communications Networks:

In the affected areas of Louisiana, Mississippi and Alabama, more than three million customer telephone lines were knocked out of service. Both switching centers and customer lines sustained damage. Thirty-eight 911 call centers went down. Approximately 100 broadcast stations were unable to transmit and hundreds of thousands of cable operators lost

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<sup>39</sup> Dep't of Homeland Security, *Sector Specific Plans*, available at [http://www.dhs.gov/xprevprot/programs/gc\\_1179866197607.shtm#0](http://www.dhs.gov/xprevprot/programs/gc_1179866197607.shtm#0) (last visited Jan. 9, 2008).

<sup>40</sup> Dep't of Homeland Security, FEMA, *National Incident Mgmt. Sys., FEMA 501/Draft* (Aug. 2007), available at [http://www.fema.gov/emergency/nims/nims\\_doc.shtm](http://www.fema.gov/emergency/nims/nims_doc.shtm) (last visited Jan. 4, 2008).

<sup>41</sup> Dep't of Homeland Security, *NRF Resource Center*, available at <http://www.fema.gov/emergency/nrf/mainindex.htm> (last visited Jan. 15, 2008).

<sup>42</sup> Press Release, Dep't of Homeland Security, *DHS Releases Nat'l Preparedness Guidelines*, (Sept. 13, 2007), available at [http://www.dhs.gov/xnews/releases/pr\\_1189720458491.shtm](http://www.dhs.gov/xnews/releases/pr_1189720458491.shtm) (last visited Jan. 15, 2008).

<sup>43</sup> DHS concerns itself with a wider array of communications systems than is addressed by this Report, which is focused on emergency communications systems used by emergency responders.



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service. Even generally resilient public safety networks experienced massive outages.<sup>44</sup>

The Gulf Coast region remains susceptible to storms of this nature.

19. The New Madrid and San Andreas fault lines are looming threats of this scale that could impact large populations, be geographically dispersed, and could damage terrestrial systems and transportation routes. Tsunamis could have a similar effect on Hawaii, our territories, and other coastline population centers. The recent California Wildfires also highlighted the impact of loss of power, damage to infrastructure, and the inability to reach damaged radio systems for repair and refueling.

20. Despite the horrific loss of life, the terrorist strikes on the World Trade Center (WTC) and the Pentagon were events with localized physical damage on communications infrastructure.<sup>45</sup> They do, however, illustrate the important point that back-up communications involves far more than infrastructure resiliency. It requires process resiliency, which demands careful advanced planning and incident management. The 9/11 Commission, for example, “mindful of the unfair perspective afforded by hindsight,” examined radio communications in and around Manhattan on 9/11. The 9/11 Commission noted instances of both operable and interoperable radio communications.<sup>46</sup> With respect to communicating evacuation instructions to emergency responders in the WTC North Tower, the 9/11 Commission found that,

[t]he success of NYPD ESU [Emergency Service Unit] instruction is attributable to a combination of (1) the strength of the radios [in the high-rise environment], (2) the relatively small numbers of individuals using them, and (3) use of the correct channel by all.<sup>47</sup>

While noting that the Pentagon response was not without difficulties, the 9/11 Commission detailed what it considered success factors from that site:

While no emergency response is flawless, the response to the 9/11 terrorist attack on the Pentagon was mainly a success for three reasons: first, the strong professional relationships and trust established among emergency responders; second, the adoption of the Incident Command System; and third, the pursuit of a regional approach to response. Many

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<sup>44</sup> Independent Panel Reviewing the Impact of Hurricane Katrina on Communications Networks, *Report and Recommendations to the Federal Communications Commission 6, 7-13 (Katrina Panel Report)* (internal quotation omitted).

<sup>45</sup> Although the resulting physical damage to the communications infrastructure was limited to the disaster regions, the PSTN common carriers implemented network management controls, thereby limiting public communications capabilities into the affected regions. These network management controls affected both domestic and international inbound communications traffic.

<sup>46</sup> *The 9/11 Commission Report* at 281-323.

<sup>47</sup> *Id.* at 322.

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fire and police agencies that responded had extensive prior experience working together on regional events and training exercises.<sup>48</sup>

21. Emergency communications also rely on the functioning of the eighty-five percent of the Nation's critical communications infrastructure that the private sector controls. For example, 911 calls cannot reach a PSAP when the PSTN is compromised or overwhelmed. Cellular phones are used for non-critical primary communications or for back-up communications when primary systems fail. Given the scale of these assets and their geographic dispersion, any Federal government role in remediation would be modest. Although the Federal government can bring in small scale solutions for temporary patching, speedy and effective recovery is dependent on those closest to the impact zone using deployable equipment, and having plans in place, coordination complete, exercises concluded, equipment caches ready, and back-up power in place. Further, vulnerabilities can be minimized by isolating single points of failure, identifying robust redundant routes, integrating satellite systems into critical communications infrastructure solutions, where appropriate, and implementing industry best practices.

22. Although this Report touches on Federal and commercial systems, its primary focus is on emergency communications systems used by emergency responders. In the sections that follow, this Report assesses vulnerabilities in three areas of the Nation's communications and information technology infrastructure that are particularly important to PSEs.

- Existing emergency responder communications infrastructure
- PSE applications
- Commercial wireless communications infrastructure

### **1. Resiliency of Existing Emergency Communications Infrastructure**

23. Emergency responders operate in an environment where lives and property are at risk. This is never more apparent than in times of large-scale disaster. To operate successfully in this environment, they require highly robust and reliable communication systems, which include reliable communications infrastructure and resilient operational procedures. Discussions with public safety representatives reveal that emergency responders currently deploy and operate a communication infrastructure that is robust and reliable even when confronted with severe external conditions.

24. Today's emergency communications systems include LMR systems<sup>49</sup> and their associated backhaul.<sup>50</sup> Various factors contribute to the resiliency of these systems including their use of fault tolerant equipment, robust network design, deployed facilities, portable back-up mechanisms, and power back-up.

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<sup>48</sup> *Id.* at 314.

<sup>49</sup> See *infra* Appendix A for more details on LMR systems.

<sup>50</sup> Backhaul refers to the transport of information from a remote site or sites to a central communications hub.

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25. Discussion with public safety representatives and other stakeholders also reveal that emergency responders enjoy communication equipment and devices that are more robust and reliable than their commercial counterparts. Such devices are designed and developed with redundant and fault-tolerant components that withstand environmentally harsh conditions. Manufacturers use higher standards of durability and tolerance (such as those used for military) to build equipment and devices for use by emergency responders.<sup>51</sup> Mechanisms envisioned in the design allow certain fall-back capabilities to commence in times of emergency. In such cases, a network may continue to operate even if key system components or site links fail.<sup>52</sup> For example, M/A-COM states, “[p]re-designed fall back modes maintained trunk radio functionality” for radio systems during Hurricane Katrina.<sup>53</sup> In the event such radio systems collapse and fail to function, the radios can be provisioned, at a minimum, to revert to the “talk around” capability allowing users to talk directly to each other.

26. Emergency responder communication networks and systems typically are deployed within environmentally hardened facilities allowing them to survive harsh conditions caused by man or nature. Accordingly, these networks often continue to function during times that many other commercial services fail or are in disarray. Radio towers in various parts of the country are built to withstand Category 5 hurricanes, earthquakes, and forest fires depending on local circumstances. For example, during the 2004 hurricane season in Florida, emergency responder systems could operate more reliably than the commercial cellular systems.<sup>54</sup> Although Orange County (Orlando, Florida) had generator start-up issues, it did not lose any of its nine 800 MHz simulcast trunk sites (with 20,000 subscriber units) during 2004 when hurricanes Charlie, Frances, and Jeanne struck.<sup>55</sup> Another example is the October 2007 southern California wildfires in Lyons Peak, San Diego County. Although the Harris Fire devastated the surrounding area, some emergency responder communication facilities withstood the fire and remained operational.<sup>56</sup>

27. Emergency responder communication networks and systems are currently backed-up by various restoration mechanisms that include portable systems that can be rapidly deployed

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<sup>51</sup> EF Johnson, Inc. (EF Johnson) uses Mil Std 810. EF Johnson presentation to FCC Staff preparing 9/11 Act Report (Oct. 22, 2007). Motorola uses Mil Std 810 C/D/E/F. See [http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/penultimate.aspx?navigationpath=id\\_803i/id\\_1388i/id\\_2353i](http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/penultimate.aspx?navigationpath=id_803i/id_1388i/id_2353i) (last visited Dec. 27, 2007). Kenwood USA Corp. (Kenwood) uses Mil Std 810 C/D/E/F. See [http://www.kenwoodusa.com/Communications/Land\\_Mobile\\_Radio/Public\\_Safety/](http://www.kenwoodusa.com/Communications/Land_Mobile_Radio/Public_Safety/) (last visited Jan. 4, 2008).

<sup>52</sup> M/A-COM, *P25 Technical Overview*, available at <http://www.macom-wireless.com/federal/P25%20Network%20Overview%208x11.pdf> (last visited Dec. 27, 2007).

<sup>53</sup> M/A-COM presentation to FCC Staff preparing 9/11 Act Report (Oct. 26, 2007).

<sup>54</sup> Florida Dep’t of Transportation, *Hurricane Response Evaluation and Recommendations, Technical Memorandum - Version 5* (Feb. 11, 2005) (“The FDOT private radio system (47 MHz) performed very well with no outages reported during the storms. The public cellular systems encountered significant problems during the hurricanes. For several days after the storms, there were intermittent problems.”).

<sup>55</sup> National Public Safety Telecommunications Council (NPSTC) presentation to FCC staff preparing 9/11 Act Report (Oct. 29, 2007).

<sup>56</sup> *Id.*

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in the field. Various state and local emergency responder communities have portable back-up systems such as Tower on Wheels (TOWs), Site on Wheels (SOWs), or Mobile Control Units (MCUs) that are pre-positioned for use when primary systems fail during emergencies.<sup>57</sup> In certain situations, emergency responders also have the capability to use portable repeater systems in their vehicles.<sup>58</sup>

28. Emergency responder communication networks and systems are frequently equipped with extended-life batteries and power generators for use during emergencies or power outages. The batteries run for approximately eight hours; the power generators can run for days or weeks, subject to refueling.<sup>59</sup> When commercial power systems fail, this extended onsite power supply availability is critical to the resiliency of emergency responders.

29. While existing emergency communications systems are reliable and resilient, they can yield to the most catastrophic disasters. Hurricane Katrina offers an example of a disaster on a scale that exceeded durability of even emergency communications infrastructures, which succumbed to high winds, flooding, and power loss.<sup>60</sup> Extended loss of commercial power was a major source of outages after back-up power systems were exhausted. Furthermore, commercial communications systems, which typically provide backhaul for emergency communications networks, did not fare as well in the high winds and subsequent flooding.<sup>61</sup>

## **2. Commercial Communications**

30. Emergency responders frequently carry commercial wireless phones to supplement their LMR radios. In addition, emergency support personnel like PSAP call-takers, may be dependent on wireline communications for operation of elements of their primary emergency communication systems. For this reason an assessment of vulnerabilities in the commercial sector is relevant to this Report.

### **a. Wireless Communications**

31. The reliability of commercial mobile telephony communication systems depends

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<sup>57</sup> Pennsylvania has four TOWs (Tower On Wheels), one in a truck and three on trailers, positioned around the state. Commonwealth of Pennsylvania, Teleconference with FCC Staff preparing 9/11 Act Report (Oct. 30, 2007). Florida has a five-channel mobile trunked system (trailer with truck) housed in Orlando. It could take 7-8 hours to get to certain areas of the state. State of Florida, Teleconference with FCC Staff preparing 9/11 Act Report (Oct. 23, 2007). Indiana currently has one SOW (Site On Wheels) for wide area disasters, and may purchase additional ones. State of Indiana, Teleconference with FCC Staff preparing 9/11 Act Report (Nov. 8, 2007). Mississippi has several SOWs around the state. State of Mississippi, Teleconference with FCC Staff preparing 9/11 Act Report (Oct. 29, 2007); Georgia has several MCUs (Mobile Control Units) around the state. State of Georgia, Teleconference with FCC Staff preparing 9/11 Act Report (Nov. 17, 2007).

<sup>58</sup> M/A-COM presentation to FCC Staff preparing 9/11 Act Report (Oct. 26, 2007).

<sup>59</sup> Public safety sites have back-up battery power for eight hours and generator power for a couple of weeks. Southern California Regional Planning Committee, teleconference with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>60</sup> *Katrina Panel Report* at 7.

<sup>61</sup> *Id.*

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on two critical elements:

- A network that is resilient to single points of failure
- Quick restoration of network functionality and affected elements

32. Commercial mobile telephony communications systems are highly resilient to localized outages. Each cell site in a commercial network typically possesses redundant equipment elements. In addition, failure of a single cell site can be partially or wholly compensated for by reconfiguring adjacent remaining sites. To repair failed network elements, commercial wireless operators possess extensive resources consisting of highly trained support personnel, mobile communication assets, deployable generators, spare parts, cooperative support agreements with other operators, and vendor agreements that allow for the quick repair of equipment and restoration of full service after a failure.

33. In the event of a failed network element, remote network operation centers (NOCs) quickly detect and diagnose the problem. Technicians can then be dispatched to replace defective parts. If a site totally fails, the service provider can deploy a Cell on Wheels (COW) or Cell on Light Truck (COLT) to provide temporary service. The overall reliability of wireless systems attests to the effectiveness of this strategy.

#### **b. Wireline Communications**

34. Emergency responder enterprises such as PSAPs are dependent on wireline communications for operation of critical systems. Like wireless systems, wireline service providers design networks to minimize single points of failure that could disrupt the network. Further, the wireline service providers plan for quick repair of critical failures. However, the strategy of no single point of failure is not applied uniformly across the network. For reasons of economy, the local loop may be vulnerable to single points of failures.<sup>62</sup> In addition, loop facilities connecting an emergency responder enterprise to the central office may use copper cable, making them vulnerable to flooding, or they may use aerial cable, which subjects them to storm and fire damage. Loss of wireline facilities is well documented in the Katrina Panel Report.<sup>63</sup>

#### **c. Large-Scale Disasters Can Impact Commercial Network Resiliency**

35. Large-scale disasters can adversely affect commercial systems in a number of ways. By their nature, they can cause failure of multiple network elements within an area. A hurricane or forest fire could cause multiple cell sites in a region to fail simultaneously. More typically, such disasters disrupt commercial power. While primary commercial network elements have generators and fuel supplies for several days of service, secondary network elements, such as individual cell towers, rely upon battery power providing four to eight hours of

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<sup>62</sup> The local loop, or “the last mile,” is the communications link connecting the customer to the service provider’s switching office.

<sup>63</sup> *Katrina Panel Report* at 8-9.

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operations. Wide-scale loss of commercial power may lead to failure of such sites. In addition, infrastructure destruction from natural events may result in lengthy repair intervals due to the scale of the destruction and associated lack of access to the affected assets.<sup>64</sup> For example, failed commercial power systems may require days to fully restore, as may wireline backhaul systems commonly used by mobile telephony commercial service providers to connect cell sites to switching nodes. In this regard last year the Commission adopted a requirement that certain local exchange carriers and commercial mobile radio service providers must maintain emergency back-up power at communications-related assets.<sup>65</sup> In doing so, the Commission recognized the importance of back-up power during times of crisis.

36. Large-scale disasters can create conditions that obstruct or interfere with the ability of commercial carriers to maintain and repair equipment, especially in the early stages of a disaster. Roads may not be passable or may have restricted access to ensure that emergency responder activities are not affected. In these cases, commercial services may not be available until commercial repair capabilities can be completed.<sup>66</sup>

37. Emergency responders require that their primary communication systems are available to them through all stages of a disaster. For the reasons cited above, commercial systems alone may not be able to fulfill this need during large-scale disasters. In addition, the surge of calls attempted post-disaster could inundate the remaining infrastructure and significantly hinder the ability of emergency responder use of typical commercial networks unless they participate in Telecommunications Service Priority (TSP) or Wireless Priority Service (WPS) communications.<sup>67</sup>

### **3. Information Systems Interoperability**

38. A contributing factor affecting vulnerability and overall reliability of emergency responder communication systems is the lack of interoperability between information systems supporting key functions and services. Unlike commercial communication systems, emergency communication systems used by emergency responders are often based on vendor proprietary designs. This may complicate the ability to interoperate different systems that span multiple regions or even different systems operating within the same jurisdiction, thereby diminishing the ability of surviving systems to maintain continuity of services during disasters and impairing the ability of multiple emergency responder communities to coordinate effectively.<sup>68</sup>

39. The 911 community provides an example of this effect. PSAPs typically use vendor proprietary designs. A critical component of these designs is the Computer Aided

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<sup>64</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, teleconference with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>65</sup> *Katrina Panel Order*, 22 FCC Rcd at 10565 ¶ 77; *Katrina Panel Recon Order*, 22 FCC Rcd at 18024-25 ¶¶ 25-27.

<sup>66</sup> *See Id.*

<sup>67</sup> *See infra* ¶¶ 91-97.

<sup>68</sup> *See, e.g.*, Gerald R. Faulhaber, *Solving the Interoperability Problem: Are We On the Same Channel?*, 59 Fed. Comm. L.J. 493 (2007).

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Dispatch (CAD) database containing the information required to make a determination of the appropriate first responder resources to dispatch in response to an 911 call. The PSAP uses the street address location associated with a caller's wireline 911 call (or the returned location for a wireless call) with the dispatch database to determine the correct local police, fire, or emergency medical service unit to respond to the call.<sup>69</sup>

40. However, if a PSAP fails, subsequent calls can be routed to an alternative PSAP designated for this event. If the back-up PSAP uses information systems provided by a different vendor, access to the CAD dispatch database is generally not possible and personnel at the PSAP will have to coordinate dispatch manually, with calls taking minutes instead of seconds to handle. Even if the CAD database was duplicated at the back-up facility, its proprietary design may not be compatible with the systems used at the back-up PSAP.

41. LMR systems provide another example of the importance of information systems interoperability to emergency communication. Vendor proprietary systems increase the difficulty of emergency responder communities cooperating effectively. It is often not possible for emergency responders arriving at an emergency scene from outside their home region to use their own LMR systems when responding to major disasters in a non-local region. Even if their radios are compatible with the incumbent LMR system, the administrative systems supporting channel assignment, identity verification, and encryption may not be compatible. Thus a common solution employed by emergency responders is to give "guest" emergency responders spare radios that are pre-programmed and fully compatible with the local LMR system.<sup>70</sup>

42. Open, standard interfaces would help to mitigate the information systems interoperability problem. Emergency responder entities have begun to make progress in this area. The Association of Public Safety Communications Officials (APCO) approved the system architecture for Project 25 (P25) in 1993.<sup>71</sup> P25 is the emergency responder's evolving standard for digital voice communications.<sup>72</sup> It has begun to show tangible results including demonstrations this year of inter-system interoperability. The P25 standards suite defines not only the air interface<sup>73</sup> between the handset and the radio tower, but also defines application level interfaces including interfaces for dispatch, network management, and inter-system functions. P25 will support interoperability between different vendors' LMR systems as well as interfacing to gateways associated with other systems.<sup>74</sup> More recently, the Department of

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<sup>69</sup> Roger Hixson, Technical Issues Director, NENA, interview by FCC Staff preparing 9/11 Act Report (Nov. 9, 2007).

<sup>70</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, teleconference with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>71</sup> See APCO, *History and Current Status of APCO 25*, available at <http://www.apcointl.org/frequency/project25/information.html#history> (last visited Jan. 3, 2008).

<sup>72</sup> P25 is an open standard for public safety defining a digital voice standard for trunked LMR systems. The P25 standards suite supports interoperability between different vendor systems. See [www.project25.org](http://www.project25.org) (last visited Dec. 19, 2007).

<sup>73</sup> "Air interface" is an industry term used to describe the RF modulation methods and protocols controlling the radio transmission of information between the radio handset and the other radio devices with which it communicates.

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Transportation, working with the National Emergency Number Association (NENA), has developed preliminary requirements for a next generation PSAP supporting open interfaces and system interoperability.<sup>75</sup>

43. Lack of investment in information systems interoperability will remain as a key obstacle in efforts to support interoperability between regional, state or national scope emergency communication systems, reducing the otherwise positive impact of investment in back-up emergency communications infrastructure.

## **B. Feasibility of Emergency Back-Up Communication Systems**

44. This Report now address the technical and operational feasibility of potential solutions for back-up emergency communications systems. This section identifies technological capabilities that readily can back-up existing emergency communications systems and, to a lesser extent, the capabilities that next-generation technologies enable. Further, this section focuses on improvements that are currently feasible and can be implemented.

45. This feasibility evaluation considers the factors prescribed by the *9/11 Act*. In particular, the Commission examined Federal assets for emergency back-up communications systems, the possibility of using various commercial assets and solutions, the feasibility of various technical options, and deployment scenarios being planned by public safety communities and developed by manufacturers. Finally, the Commission examined the operational aspects of alternatives for the back-up emergency communications systems.

46. The feasibility evaluation begins with a description of emergency responder communities in which public safety entities have different communications requirements. The common denominator of current emergency communication needs and requirements appears to be the critical importance of voice applications. Data communication, while growing in importance, is currently secondary relative to voice capability. Accordingly, voice appears to be the priority back-up application in the near future. As broadband initiatives like the Commission's 700 MHz Public/Private Partnership<sup>76</sup> begin to emerge, data communications will grow in importance as new applications are enabled by the emergency communication network.

47. This Report continues with a description of key findings indicating that no single uniform solution for back-up emergency communications systems exists at this time. The key findings that follow are grouped into two categories. The first category consists of technologies and processes that improve the resiliency of existing emergency communications systems, and those that leverage commercially available products and services to provide back-up capability

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<sup>74</sup> See Glenn Bischoff, "ISSI: More Than Expected," *MRT Magazine*, (Sept. 1, 2007), available at [http://mrtmag.com/mag/radio\\_issi\\_expected/](http://mrtmag.com/mag/radio_issi_expected/) (last visited Jan. 9, 2008).

<sup>75</sup> See U.S. Dep't of Transportation, *Next Generation 9-1-1 System Initiative, System Description and Requirements Document, Version 2.0*, (Oct. 10, 2007); See also U.S. Dep't of Transportation, Research and Innovative Technology Admin., *Intelligent Transportation Systems - Next Generation 9-1-1: Stakeholder Involvement*, available at [http://www.its.dot.gov/ng911/ng911\\_stake.htm](http://www.its.dot.gov/ng911/ng911_stake.htm) (last visited Jan. 4, 2008).

<sup>76</sup> See *700 MHz Second Report and Order*, *supra* note 2.



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for current emergency communications systems. The second category of key findings describes a trend towards cooperative regional and state efforts and includes associated planning processes as well as the communications networks that support these plans. This section concludes with an inventory of Federal assets that can be used to support back-up emergency communications capabilities.

48. Where possible,<sup>77</sup> as Section 2201(b)(2)(D) prescribes, the feasibility assessment includes representative cost information for “software, equipment, handsets or desktop communications devices.” This cost information is provided in this Report for illustrative purposes only and does not necessarily represent acquisition costs for a typical emergency responder entity.

### **1. Emergency Responder Communities**

49. In order to evaluate the feasibility of a back-up emergency communications system for emergency responders, it is first necessary to understand the structure of the emergency responder segment. Emergency responders do not represent a monolithic population. Rather, they constitute a collection of communities with distinct tasks, operations, inter-community responsibilities and communications capabilities. Solutions proposed for back-up emergency communication systems must take into account the distinct needs as well as the capabilities and resources of each community. A list of emergency responder organizations include:

- 19,000 law enforcement offices and agencies
- 33,000+ fire and rescue organizations
- 7,500+ PSAPs handling 911 and similar services
- 8,000+ public-health departments
- 5,600 hospital emergency departments
- 5,000+ critical-care facilities
- 1,000+ emergency management departments
- Private-Sector NGOs
- Public works and transportation officials
- Federal agency response coordination officials, for example DHS, the Department of Health and Human Services, and the Centers for Disease Control
- State and municipal leadership and other key decision makers<sup>78</sup>

50. A simpler perspective on emergency responder communities can be gained by recognizing that agencies and emergency responders within a state are typically organized along

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<sup>77</sup> Cost data is often a closely guarded trade secret and is often known only to the producer of the software, equipment, handset, or desktop communications device in question. Even price information is frequently known only to the customer and supplier in a specific contract and varies considerably with volume.

<sup>78</sup> See National Security Telecommunications Advisory Committee (NSTAC), *Report to the President on Emergency Communications and Interoperability*, (Jan. 16, 2007), available at <http://www.ncs.gov/nstac/reports/2007/NSTAC%20Report%20on%20Emergency%20Communications%20and%20Interoperability.pdf> (last visited Jan. 4, 2008).

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political boundaries with varying responsibilities and resource levels.

**a. State Level Agencies**

51. At the state level, emergency operations centers (EOCs) support central coordination of emergency efforts over a wide area or region. State EOCs are often constructed as hardened facilities with diverse communication systems to support essential command, control and coordination functions. EOCs are typically integrated with various LMR systems providing high-availability communications with emergency responders and other emergency personnel throughout the state, and with commercial communication systems including cellular, satellite and terrestrial facilities, and data facilities. Secondary back-up centers and mobile command centers can further enhance overall communications resiliency. Mobile command centers, in addition, can provide on-site emergency communication facilities to emergency responders in place of failed local systems and can link emergency responders in an affected area via satellite or wireless communications backhaul facilities to regional or state LMR networks via satellite or wireless communications backhaul facilities.<sup>79</sup>

**b. Local Agencies**

52. Fixed, county-level facilities typically provide critical emergency functions in support of the emergency responder community during local emergencies. Examples of county-organized emergency responder communities include PSAPs providing 911 call support and police and fire dispatch capabilities, hospitals and other emergency medical centers providing emergency health services, and county EOCs providing a similar role to state EOCs but at a county level. The overall level of resiliency varies widely across counties. Some county PSAPs and EOCs (which may be combined) exhibit the highest levels of resiliency, incorporating secure buildings, diverse communication paths, generators for power and multi-day fuel supplies. More typically, county sites are dependent on non-diverse commercial communication systems for continuity of operations.<sup>80</sup> A PSAP, for example, may typically use non-diverse voice circuits for 911 calls and non-diverse data circuits for transmission of information to its 911 call center. Loss of these facilities may result in calls being re-routed elsewhere, often with diminished capabilities at the alternate PSAPs due to interoperability issues. Such vulnerability is often a by-product of economics. Annual budgets for some county emergency facilities may be extremely limited, further constraining their communication resources.

53. County-level communication systems may be highly vulnerable to loss of commercial wireline facilities on which they are dependent for normal operations. There may only be a single communication path connecting a county PSAP or emergency medical facility to its serving central office. Furthermore, use of aerial cable, as is common, may further heighten vulnerability in a natural disaster such as a major storm or fire. Facilities with easy access to

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<sup>79</sup> John Gibb, New York State Emergency Management Office, interview with FCC staff preparing 9/11 Act Report (Oct. 30, 2007).

<sup>80</sup> Steve Souder, Director, Dep't of Public Safety Communications, Fairfax County, VA, interview with FCC staff preparing 9/11 Act Report (Nov. 7, 2007); Jim Bugel, Vice President, AT&T, interview with FCC staff preparing 9/11 Act Report (Sept. 27, 2007).

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robust communications infrastructure, as is often the case in major metropolitan areas, can have a range of economic options to increase survivability in a disaster. Agencies in suburban and rural counties correspondingly have more limited choices as investment in communications infrastructure in these less populous areas is generally constrained.

### **c. Emergency Responders**

54. Emergency responders comprise local police, fire, and emergency medical services personnel. Their primary means of communication is voice-based LMR systems. LMR systems have evolved to include a number of capabilities, e.g., talk groups (a voice bridge connecting all parties in a group conversation) encryption, push-to-talk capability and other features that emergency responders deem for communications.<sup>81</sup>

55. Communications among emergency responders is heavily structured and functionally organized. Their attributes are quite distinct from those found in commercial voice communications. Talk groups tend to be significantly larger than for commercial voice. Communication sessions tend to be extremely short in comparison to a commercial voice call, focused on giving only essential information to personnel who understand the task at hand. Communications assume a hierarchical command and control architecture. One person often coordinates the talk group. Talk groups and channels are pre-assigned to support specific common functions. For example, all firefighters within a company may be assigned a single channel to ensure that all members within a group have access to critical data. Company commanders may have a second channel reserved for communication with other commanders. Emergency responders with dual roles often carry more than one radio during an emergency, each locked to a different channel. Thus, the communication processes and systems used by emergency responders are highly specific to their functions and responsibilities.<sup>82</sup>

56. More recently, emergency responders have begun to use data communications to assist them in their job functions. Transmission of license plate numbers, fingerprints, or reception of data on hazardous materials or building design can now be accomplished wirelessly. Modern LMR systems can support limited data transmission. In addition, the growing availability of commercial broadband wireless systems has provided a new option for emergency responders. While the emergency responder community has traditionally avoided depending on commercial services for critical communications, growing acceptance of commercial capabilities for data services is driven by two factors: lower cost and the emergency responder viewpoint that data services are not critical in an emergency. Commercial systems can offer significant costs savings, coverage, and capabilities over dedicated state or county deployed systems, dramatically increasing the feasibility and scope of the application.<sup>83</sup>

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<sup>81</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>82</sup> John Powell, Chair, Interoperability Committee, National Public Safety Telecommunications Council (NPSTC), interview with FCC staff preparing 9/11 Act Report (Oct. 29, 2007); Tim Severson, Pennsylvania Emergency Management Agency, interview with FCC staff preparing 9/11 Act Report (Oct. 30, 2007).

<sup>83</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

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## 2. A Unified Solution Is Not Feasible In the Near Term

57. Information from public safety, manufacturers, and communications service provider stakeholders reveals that it is not feasible in the foreseeable future to conceive and implement a single back-up emergency communications system that will satisfy the needs of all emergency responder communities. Each emergency responder community has its own unique requirements. These include:

- *Technological Requirements*

Technical requirements include high reliability LMR voice communications using various frequency bands, broadband data circuits, PSTN trunks, video circuits as well as other requirements.

- *Operational Requirements*

Current emergency responder communities are typically organized as stand alone agencies. The processes, applications, and management systems supporting the individual emergency communication systems are unique. This lack of standardization complicates the ability of emergency responder communities to utilize a single back-up system.

- *Regional Scope*

Some emergency communication systems cover the area of a small town, while other systems are designed to cover an entire state-wide region.

- *Political Organization*

Emergency responder communities are organized along political boundaries. Local, county, and state level agencies have different responsibilities, different communication requirements, and different funding capability.

58. An effective back-up emergency communication system must not merely apply an alternative mode of communications, for it also needs to fully and transparently support the emergency responder community's customary communications requirements. This is an extremely important principle. Many emergency responders have pointed out that the emergency communications solutions used in times of disaster must, when possible, be the same as used on a daily basis for more routine emergencies.<sup>84</sup> Such solutions have evolved to best fit the needs of the emergency responder community, allowing it to fully concentrate on primary tasks. In effect, back-up solutions should adapt well to their targeted emergency community rather than requiring the community to adapt to the solution.

59. Emergency responders indicated that it is vital that they train on the communication systems on which they depend. If back-up systems are to be part of an overall

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<sup>84</sup> John Powell, Chair, Interoperability Committee, NPSTC, interview with FCC staff preparing 9/11 Act Report (Oct. 29, 2007).

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disaster plan, such systems must be incorporated into the regular disaster training exercise performed by emergency responders to insure that they are integrated into the incident management process.<sup>85</sup>

60. As a result of these diverse needs, multiple solutions exist today to support the communication needs of emergency responders. The abundance of solutions, however, greatly complicates the development of any unified back-up emergency communications system. Technological change is occurring within the emergency responder community, however, and this may, in the long term, allow for a convergence of requirements that could lead to the back-up emergency communications system envisioned in the *9/11 Act*. The commercial communications industry's growing trend towards broadband multi-service platforms foreshadows the likely evolution of emergency communications systems. The increasing use of commercial broadband IP-enabled services<sup>86</sup> to support the data needs of the emergency responder community, the likely deployment of broadband wireless services, and the growing interest in the emergency responder community for solutions employing the economies of scale of commercial off-the-shelf technologies (COTS) suggest an evolutionary path where a broadband emergency communications network could support a range of emergency communities and applications with high resiliency. This evolution is expected to be driven in part by the Commission's recent Second Report and Order in the 700 MHz proceeding.<sup>87</sup> The realization of this potential would require emergency responder communities to change at many levels, from the technology to the application level, and would necessarily occur over a length of time. It should be re-emphasized that the emergency responder community is historically conservative in adapting to change, as the public's safety and their own lives depend on the proper and reliable functioning of these communications systems.

### 3. Discrete Back-Up Capabilities

61. Section 2201(b)(2)(C) of the *9/11 Act* directs the Commission to evaluate the "technical options, cost, and deployment methods of software, equipment, handsets or desktop communications devices for public safety entities in major urban areas, and nationwide." While there is no unified back-up emergency communications system that is feasible in the near-term, there are a number of feasible technical steps that can be taken to provide back-up capabilities for existing emergency communications systems. These include provisioning ample back-up power, back-up techniques for LMR systems, use of satellite services, use of commercial terrestrial services, and use of priority communications services. Each of these solutions is feasible for implementation today. Furthermore, with the exception of regional variations in LMR performance depending on frequency band,<sup>88</sup> these discrete back-up capabilities have application in both urban areas and nationwide.

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<sup>85</sup> *Id.*; Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing *9/11 Act Report* (Oct. 12, 2007).

<sup>86</sup> IP-enabled services are communication services and applications using the Internet Protocol (IP) to enable multiple services to share a common communications infrastructure.

<sup>87</sup> See *700 MHz Second Report and Order*, *supra* note 2.

<sup>88</sup> See *infra* Appendix A – Technical Tutorial.

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**a. Ample Back-Up Power**

62. Ample back-up power is essential to maintaining emergency responder communications during a commercial electric power outage. “Sustainable power is the most important issue. Both [for] infrastructure and subscribers [handsets].”<sup>89</sup> Without back-up power for LMR network infrastructure and handsets, emergency responder communications towers and infrastructure will be out of service if they lose commercial power. In addition, emergency responders use their portable radios extensively during an emergency. This shortens the usable battery life and heightens the need for handset back-up power solutions.

**(i) Back-Up Power for LMR Infrastructure**

63. LMR towers and communications infrastructure is normally powered by the commercial electric distribution grid. When there is a commercial electric power outage, emergency responder communications require an alternate power source to continue operation. Most emergency responder communication systems are designed with back-up power. For example, Florida officials reported that its base stations are designed with five days of generator back-up power, but that it usually begins refueling generators three days after a power outage begins.<sup>90</sup>

64. The amount and duration of back-up power varies among public safety jurisdictions. Officials from Montgomery County, Maryland reported that all of its emergency communications sites have uninterruptible power supplies and back-up generators. Some, if not all, have back-ups for the back-ups (i.e., a propane tank is available even where back-up power is fueled by natural gas).<sup>91</sup> Officials from Missouri reported that its average public safety site has twelve hours of back-up battery power.<sup>92</sup> The amount of back-up power deployed at public safety communications facilities is often driven by past experience within that jurisdiction. Many parts of the United States have very stable natural environments and experience only a few short commercial power outages in a given season.

65. The feasibility of provisioning emergency responder communications systems with back-up power is demonstrated by the existence of emergency responder communications facilities which are already equipped with such power back-up. As previously discussed, some public safety entities provide only a few hours of back-up power while others provide several days.<sup>93</sup>

**(ii) Power for Handsets**

66. First responders rely on their mobile and portable handsets for critical

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<sup>89</sup> NPSTC, *Report to Congress: Maintaining Communications Following a Major Disaster*, 21 (Oct. 29, 2007).

<sup>90</sup> State of Florida, teleconference with FCC staff preparing 9/11 Act Report (Oct. 23, 2007).

<sup>91</sup> Montgomery County (MD) Public Safety Communications Officials, meeting with FCC staff preparing 9/11 Act Report (Oct. 15, 2007).

<sup>92</sup> State of Missouri, conference call with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>93</sup> See *supra* ¶¶ 63-64.

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communication. Mobile handsets are most commonly mounted in vehicles and powered by the vehicles' electrical systems. Ample power exists as long as the vehicle is functioning properly.

67. Maintaining caches of batteries and charging units, as reported by several emergency responder entities, demonstrates the feasibility of caching portable handset batteries and charging units as an effective way to improve the resiliency of emergency responder communications. A battery cache can include rechargeable batteries and disposable batteries that can power a radio for eight hours. One public safety organization recommended that a cache of AA batteries should be maintained to augment normal supplies during emergencies.<sup>94</sup> In large-scale emergencies, heavy and extended radio use is likely making it difficult to keep rechargeable batteries charged and a sufficient quantity of disposable batteries at hand. The importance of having readily available useable batteries for portable handsets is essential for continued emergency responder communications.

#### **b. Back-up LMR Infrastructure Capabilities**

68. In a large-scale disaster, local LMR systems may no longer operate due to the loss of an infrastructure site or damage to equipment such as a base station or repeater. Agencies can retain and maintain, possibly through arrangements with their equipment vendors, a cache of equipment components to quickly repair and restore emergency communications. There may be instances where an infrastructure site is completely destroyed or inaccessible for repair. In these instances mobile or drop-in assets, which are stand-alone LMR systems, can be deployed to restore communications to an area.

69. Situations may arise where LMR antennas provide fill-in coverage over a small area. Since these antennas only provide fill-in coverage, restoring service is not always critical if the site is rendered inoperable. If a primary base station or repeater ceases to operate, coverage is lost over a large area thus increasing the critical nature that service be restored quickly. An equipment cache and deployable LMR systems can be vital to maintaining emergency communications during a disaster.

#### **(i) Base Station and Repeater Restoration**

70. Access to a cache of equipment that can be used for base station and repeater restoration is an important part of any back-up communications plan. A back-up equipment cache can consist of tower system components including portable towers, power system components including truck mounted back-up generators, back-up radio equipment, equipment housing, and back-up microwave equipment for backhaul. In southern California, San Bernardino County has back-up equipment to rebuild a tower if one is lost. This equipment includes portable towers, truck mounted back-up generators, back-up RF equipment and back-up microwave equipment used for backhaul. LMR base stations are offered across a price range of \$3,000 - \$20,000 per channel.<sup>95</sup> Portable microwave systems on trucks cost approximately

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<sup>94</sup> NPSTC, presentation to FCC staff preparing 9/11 Act Report (Oct. 29, 2007).

<sup>95</sup> Motorola response to questions from FCC staff preparing 9/11 Act Report (Oct. 25, 2007).

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\$100,000.<sup>96</sup> Back-up generators cost approximately \$30,000.<sup>97</sup> Agencies that do not wish to bear the expense of keeping extra equipment on hand can contract with a private company to provide support in an emergency.<sup>98</sup> Another option to ensure that back-up equipment is available for disaster situations is to maintain a cache of equipment at a regional or state level for use across a larger area.

**(ii) Stand Alone Deployable Systems**

71. Stand alone deployable systems, also known as mobile or drop-in assets, can be deployed to an area to restore emergency communications where infrastructure is damaged or destroyed. Unlike individual base stations and repeaters, these are fully functional LMR systems that can be deployed to an area to restore emergency communications service when an infrastructure site is inaccessible or beyond repair. These units are capable of conventional operation, trunked operation, or both. They can use microwave or satellite facilities for backhaul where terrestrial infrastructure is not available. The size, capabilities, and options for use vary widely.<sup>99</sup> They can include:

- Suitcase repeaters
- Vehicular repeaters
- RF SOWs
- TOWs

72. Suitcase repeaters, which can range in cost from \$8,000 - \$30,000 per unit,<sup>100</sup> are portable solutions that can be easily loaded into a vehicle and transported to an area, whereas vehicular repeaters are permanently installed in a vehicle. Both provide coverage over a small area. They are useful for range extension and can immediately establish communications. Some states, such as Pennsylvania, install vehicular repeaters in emergency vehicles to provide extended coverage into buildings.<sup>101</sup> These repeaters can also serve as a back-up communications system to provide service over a small area when the primary system fails. SOWs and TOWs, which can range in cost from \$450,000 - \$1,000,000,<sup>102</sup> are fully integrated

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<sup>96</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>97</sup> *Id.*

<sup>98</sup> Motorola indicates that it provides a wide range of restoration services. Motorola response to questions from FCC staff preparing 9/11 Act Report (Oct. 25, 2007).

<sup>99</sup> New types of systems are under development. Some states are developing airborne emergency trunking systems that could be carried on National Guard or Department of Defense aircraft to provide emergency communications to areas with large scale communication failures. The coverage area of these systems could be adjusted by varying the hovering altitude of the aircraft.

<sup>100</sup> Motorola response to questions from FCC staff preparing 9/11 Act Report (Oct. 25, 2007).

<sup>101</sup> Commonwealth of Pennsylvania, conference call with FCC staff preparing 9/11 Act Report (Nov. 6, 2007).

<sup>102</sup> Motorola response to questions from FCC staff preparing 9/11 Act Report (Oct. 25, 2007). Dave Buchanan and Steve Devine estimated that a 5-channel trunked system cost approximately \$1,000,000. Dave Buchanan,

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LMR sites that can quickly be deployed to provide coverage over a larger area. They generally include radio equipment, a shelter, antenna, generator, trailer and fuel to operate four to five days. These systems vary in size and capability. They can be built to handle disasters of varying intensity.

73. Rapid deployment of these systems is essential. In many cases, mobile assets are strategically located around a state or region for operation anywhere in a short time period. Planning is imperative for determining operational frequencies so the systems can be quickly deployed and brought into service. Deployed systems should work with the local emergency responders' usual handsets and operate on FCC authorized frequencies that are used in the area, as well as FCC authorized mutual aid channels that have already been programmed into local radios. If other frequencies are used and additional handsets are needed, caches of handsets and batteries can accompany the deployable system. Some emergency responder agencies have suggested that it would be useful to have frequencies set aside specifically for drop-in asset use.<sup>103</sup> First responders entering an area will know the frequencies a drop-in asset will use and the frequencies can be preprogrammed into compatible handsets.<sup>104</sup>

74. The feasibility of deployable assets as a near-term back-up emergency communications capability is supported by many real-world examples. Several states and regions have incorporated deployable assets into their emergency plans, tailoring these assets to meet their individual needs. In Southern California, San Bernardino County has a five-channel TOW to provide support during a disaster. The system operates on frequencies that are already programmed into the county handsets. The county deploys equipment on four-wheel drive trucks that provide greater access to mountainous areas, which is especially important for fighting wildfires.<sup>105</sup> Florida also has a five-channel TOW system. The system is housed in Orlando and can be deployed anywhere in the state within eight hours. For wide-area disasters, Indiana currently has one LMR SOW. The National Capital Region ("NCR") has vehicular repeaters in its fire vehicles. These repeaters provide back-up service over a localized area if the primary system is inoperable. Pennsylvania has four TOWs positioned around the state for quick deployment to any area of the state. Pennsylvania does not deploy radios with the TOWs because users on its system can log on to any radio with the system automatically configuring the radio for the user.<sup>106</sup> Georgia has two MCUs strategically located throughout the state for rapid deployment to add capacity or replace a failed LMR system in a disaster area.<sup>107</sup> These units

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Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007); Steve Devine, Chairman, Missouri Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 25, 2007).

<sup>103</sup> NPSTC, meeting with FCC staff preparing 9/11 Act Report (Oct. 25, 2007). Steve Devine, Chairman, Missouri Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 25, 2007).

<sup>104</sup> Use of frequencies must be pursuant to an FCC authorization (e.g., FCC license, Special Temporary Authority).

<sup>105</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>106</sup> Commonwealth of Pennsylvania, conference call with FCC staff preparing 9/11 Act Report (Oct. 30, 2007).

<sup>107</sup> State of Georgia, meeting with FCC staff preparing 9/11 Act Report (Nov. 19, 2007).

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have a wide variety of radio resources including VHF and 800 MHz trunked repeater capability and a cache of handsets.<sup>108</sup> They can operate in free standing mode or interconnect with the network via satellite. Missouri's disaster plan anticipates that a major earthquake could cause ground liquefaction in certain areas rendering site replacement impractical in those areas. They are considering non-terrestrial solutions such as radio sites on dirigibles to restore service.<sup>109</sup>

### (iii) Handset Caching

75. Another feasible option for emergency responder agencies planning to provide back-up communications during an emergency is radio caching. Local agencies or states may choose to keep extra handsets on hand for distribution to incoming emergency responders during an emergency or to replace damaged units. Even though it is preferable for personnel to use their own equipment, there are times when handsets must be distributed to incoming personnel to allow access to the local LMR system. According to the US Department of Homeland Security's SAFECOM Program, the existence of a cache of portable handsets ready for the next event is the lowest level of interoperability readiness a community can have.<sup>110</sup>

76. The cost of public safety handsets tends to be significantly higher than the cost of its European public safety equivalent and standard commercially available equipment.<sup>111</sup> Some of this may be due to the fact that the emergency responder handset needs to be more sturdy and reliable than most commercial equipment. The equipment needs to be hardened to withstand severe conditions, such as a fire, and capable of maintaining reliable operations at very high speeds, such as in a police chase. Vendors have also noted that part of the high cost results from the relatively small market base represented by first responders.

77. LMR handsets costs vary greatly. Estimates range from \$1000 - \$5000 per handset.<sup>112</sup> Handset costs vary according to the frequency band of operation and technology.

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<sup>108</sup> Radio resources include VHF repeater, 5-channel 800 MHz trunking capable repeater system on one unit, one aviation radio, two amateur radios, two 800 MHz control stations, two VHF control stations, two UHF control stations, one low band control station, a cache of twenty-five 800 MHz and twenty-five VHF portable radios. State of Georgia, meeting with FCC staff preparing 9/11 Act Report (Nov. 19, 2007).

<sup>109</sup> Steve Devine, Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 25, 2007).

<sup>110</sup> Dep't of Homeland Security, SAFECOM, *Interoperability Continuum: A Tool for Improving Emergency Response Communications and Interoperability*, available at <http://www.safecomprogram.gov/NR/rdonlyres/65AA8ACF-5DE6-428B-BBD2-7EA4BF44FE3A/0/Continuum080106JR.pdf> (last visited Jan. 4, 2008).

<sup>111</sup> See Glenn Bischoff, "Interoperability might be a technology play after all," *MRT - Newsletter Commentary*, Aug. 9, 2006, available at [http://mrtmag.com/commentary/newsletters/interoperability\\_rauter\\_apco\\_080906/index.html](http://mrtmag.com/commentary/newsletters/interoperability_rauter_apco_080906/index.html) (last visited Jan. 7, 2008) ("Of course, P25-compliant radios also are quite expensive -- as much as \$5000 per radio -- which puts them out of the financial reach of many agencies. [Mr. Steve] Rauter, [chief of the Lisle-Woodridge Fire Department in suburban Chicago], told his audience of a United Kingdom-based vendor that has produced a TETRA-compliant radio -- the European equivalent of P25 -- that costs only \$300. 'What are we doing wrong?' Rauter asked rhetorically. 'Why do I have to spend \$5000 for a fully loaded P25 radio.'").

<sup>112</sup> National Capital Region provided an estimate from \$3500 - \$5000. National Capital Region, meeting with FCC staff preparing 9/11 Act Report (Oct. 16, 2007). The Commonwealth of Pennsylvania provided an estimate of \$2500. Commonwealth of Pennsylvania, conference call with FCC staff preparing 9/11 Act Report (Oct. 30, 2007).

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Lower band equipment is generally less expensive than higher band equipment.<sup>113</sup> In addition, P25 equipment is more expensive than non-P25 equipment.<sup>114</sup> The cost of P25 handsets may decrease as the standard matures and more P25 system and radios are manufactured. The cost of handsets also significantly impacts an agency's ability to purchase new equipment or make extra handsets available for back-up use.

78. Responsibility for accumulating a handset cache can rest at different levels of the emergency responder governance hierarchy. Caching at the local level may be simplified by the fact that there are fewer LMR systems to consider; but, the cost for local agencies to purchase and store a large number of extra handsets along with the necessary batteries and accessories may be prohibitive. There are many examples of handset caching at a regional or state level.<sup>115</sup> Handsets must be capable of operation on different systems if caching is done at this level; however, the agency maintaining the aggregate cache may be in a better position to afford it. In addition to a handset cache, agencies may enter agreements with vendors to quickly purchase or lease handsets in an emergency situation.<sup>116</sup> Radio caching and planning at a higher jurisdictional level may be an efficient means of ensuring enough handsets are on hand for incoming emergency responders in a disaster.

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Steve Devine, Chairman, Missouri Regional Planning Committee, provided an estimate of \$3200. Steve Devine, Chairman, Missouri Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 25, 2007). Montgomery County, Maryland budgets \$4500 - \$5000 per radio. Montgomery County (MD) Public Safety Communications Officials, meeting with FCC staff preparing 9/11 Act Report (Oct. 15, 2007). Indiana provided an estimate of \$3000. Indiana Dep't of Homeland Security, interview with FCC staff preparing 9/11 Act Report (Nov. 8, 2007). Dave Buchanan, Chairman, Southern California Regional Planning Committee, provided an estimate of \$1000 - \$3000. Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>113</sup> Steve Devine, Regional Planning Chairman, indicated that low band equipment is cheaper which makes it attractive to smaller municipalities. Steve Devine, Chairman, Missouri Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 25, 2007). Dave Buchanan, Southern California Regional Planning Committee Chairman indicated that a VHF radio cost \$1000 compared to \$2000 - \$3000 for an 800 MHz radio. Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>114</sup> Dave Buchanan, Southern California Regional Planning Committee Chairman indicated that a trunked 800 MHz non-P25 radio cost \$2000 and a trunked 800 MHz P25 radio cost \$3000. Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007). EF Johnson indicated that the company's 5100 Series radio costs \$2000 per device. EF Johnson, conference call with FCC staff preparing 9/11 Act Report (Oct. 18, 2007).

<sup>115</sup> The State of Florida indicated that its state communication agency keeps a cache of radios at the state level. State agencies responsible individual disciplines (fire, police, etc.) also maintain a radio cache of radios. Local agencies needing back-up radios would first use their own cache of radios and then look to the state agency responsible for that discipline for radios. If the state agency responsible for the discipline no longer has radios, the agency would look to the state communications agency for radios. State of Florida, teleconference with FCC staff preparing 9/11 Act Report (Oct. 23, 2007). National Capital Region maintains a cache of 1,250 radios. Montgomery County (MD) Public Safety Communications Officials, meeting with FCC staff preparing 9/11 Act Report (Oct. 15, 2007).

<sup>116</sup> The State of Florida indicated that it has points of contact to quickly buy or lease radios through commercial vendors. Radios would be available within 24-48 hours. State of Florida, teleconference with FCC staff preparing 9/11 Act Report (Oct. 23, 2007).

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**(iv) Operational Issues**

79. A common set of operational issues applies to the infrastructure solutions described above. These issues need to be addressed to ensure that back-up equipment and deployable systems can be used effectively by emergency responders. They include maintenance, testing, training, and standardized credentialing. Routine maintenance and testing must be performed on deployable equipment to ensure its usefulness. Specialized solutions that are used infrequently must be tested regularly, including training emergency responders in their use. Personnel, including communications restoration teams, may have difficulty getting into a controlled area to restore service or keep a system operational. Standardized credentialing that allows critical personnel access to disaster areas together with integration of these personnel into the overall incident management system would address this problem.

**c. Satellite Communications Capabilities**

80. Satellite communications, which can cover large portions of the Earth's surface, can provide an immediate back-up emergency communications capability to restore emergency responder command and control communications when terrestrial infrastructure is severely damaged or destroyed.<sup>117</sup> Like other communications systems, orbiting satellites and their corresponding terrestrial infrastructure are not immune from threats. For example, satellites face unique space-based vulnerabilities. Typically, the terrestrial infrastructure, such as hub and gateway earth stations, is well protected, reliable, and redundant. Thus, satellite communications networks can weather terrestrial disasters if their associated earth stations survive, and can generally be restored to operation more quickly than terrestrial communications networks that rely on wireline infrastructure to operate.

81. Some emergency responder entities and commercial communications entities use Very Small Aperture Terminals (VSAT) to provide backhaul for COLTs, COWs, and TOWs.<sup>118</sup> These terminals typically have an outdoor "dish" antenna about three feet in diameter and an indoor electronics box. VSAT terminals may require minor antenna re-pointing to restore communications after an emergency. When installed at EOCs and other public safety facilities VSATs can provide continuity of communications when terrestrial communications links are severed as long as electrical power is available, whether through the commercial power grid or back-up power systems.

82. Satellite handsets, which provide voice communications via satellite both to other satellite handsets and to other telephones on the PSTN, are generally available for service during and immediately after a disaster when other means of communication that rely on terrestrial infrastructure may be disrupted. As such, satellite communications may provide a viable back-

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<sup>117</sup> See *infra* Appendix A for more details.

<sup>118</sup> For example, the State of Georgia uses satellite terminals to provide backhaul on its Mobile Control Units (MCUs). Sprint Nextel has a satellite-based Cell-On-Light-Truck vehicle (SatCOLT™) that enables rapid deployment of a cellular base station in remote and/or disaster environments. See Richard Zinno, CBCP, Sprint, Network Disaster Recovery Team, *Cellular Networks: Benefits and Shortfalls for Emergency Communications*, slide presentation, at slide 13, available at [http://cpaccarolinas.org/Presentations/Benefits-shortfalls\\_of\\_cellular\\_communications.pdf](http://cpaccarolinas.org/Presentations/Benefits-shortfalls_of_cellular_communications.pdf) (last visited Jan. 4, 2008).

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up communications solution particularly in cases of large scale disasters. Indeed, in the *700 MHz Second Report and Order*, the Commission has adopted certain network requirements that allow the integration of 700 MHz public safety spectrum and satellite frequencies within a handset.<sup>119</sup> The requirements could lead to economies in scale in terms of handset and service costs, as well as integration of evolving developments in satellite network technology.

83. Satellite handsets may have some limitations. For example, satellite handsets require a clear “line of sight” to the satellite. Unless one installs an outdoor antenna, satellite handsets do not work inside buildings and vehicles. Further their coverage is limited by foliage, and, may be limited in certain urban areas in natural canyons.<sup>120</sup> In addition, the cost of satellite handsets for Mobile Satellite Services<sup>121</sup> can range from \$700 to \$4,000 and monthly service access fees range from \$30 to \$70/month, not including usage charges, which are typically close to \$1.00 per minute.<sup>122</sup> These factors may limit the utility of satellite handsets for routine day-to-day emergency use.<sup>123</sup>

84. To support emergency communications, some of the Mobile-Satellite Service (MSS) providers have developed Push-to-Talk (PTT) capability that provides additional benefits regarding resiliency to PSTN infrastructure damage as well as significant cost advantages compared to traditional satellite telephony. For example, Mobile Satellite Ventures (MSV), under the sponsorship of the Department of Justice (DOJ) and the Federal Bureau of Investigation (FBI), has implemented a "Satellite Mutual Aid Radio Talkgroup" (SMART) capability on its satellite network. SMART provides two-way, PTT service for up to 10,000 users. Each MSV satellite handset has a capability of accessing 15 different talk groups.

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<sup>119</sup> Specifically, the commercial partner must make available "at least one handset that would be suitable for public safety use and include an integrated satellite solution capable of operating both for public safety use and include an integrated satellite solution capable of operating both on 700 MHz public safety spectrum and on satellite frequencies." *700 MHz Second Report and Order*, 22 FCC Rcd at 15,434 ¶ 405.

<sup>120</sup> During the review process, various public safety entities including representatives of the Southern California Regional Planning Committee, NPSTC and Montgomery County, Maryland, told Commission staff that satellite telephones are currently an unreliable means of communication due to line-of-sight obstruction problems. Additionally, according to the *Katrina Panel Report*, “[s]ome satellite phones require specialized dialing in order to place a call. They also require line of sight with the satellite and thus do not generally work indoors. Users who had not been trained or used a satellite phone prior to Katrina reported frustration and difficulty in rapid and effective use of these devices. Satellite phones also require charged batteries. Handsets that were not charged and ready to go were of no use as there was often no power to recharge handsets. Additionally, most of Louisiana’s parishes (all but three) did not have satellite phones on hand because they had previously chosen to discontinue their service as a cost-saving measure.” *Katrina Panel Report*, *supra* note 42 at 11.

<sup>121</sup> See *infra* Appendix A for a technical description of Mobile Satellite Service.

<sup>122</sup> These costs were obtained from the public web sites of several satellite service providers or their value added resellers. They represent the prices consumers would pay for service. Emergency responder entities would likely have different acquisition costs depending primarily on volume.

<sup>123</sup> Several satellite telephony providers plan to enhance their satellite networks using Ancillary Terrestrial Component (“ATC”) systems of cell phone-like towers on the ground, which should enhance the day-to-day usability of satellite telephones. However, like conventional cellular telephone networks, ATC will rely on terrestrial infrastructure that may be damaged or destroyed during a disaster.

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Coverage is provided across North America, and is independent of the PSTN. This capability is available at no additional cost to current MSV satellite service subscribers upon application to the DOJ's SMART administrator.<sup>124</sup>

**d. Commercial Communications Capabilities**

85. Commercial wireless services, such as cellular communications among others, could be used in many instances to back-up or augment emergency communications. Although commercial wireless services may not be appropriate for critical communications when primary emergency communications systems are operational, they could provide emergency responders with the means to quickly reestablish or augment their communications capability when their primary networks are temporarily disabled or insufficient. For example, emergency responders carry cell phones to supplement their primary LMR systems. After Hurricane Ivan hit Western Pennsylvania in 2004, flooding destroyed equipment at the Carnegie Fire Department, causing the LMR system to fail. To continue search and rescue missions, emergency responders quickly signed up for service with Nextel Communications and Verizon Wireless, whose cellular systems were fully operational around the City of Carnegie.<sup>125</sup>

86. Other commercial communications services, such as unlicensed wireless and broadband access, while no substitute for primary emergency communications systems, have the potential to provide numerous benefits to emergency responders in a back-up capacity.<sup>126</sup> Commercial communications systems, while typically less resilient than primary emergency communications systems, benefit from the availability of a dedicated service restoration staff and a business incentive to restore service quickly. For example, commercial service providers could, to the extent that they have access to the affected area, draw on mobile assets such as COWs and other equipment to restore commercial service independent of the damaged primary emergency communications infrastructure. Likewise, IP-based technologies could enable public safety entities to quickly restore service in the event of a failure as well as facilitate communications interoperability for emergency response providers generally.<sup>127</sup>

**(i) Cellular Technologies**

87. Cellular radio service in the United States today is provided primarily through two air interfaces: Code Division Multiple Access (CDMA) and Global System for Mobile

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<sup>124</sup> Dep't of Justice, Wireless Management Office, *The Department of Justice High-Risk Metropolitan Areas Interoperability Assistance Project, "25 Cities": The 25 Cities Solution in San Francisco Project*, Presentation to Communications Interoperability Panel, 9<sup>th</sup> Annual Technologies for Critical Incident Conference & Expo, slide 20 (Nov. 8, 2007), available at <http://www.nlectc.org/training/nij2007/zanger.ppt#662,20,Slide> (last visited Jan. 15, 2008).

<sup>125</sup> See Jon M. Peha, *Fundamental Reform in Public Safety Communications Policy*, 59 Fed. Comm L.J. 517, 525-526 (2007).

<sup>126</sup> See Federal Communications Comm'n, *Report to Congress on the Study to Assess Short-Term and Long-Term Needs for Allocations of Additional Portions of the Electromagnetic Spectrum for Federal, State and Local Emergency Providers*, Submitted Pursuant to Public Law No. 108-458, December 19, 2005, 16-23.

<sup>127</sup> *Id.* at 15, ¶¶ 28-29.

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Communications (GSM).<sup>128</sup> Cellular technologies, which offer “anytime, anywhere” mobility, could be an important tool for emergency responders when their primary communications systems become unavailable. The existence of multiple cellular service providers with national footprints greatly increases dependability and coverage even if individual commercial networks are suffering disruptions or do not necessarily meet all of public safety’s requirements. For example, some cellular services enable one-to-one and one-to-many half-duplex communications (e.g., Push-to-Talk or PTT), which would allow emergency responders to communicate in their accustomed manner when their primary emergency communications systems are unavailable.<sup>129</sup>

88. Public safety entities could greatly benefit from utilizing mobile commercial infrastructure that could quickly reestablish communications after a disaster that disables the local primary emergency communications infrastructure. If a cellular tower or its associated power and backhaul capabilities are lost during a disaster, they could be temporarily replaced with a portable tower, back-up generators, and back-up microwave radio backhaul equipment.<sup>130</sup> For example, AT&T Wireless’ primary service restoration mechanisms include transportable standard switching and transmission gear allowing for direct replacement of damaged components including rerouting of facilities to these temporary “offices,” use of portable equipment such as cells on wheels to restore damaged cell sites, and use of line-of-sight (LOS) radio or satellite communications to provide quick restoration of backhaul facilities. The typical restoration method is to use wireline facilities if available, or LOS radio if not. Satellite communications are not used very frequently.<sup>131</sup>

## (ii) Unlicensed Wireless Access

89. Wireless Fidelity (known as Wi-Fi) generally refers to any type of wireless local area network (LAN) employing an 802.11 standard developed by the Institute of Electrical and Electronics Engineers, Inc. (IEEE) using unlicensed wireless spectrum.<sup>132</sup> Wi-Fi access points

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<sup>128</sup> Code Division Multiple Access (CDMA) is a “spread spectrum” technology, allowing many users to occupy the same time and frequency allocations in a given band/space. As its name implies, CDMA assigns unique codes to each communication to differentiate it from others in the same spectrum. Global System for Mobile Communication (GSM) is a digital air interface for wireless systems that divides each channel into eight discrete time slots, which allows up to eight simultaneous calls using the same frequency.

<sup>129</sup> Push-to-Talk allows a mobile phone, when in a special mode, to function as a digital two-way radio in PTT operation (similar to the trunking feature of newer commercial and public safety two-way radios). PTT uses the General Packet Radio Service (GPRS) connection, on which the amount of data transmitted is billed, rather than the minutes of conversation, and commonly does not deplete regular airtime minutes. Currently, PTT is not interoperable and is supported only between parties using the same mobile carrier service; users with different carriers will be unable to transmit to each other by PTT.

<sup>130</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, interview with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>131</sup> Jim Bugel, Vice President, AT&T, interview with FCC staff preparing 9/11 Act Report (Sept. 27, 2007).

<sup>132</sup> The term Wi-Fi was originally used to describe unlicensed wireless devices operating in the 2.4 GHz band in accordance with the Institute of Electrical and Electronics Engineers (IEEE) 802.11b standard. More recently, however, the term has also been applied to unlicensed wireless devices operating in the 5 GHz band in accordance with IEEE 802.11a. *See Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion*, Notice of Inquiry, 19 FCC Rcd 5136, 5144 n.30 (2004) (*Advanced Telecommunications Capability NOI*). In general, 802.11 standards refer to a family of specifications developed by

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typically have a range of 100 meters or less. Wi-Fi technologies could offer a low-cost, rapidly configurable, feasible back-up emergency communications option in certain configurations.<sup>133</sup> For example, Tropos Networks has been providing its 802.11-capable wireless Mesh Networks (both hardware and software) on unlicensed bands as well as licensed 4.9 GHz<sup>134</sup> band, which is supported by varied wired broadband access backhaul, to offer public safety entities data connectivity for fixed and mobile installations.<sup>135</sup> Similarly, Motorola has developed a prototype P25-compatible SMARTRadio that can operate over a WiFi network.<sup>136</sup>

### (iii) Broadband Wireless Access Technologies

90. The rapid deployment and availability of broadband wireless access technologies by major cellular carriers provides a unique opportunity for the emergency responder community to augment their existing emergency communications capabilities with the services provided by these technologies. These commercial services could provide various data applications that can serve as the back-up to non-critical data needs of emergency responder communities. Currently, there are two broadband wireless access technologies, Evolution Data Only or Evolution Data Optimized (EV-DO)<sup>137</sup> with practical data rates of 300-600 kbps, and various versions of GSM-based technologies with practical data rates of 100 kbps – 1 Mbps.<sup>138</sup> AT&T and T-Mobile deploy GSM based technologies while Verizon Wireless and Sprint deploy EV-DO in their networks. A third broadband access technology known as WiMAX, Worldwide Interoperability for Microwave Access, is based upon the IEEE 802.16 family of standards. The IEEE 802.16 standard was developed to deliver non-LOS connectivity between a subscriber station and base station with typical cell radius of two to six miles.<sup>139</sup> WiMAX products can accommodate fixed

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the IEEE for wireless LAN technology. The Commission does not require devices operating in either the 2.4 or 5 GHz bands to meet the IEEE standards, however. For more information on 802 standards, see the IEEE web-site at <http://www.ieee.org/portal/site> (last visited Jan. 15, 2008).

<sup>133</sup> Provided that coordination with other unlicensed systems in the vicinity of the emergency theater is carried out so to avoid or minimize interference.

<sup>134</sup> The Commission allocated the fifty megahertz of spectrum in the 4.9 GHz band for fixed and mobile services (except aeronautical mobile service) and designated the band for use in support of public safety. 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). In the *4.9 GHz Third Report and Order*, the Commission established licensing and service rules for the 4.9 GHz band. The 4.9 GHz Band Transferred from Federal Government Use, *Memorandum Opinion and Order and Third Report and Order*, 18 FCC Rcd 9152 (2003).

<sup>135</sup> Tropos Networks, meeting with FCC staff preparing 9/11 Act Report, (Nov. 1, 2007).

<sup>136</sup> Motorola meeting with FCC, (Oct. 2, 2007).

<sup>137</sup> EV-DO has two revisions, Rev 0, and Rev A. It is a technology on the evolution path of CDMA (Code Division Multiple Access).

<sup>138</sup> There are various versions of GSM based technologies including GPRS, EDGE, WCDMA, HSDPA, etc.

<sup>139</sup> Specifically, the 802.16a standard is used for systems operating between 2 and 11 GHz, while the 802.16b standard is used for systems operating between 10 and 66 GHz. See *Advanced Telecommunications Capability NOI*, 19 FCC Rcd at 5144 n.30. WiMAX systems have a maximum speed of 75 Mbps and a theoretical range of 30 miles under ideal conditions but require a clear line of sight. See *id.* For more information on 802 standards, see the IEEE web-site at <http://www.ieee.org/portal/site> (last visited Jan. 15, 2008).



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(IEEE 802.16d standard) and mobile (IEEE 802.16e standard) usage models. Sprint Nextel announced plans to develop and build a nationwide broadband mobile network based on the IEEE 802.16e-2005 technology standard.<sup>140</sup> The WiMAX Forum projects downlink data rates ranging from 6.34 Mbps to 15.84 Mbps in a 5 MHz channel.<sup>141</sup>

**e. Priority Communications Services Capabilities**

91. The Federal government has three priority communications programs that could be of service to the Public Safety community:

- Government Emergency Telecommunications Service (GETS)
- Telecommunications Service Priority (TSP)
- Wireless Priority Service (WPS)

92. The Commission sets the policy and regulations for TSP<sup>142</sup> and WPS,<sup>143</sup> which DHS's NCS administers, along with GETS.<sup>144</sup> Under Federal directive (NCS Directive 3-10), all Federal departments and agencies with COOP responsibilities must have appropriate GETS and WPS coverage and enrollment of critical continuity circuits in TSP. The emergency responder community qualifies to use the priority communications programs.<sup>145</sup>

93. GETS and WPS provide, respectively, priority treatment over the local and long distance segments of the Public Switched Telephone Network (PSTN) and the Commercial Mobile Radio Service (CMRS) for National Security/Emergency Preparedness (NS/EP) users. Additionally, the programs are interoperable so callers can receive end-to-end priority treatment regardless of the kinds of networks the call traverses. During times of peak network congestion—as often happens in an emergency—use of GETS and WPS have resulted in call completion rates greater than ninety percent.<sup>146</sup> TSP enrollment provides for priority restoration and provisioning of critical communications circuits as expressed by the enrollee's respective NS/EP status level. By Commission regulation, the telecommunications service provider must restore or provision TSP-covered circuits before it services customer circuits that are not enrolled

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<sup>140</sup> See News Release, Sprint Nextel, *Sprint Nextel Announces 4G Wireless Broadband Initiative with Intel, Motorola and Samsung*, (Aug. 8, 2006), available at [http://www2.sprint.com/mr/news\\_dtl.do?id=12960](http://www2.sprint.com/mr/news_dtl.do?id=12960) (last visited Jan. 15, 2008).

<sup>141</sup> See WiMAX Forum, *Mobile WiMAX – Part I: A Technical Overview and Performance Evaluation* 18 (Table 3), available at [www.wimaxforum.org/news/downloads/Mobile\\_WiMAX\\_Part1\\_Overview\\_and\\_Performance.pdf](http://www.wimaxforum.org/news/downloads/Mobile_WiMAX_Part1_Overview_and_Performance.pdf) (last visited Jan. 15, 2008).

<sup>142</sup> 47 C.F.R. Part 64, App. A.

<sup>143</sup> 47 C.F.R. Part 64, App. B.

<sup>144</sup> For more information, see Federal Communications Comm'n, "Priority Communications Services," available at <http://www.fcc.gov/pshs/emergency/priorityservices.html> (last visited Jan. 15, 2008) and National Communications System, "NCS Priority and Other Services," available at <http://www.ncs.gov/services.html> (last visited Jan. 15, 2008).

<sup>145</sup> State, tribal, and local governments, along with the private sector and NGOs can qualify for sponsorship into these programs if they meet the applicable NS/EP requirements. See *id.*

<sup>146</sup> Priority call treatment does not cause queued calls to be dropped.

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in TSP.<sup>147</sup>

94. WPS is being offered by several cellular carriers domestically. WPS relies on commercial wireless technology to provide an end-to-end nationwide wireless priority communications capability for NS/EP entities during natural or man-made disasters or emergencies that cause network congestion. Under the Commission's WPS rules, authorized NS/EP users in emergencies may gain access to the next available wireless channel to originate a call (i.e., be queued for the next available radio channel); however, the priority calls would not preempt calls in progress. The Commission approved the WPS for NS/EP requirements on a call-by-call priority basis and maintains oversight responsibilities for the WPS program.<sup>148</sup> Currently, WPS is widely available from AT&T, Edge Wireless, SouthernLINC, Sprint Nextel, T-Mobile, Verizon Wireless, and Cellular South.<sup>149</sup>

95. The Commission and the NCS, along with the national organizations that represent PSAPs—NENA, the National Association of State 9-1-1 Administrators (NASNA), and the Association of Public-Safety Communications Officials, International (APCO)—have encouraged administrators to enroll PSAP circuits in TSP. The Commission also partners with the Department of Health and Human Services (HHS) to get critical hospital and healthcare circuits enrolled in TSP.

96. Landline circuits interconnecting PSAPs and those serving EOCs are the types of circuits that emergency responders should enroll in TSP. Despite the demonstrated benefits of TSP and the other priority communications programs, the emergency responder community is, to some extent, either unfamiliar with the programs, faces a financial enrollment hurdle, or finds little value in enrollment. GETS cards are free, with calls costing 7¢ to 10¢ per minute. WPS has a \$10 enrollment fee, \$4.50 monthly fee, and 75¢ per minute charge. TSP rates derive, for the most part, from State tariffs. The average TSP circuit enrollment is \$100 with a monthly fee of \$3.<sup>150</sup>

97. The Commission and NCS have worked extensively to promote awareness of and subscription to priority services. As a consequence, for CY 2007, GETS enrollment is up 20% and WPS enrollment is up 52%. For the same period, State and local government enrollment in TSP is up 58%; the hospitals and healthcare sector shows an increase of 101%.

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<sup>147</sup> Given the use of bundled or aggregated circuits, the enrollment of one circuit in such a pipe (e.g., T1) may result in the companion circuits also receiving priority restoration.

<sup>148</sup> See 47 C.F.R. Part 64, App. B.

<sup>149</sup> See National Communications System, *Wireless Priority Service*, available at <http://wps.ncs.gov/> (last visited Jan. 9, 2008).

<sup>150</sup> DHS Homeland Security grants will cover some, if not all, of these costs. See Dep't of Homeland Security, *Open for Business – Grants*, available at <http://www.dhs.gov/xopnbiz/grants/> (last visited Jan. 9, 2008).

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**f. Back-Up Capabilities Must Be Readily Usable**

98. NPSTC<sup>151</sup> states that “use breeds familiarity – never introduce something new during a crisis – it won’t get used.”<sup>152</sup> Emergency responder back-up capabilities are expected to be available and useful at precisely such times. However, if back-up communications equipment and capabilities differ in substantive ways from those of the primary system and are exercised only infrequently, they may lose much of their usefulness to emergency responders during a crisis. Among the possible problems are failure of back-up equipment to operate as expected or at all, and burdensome operation of unfamiliar equipment. A number of strategies have evolved to minimize the sense of newness and reduce surprises that may occur when emergency responders try to use backup equipment or capabilities:

- Specialized but not regularly used solutions must be tested and exercised regularly, preferably by the personnel who will be responsible for their use during a crisis. For example, emergency responders should routinely turn on and test repeater systems used to boost radio signal strength to and from high rise buildings to make sure that the repeaters work and that the responders know how to use them.<sup>153</sup>
- Handsets used with backup systems should be used regularly so that emergency responders are confident in their operation. If the handset used with the backup system is the same set used with the primary system, or if it shares a “common look and feel” with and works much like the set used with the primary system, the back-up will be accepted and used more easily. Scheduled training and dry run exercises are usually required if the handset to be used during a large-scale disaster may be a new one or have different features.
- As a corollary to the above, mobile assets, such as LMR SOWs and TOWs, deployed to back up a failed tower should preferably work with the local emergency responders’ usual handsets, rather than requiring different one(s), which may also need to be distributed.

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<sup>151</sup> The National Public Safety Telecommunications Council (NPSTC) is a federation of organizations whose stated mission is to improve public safety communications and interoperability through collaborative leadership. See NPSTC, *Who Or What is NPSTC?*, available at <http://www.npstc.org/npstcintro.jsp> (last visited Jan. 9, 2008).

<sup>152</sup> *Id.*

<sup>153</sup> The *9/11 Commission Report* details the tragic circumstances surrounding the failure to properly turn on and operate a rarely used repeater system on 9/11. The repeater system had been installed in the World Trade Center (WTC) complex to assist with FDNY (Fire Department of New York) emergency communications between floors in the high-rise buildings. Installed following the WTC bombing in 1993, the repeater system was normally turned off because FDNY found it interfered with day-to-day FDNY radio communications in the area. See *The 9/11 Commission Report* at 278-284. On September 11, 2001, following the crash of the first jet, the repeater was turned on; but its communications capabilities were only partially enabled. The feature that would have permitted FDNY chiefs to transmit from the command center to firefighters in the high rise was never enabled because “[the transmit] button was never activated on the morning of September 11.” *The 9/11 Commission Report* at 297 Thus, incident command could not communicate directly with those firefighters; and when it issued an evacuation order to emergency responders in the north tower, the order had to be transmitted by less effective means. See *The 9/11 Commission Report* at 285-310.

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99. Ease of use and familiarity of operation are also considerations in the particular case where commercial wireless services are proposed as back up to conventional public safety radio systems such as LMR. Commercial wireless services and handsets typically have a different look and feel from those of conventional public safety radio, and also from each other. Depending on the circumstances in which they are used, use of a typical commercial handset may prove cumbersome. At the very least, emergency responders must be trained and exercised in using the features of the commercial handset that they will find useful in emergency situations.

#### **4. Interoperable State and Regional Back-Up Solutions**

100. Section 2201(b)(2)(D) of the *9/11 Act* calls on the Commission to evaluate the “feasibility of and cost of necessary changes to the network operations center of terrestrial-based or satellite systems to enable the centers to serve as emergency back-up communications systems.”<sup>154</sup> The most likely feasible such application for carrier network operations centers (NOCs) would be to provide back-up capabilities for the NOCs that administer state or regional emergency communications networks. However, the management applications that are resident at carrier NOCs are typically vastly different than those that are used in state or regional NOCs, which are often vendor-specific and closely tied to the state or regional network design and distributed components. Hence, a carrier’s NOC, such as one operated for a terrestrial based or satellite system,<sup>155</sup> could not feasibly provide a useful back-up function for a state’s or region’s NOC, let alone “serve as emergency back-up communications systems.”<sup>156</sup>

101. However, in addition to the discrete capabilities for back-up emergency communications described above, there is a trend among state and regional emergency response entities toward greater planning and cooperative agreements, including investments in interoperable and resilient state and regional communications infrastructure. These efforts can facilitate a more holistic approach to using the discrete back-up technologies and methods described earlier in this Report to produce more interoperable and resilient emergency communications in times of disaster.

102. Regions and states face the same broad spectrum of networking issues that confronts the emergency responder community as a whole. Potentially, their solutions are comprehensive enough to cover a disaster of some scale. Such solutions can take into account specific state and regional needs.

103. Some states and regions have focused on the deployment of networks that are resilient and provide capabilities needed for interoperability. Others have focused mainly on the development and implementation of specific plans for interoperability and resiliency that rely on coordinated use of existing emergency communications capabilities and assets by multiple

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<sup>154</sup> *9/11 Act*, § 2201(b)(2)(D).

<sup>155</sup> Meeting at Hughes Network Systems, LLC (HUGHES) Network Operating Center for FCC staff preparing 9/11 Act Report (Oct. 31, 2007); Tour of the AT&T Global Network Operations Center (GNOC) Bedminster, NJ for FCC staff preparing 9/11 Act Report, (Nov. 2, 2007).

<sup>156</sup> *9/11 Act*, § 2201(b)(2)(D).

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jurisdictions and agencies during an emergency. There is overlap between these approaches in that both require significant planning by and cooperation among the multiple participating agencies and jurisdictions to deal effectively with the problems of interoperability and back-up.

104. The remainder of this section is divided into two main subsections: state and regional planning and state and regional emergency communications networks.

**a. State and Regional Planning for Interoperability and Resiliency of Emergency Responder Communications during Large-Scale Emergencies**

105. This section discusses planning for interoperable emergency responder communications that can be maintained or quickly restored in the event of primary system failure. It also discusses issues that states and regions that are planning for such communications often consider, regardless of whether a region has a single emergency communications network or has many systems belonging to multiple agencies in different jurisdictions.

106. Emergency communications involves more than just the technical aspects of communications networking. Effective communications also requires a culture of collaboration supported by established methods and procedures. Achieving the level of emergency communications interoperability and resiliency required to handle large-scale disasters is equally a result of detailed joint operations planning and preparation among the probable responding agencies and jurisdictions—done well in advance of the event—as it is of having a common network or networking technology. The recent southern California wildfires are a good example.

107. The emergency communications arrangements in southern California are not a single unified network or system so much as a collection of systems used by multiple counties and agencies that—possibly out of necessity—have learned how to work with each other. Responding agencies, however, have applied many of the technologies and methods described in an earlier section of this document.<sup>157</sup> Coupled with good inter-jurisdictional planning to respond effectively to wide-area emergencies, they have resolved issues concerning incompatible communications technologies, and the use of available communications channels and frequencies. If multiple fire departments tried to address these problems for the first time on the day of the big fire, the result would be catastrophic. However, the people and agencies involved have learned from years of experience how to deal with wildfire events. Despite not having a single unifying network, they have developed plans that incorporate what they have learned.<sup>158</sup> Hence, even if a state does not have a statewide emergency responders' network, it can benefit from statewide interoperability and resiliency planning as long as this planning is done well in

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<sup>157</sup> See *supra* Section III.B.4.

<sup>158</sup> Dave Buchanan, Chairman, Southern California Regional Planning Committee, teleconference with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

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advance of the emergency and there is time to train emergency responders accordingly.<sup>159</sup>

**b. State and Regional Emergency Communications Networks**

108. A number of regions and states are building communications networks that are designed, managed, and operated to meet the needs of emergency responders.<sup>160</sup> This section is divided into three subsections on economies of scale and other benefits and limitations of state and regional networks, design for interoperability, and design for resilience.

**(i) Economies of Scale and Other Benefits and/or Limitations of State and Regional Networks**

109. An examination of state and regional networks that support emergency communications reveals that they are generally shared by a core group of state or county agencies that typically includes state law enforcement.<sup>161</sup> Many are open to broader local, tribal, and federal government use.<sup>162</sup>

110. This shared use of network resources provides economies of scale for the state that would not be achievable by smaller, dedicated infrastructures supporting the same

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<sup>159</sup> During this study the Commission received information, directly or indirectly, on planning in numerous states, including, but not limited to, information from the following sources: William H. Butler, Senior Project Manager, Telecommunications Development Corp., National Capital Region Contract Staff, presentation to FCC staff preparing 9/11 Act Report (Oct. 19, 2007); Dave Buchanan, Chairman, Southern California Regional Planning Committee, presentation to FCC staff preparing 9/11 Act Report (Oct. 12, 2007); State of Florida, presentation to FCC staff preparing 9/11 Act Report (Oct. 23, 2007); State of Georgia, conference call with FCC staff preparing 9/11 Act Report (Nov. 19, 2007); Douglas Cobb, with slides co-authored by Doug Cohen and Jay Sexton, all from Georgia Tech Research Institute (GTRI), “Overview of Georgia’s Interoperable Communications System,” originally presented at APCO International Conference, August 5-9, 2007, presentation to FCC staff preparing 9/11 Act Report (Nov. 19, 2007); Don West, Communications Director, Indiana Dep’t Homeland Security, presentation to FCC staff preparing 9/11 Act Report (Nov. 8, 2007); Mississippi, presentation to FCC staff preparing 9/11 Act Report (Oct. 29, 2007); State of Missouri, conference call with FCC staff preparing 9/11 Act Report (Oct. 12, 2007); State of Minnesota, written answers to questions from FCC staff preparing 9/11 Act Report; Commonwealth of Pennsylvania, conference call with FCC staff preparing 9/11 Act Report (Oct. 30, 2007); Montgomery County (MD) Public Safety Communications Officials, meeting with FCC staff preparing 9/11 Act Report (Oct. 15, 2007); Tracy Shelton (Fairfax County, VA) and David Evans (Virginia Department of Transportation), “PSTOC – Public Safety and Transportation Operations Center,” slide presentation, at slide 10, presentation to FCC staff preparing 9/11 Act Report (Nov. 7, 2007).

<sup>160</sup> *Id.* Many states have also implemented telecommunications networks just to serve the administrative—not emergency—needs of their agencies, often allowing local governments to make use of spare capacity and possibly charging only incremental costs. This Report does not address such purely administrative networks.

<sup>161</sup> State of Mississippi, conference call with FCC staff preparing 9/11 Act Report (Oct. 29, 2007) (“principle users are the Departments of Public Safety and Transportation and the Highway Patrol”); *Pennsylvania State-wide Radio Network Factsheet* (“used by State Police, Department of Health, Emergency Management Agency, Department of Transportation”); *Missouri Public Safety and Critical Infrastructure Communications Strategic Plan 2007* (“The movement nation-wide is to share [state-wide] systems . . .” 8).

<sup>162</sup> State of Minnesota, written answers to questions from FCC staff preparing 9/11 Act Report; Commonwealth of Pennsylvania, conference call with FCC staff preparing 9/11 Act Report (Oct. 30, 2007); State of Florida, conference call with FCC staff preparing 9/11 Act Report (Oct. 23, 2007) (“primarily used for state law enforcement; local and Federal users can join the system; currently 12 third-party subscribers.”).

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communications requirements.<sup>163</sup> These scale economies derive from the ability to share, for example, expensive radio towers and rights-of-way, lower cost-per-bit high capacity long-haul transmission facilities, and network management resources. Such savings translate to an increased ability to design and support state and regional networks to a “public safety grade” standard, which generally includes such features as full redundancy in the wide-area infrastructure, back-up operations centers, round-the-clock operations coverage<sup>164</sup> (sometimes provided by the equipment provider),<sup>165</sup> and mobile resources for restoring physical facilities. Planning for a state network generally forces the participants to do the kinds of planning activities described earlier.<sup>166</sup>

111. The shared wide-area infrastructure itself can be provisioned according to a range of “make-or-buy” business models. In some instances, a lead agency bears the responsibility for the design, operation, and maintenance of state-owned emergency communications infrastructure.<sup>167</sup> In other instances a state information technology agency may support public safety needs on a multi-use state infrastructure.<sup>168</sup> And in still other instances, the state may rely

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<sup>163</sup> This is particularly important to agencies that are considering purchasing a new agency network at about the same time that the state or regional network is being purchased. The economics are different for an agency that has recently purchased its own network or system.

<sup>164</sup> Operations capabilities typically can include remote fault monitoring, congestion control, over-the air programming of handsets, remote operation and monitoring of generators, etc. These capabilities enable timely detection of and response to network problems, and faster restoration of failed and failing network services.

<sup>165</sup> State of Florida, conference call with FCC staff preparing 9/11 Act Report (Oct. 23, 2007) (“SLERS is owned by M/A-COM; M/A-COM has the Network Operations Center that can remotely see what is happening at every site”); Conference call with State of Missouri, conference call with FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>166</sup> See *supra* Section III.B.5.a.

<sup>167</sup> See Commonwealth of Pennsylvania, Office of Public Safety Radio Services, *Pennsylvania Statewide Radio Network*, available at <http://www.portal.state.pa.us/portal/server.pt?open=512&objID=485&mode=2>, (last visited Jan. 9, 2008) (“Part of the Governor's Office of Administration, OPRS oversees the design and development of the Pennsylvania Statewide Radio Network (PA-STARNet), operates and maintains its infrastructure, and supports and regulates its use for the benefit of all agencies requiring two-way radio communication”); See, *State of Minnesota Statewide Radio Project 9* (Dec. 2002), (“expedite and manage with the Department of Transportation the technical design process, the contracting for and leasing of sites, and the negotiating of cooperative agreements.”), available at <http://www.srb.state.mn.us/pdf/PublicSafetyStatewideRadioProject-Plan-Scope123002.pdf> (last visited Jan. 9, 2008).

<sup>168</sup> See State of Florida, Dep’t of Management Services, *Routed Transport Services*, available at [http://dms.myflorida.com/cits/portfolio\\_of\\_services/suncom/data\\_transport\\_services/routed\\_transport\\_services\\_rts](http://dms.myflorida.com/cits/portfolio_of_services/suncom/data_transport_services/routed_transport_services_rts) (last visited Jan. 11, 2008) (“The RTS (Routed Transport Service) is the statewide multi-protocol fully routed data communications service which comprises the majority of the State Intranet... This SUNCOM service is being phased out by July 2008 as part of the migration to MyFloridaNet Services.”); See State of Florida, Dep’t of Management Services, *System Description*, available at [http://dms.myflorida.com/cits/public\\_safety/radio\\_communications/florida\\_interoperability\\_network\\_fin/system\\_description](http://dms.myflorida.com/cits/public_safety/radio_communications/florida_interoperability_network_fin/system_description) (last visited Jan. 11, 2008) (“The State's Suncom RTS service connects the dispatch centers.”). Regarding the MyFloridaNet services destined to replace RTS, See State of Florida, Department of Management Services, *MyFloridaNet*, available at [http://dms.myflorida.com/cits/portfolio\\_of\\_services/suncom/data\\_transport\\_services/myfloridanet](http://dms.myflorida.com/cits/portfolio_of_services/suncom/data_transport_services/myfloridanet) (last visited Jan. 11, 2008) (“MyFloridaNet is a comprehensive solution providing a rich and flexible private enterprise

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on virtual private network services provisioned by a commercial carrier over commercial infrastructure.<sup>169</sup>

112. In addition to providing emergency communications with scale economies and increased resiliency, sharing state-level infrastructure also provides an incentive for the state itself to promote interoperability among different agencies. Consequently, many states have created Statewide Interoperability Executive Committees to promote cooperation among local, tribal, state and federal public safety users,<sup>170</sup> as well as facilitate state-to-state relationships.<sup>171</sup> Accordingly, sharing infrastructure and achieving appropriate interoperability seems most likely to be successful where agencies and jurisdictions have established collaborative and trustful relationships.<sup>172</sup>

113. Collaborative inter-agency and inter-jurisdiction relationships aimed at building and operating shared state- or regional communications infrastructure facilitates the deployment of trunked radio systems that provide increased resiliency, interoperability and efficiency.

114. An additional frequent feature of shared, state-wide networks of all models is the use or planned use of IP-enabled technologies.<sup>173</sup> For state-wide networks that are deployed on a

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communications infrastructure dedicated for the exclusive use of State of Florida customers. This new enterprise infrastructure is based on a Multi-Protocol Label Switching (MPLS) technology...”).

<sup>169</sup> State of Georgia, teleconference with FCC staff preparing 9/11 Act Report (Nov. 19, 2007); State of Missouri, conference call with FCC staff preparing 9/11 Act Report (Oct 12, 2007) (compared to states with a dominant provider “Missouri has a lot of little local exchange companies,” which makes commercial links prohibitively expensive.).

<sup>170</sup> Any sharing of spectrum with federal entities requires that the federal and non-federal licensees have appropriate authorization from the National Telecommunications and Information Administration (NTIA), and the FCC, respectively, to use the spectrum.

<sup>171</sup> Nat’l Governors Ass’n, “Governors Improve States Public Safety Through Interoperable Communications,” *available at* <http://www.nga.org/portal/site/nga/menuitem.6c9a8a9ebc6ae07eee28aca9501010a0/?vgnextoid=59b2c72fc0f60110VgnVCM1000001a01010aRCRD&vgnnextchannel=6d4c8aaa2ebbf00VgnVCM1000001a01010aRCRD> (last visited Jan. 10, 2008); State of Missouri, conference call with FCC staff preparing 9/11 Act Report (Oct 12, 2007) (“State Interoperability Executive Committee (SEIC) is a good way to bring people together.”). Different states use different names for these committees, although they generally have the form state or statewide interoperability executive committee or council.

<sup>172</sup> Dennis Aylward, COMCARE presentation to Joint Advisory Committee on Communications Capabilities of Emergency Medical and Public Health Care Facilities (Oct. 29, 2007) (“I think that rural America could get those services faster than New York City because when I go to Winchester, Virginia, to talk about this kind of stuff the police chief, and the fire chief, and the emergency manager and the head of the hospital [are] all sitting around at the table, they’re all friends, they want to work together, they want to do new stuff.”); State of Missouri, conference call with FCC staff preparing 9/11 Act Report (Oct 12, 2007) (“Next generation technology will have all the same people problems that current systems have. We need to look at the lessons learned on bringing people together and involving all players.”).

<sup>173</sup> Motorola, meeting with FCC staff preparing 9/11 Act Report, (Oct. 2, 2007); Tropos Networks, meeting with FCC staff preparing 9/11 Act Report, (Nov. 1, 2007); EF Johnson, meeting with FCC staff preparing 9/11 Act Report (Oct. 18, 2007); M/A COM, meeting with FCC staff preparing 9/11 Act Report, (Oct. 26, 2007); State of

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state-owned backbone, IP technology provides an efficient form of statistical multiplexing over existing spectrum resources. Generally lower in cost<sup>174</sup> than alternative equipment based on Time-Division Multiplexing (TDM) or proprietary standards, COTS IP network technology provides the agility to exploit the redundancies designed and built into the state-wide infrastructure.

115. Some state-wide networks are implementing shared infrastructures built on IP technology, gateway devices to achieve legacy interoperability, and trunked systems. These approaches are generally positive from the standpoint of cost, resiliency and interoperability. Even so, they rely heavily on vendor-specific software and equipment, and have network databases with agency- and user-specific information. If one were to deploy a back-up network in advance for use in the event of failure of the primary network; a connection, sometimes including a gateway, would need to be provided between a working part of the failed network and the back-up network. Since one does not know in advance which part of the network will fail, connections from at least two different parts of the primary to the backup are actually needed. In addition, features and user- and agency-specific data must be maintained consistently between the two systems. Because of the complexity, communications back-up capability must be planned and designed into both systems (the one that might fail and the planned back-up). As a result, no single back-up network can be affordably deployed or have its databases and software kept in synchronization with every primary emergency communications network and system.

## (ii) Design for Interoperability

116. States are by no means uniform in their approach to providing communications capabilities for emergency responders.<sup>175</sup> Important factors in determining the approach include

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Florida, conference call with FCC staff preparing 9/11 Act Report (Oct. 23, 2007); National Capital Region, meeting with FCC staff preparing 9/11 Act Report (Oct. 19, 2007); State of Minnesota, written answers to questions from FCC staff preparing 9/11 Act Report; Commonwealth of Pennsylvania, conference call with FCC staff preparing 9/11 Act Report (Oct. 30, 2007).

<sup>174</sup> EF Johnson, meeting with FCC staff preparing 9/11 Act Report (Oct. 18, 2007).

<sup>175</sup> The primary and most critical emergency communication need is voice, but newer systems are incorporating data and even video in at least one case. For example, Pennsylvania's 800 MHz public safety radio system is a data network with voice applications. Commonwealth of Pennsylvania, conference call with FCC staff preparing 9/11 Act Report (Oct. 30, 2007). National Capital Region uses wireless data channels for video surveillance. William H. Butler, Senior Project Manager, Telecommunications Development Corp., National Capital Region Contract Staff, presentation to FCC Staff preparing 9/11 Act Report (Oct. 19, 2007). To include data and video transmission capability some jurisdictions provide a backbone that carries traffic as IP. (The IP packets may ride over several different kinds of transmission media including T-carrier, microwave radio, fiber and satellite.) Equipment at the edge of the network digitizes voice and video and places them into packets for transmission from one site to another over the same backbone links used for data. As a practical matter, emergency responders are limited to low speed data because of the channel size available on UHF, VHF, and 800 MHz systems. In some cases voice channels in radio links carry low speed data to (for example) a police car. Although the data is low speed, it is still adequate for many public safety applications, such as vehicle/driver checks and Automatic Vehicle Location. The New York state wireless network (SWN) carries voice and 19.2 Kbps data. See Melodie Mayberry-Stewart, Ph. D., Chief Information Officer, New York State Office for Technology, *Open Sky*, available at <http://www.oft.state.ny.us/SWN/Technology/opensky.htm> (last visited Jan. 10, 2008).

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who the primary users are (most commonly state law enforcement entities), what the funding sources are, and when the state makes investment determinations. Older approaches often resulted in separate VHF, UHF and 800 MHz radio systems for different emergency responders, such as police and fire departments.<sup>176</sup> In some cases, regional cooperation has enabled existing systems that use different technologies to interoperate.<sup>177</sup>

117. State and regional networks are designed as primary networks to carry traffic among certain emergency responders in the associated state or region. In addition, most of these systems use gateways to provide some interoperability for agencies that use legacy radio systems described above.<sup>178</sup> The gateways convert between the format of legacy radios and the format of the state or regional backbone, which is typically IP, and hence allow legacy emergency communications systems to interoperate via the common backbone.<sup>179</sup> They also generally permit the attached local networks to continue to operate even if a gateway or the backbone fails. Although wide-area network (WAN) connectivity remains important particularly in the large-scale emergencies, the backbone communications network is not as critical as it would be if its loss also caused the loss of local emergency communications. Individual agencies typically are responsible for deciding whether to use a gateway to attach their local emergency communications system to a larger network.

118. One long-term goal of many state networks is to integrate local and non-participating state agencies. Their timetable, however, may be influenced by external factors including funding considerations, availability of frequencies in the state network, and level of interest by agencies and jurisdictions. In particular, some agencies and jurisdictions may choose not to participate. In any event, interoperability between newer state systems and legacy systems used by various municipalities and agencies may be desirable, needed, and required in a state's network request for proposal. It may be much less expensive to place a gateway or bridge<sup>180</sup> in a municipality than to replace its entire legacy radio system, regardless of whether the new investment is being made by the state or the municipality.

119. A statewide or regional network may provide additional options for reaching

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<sup>176</sup> Indiana has a 155 MHz system connecting EOCs for police and an 800 MHz P16 system for public safety. Don West, Communications Director, Indiana Dep't of Homeland Security, presentation to FCC staff preparing 9/11 Act Report (Nov. 8, 2007).

<sup>177</sup> Southern California counties put together regional systems that support each other. Dave Buchanan, Chairman, Southern California Regional Planning Committee, presentation to FCC staff preparing 9/11 Act Report (Oct. 12, 2007).

<sup>178</sup> Based on the state and local jurisdiction interviews in this study the most commonly used gateways are the Motorola MOTOBridge, Raytheon ACU-1000, and M/A-COM NetworkFirst.

<sup>179</sup> Georgia connects disparate radios through gateways and then routers to a commercial IP/MPLS backbone. Press Release, Georgia Tech Research News, *Crisis Talk: Georgia Tech Helps Implement Statewide Interoperable Communications System*, (Feb. 28, 2006), available at <http://gtresearchnews.gatech.edu/newsrelease/emergency-radio.htm> (last visited Jan. 10, 2008).

<sup>180</sup> In the context of communications networks, a "bridge" is a device that links or routes signals from one network to another. See *ATIS Telecom Glossary 2000, T1.523-2001*, available at <http://www.atis.org/tg2k/> (last viewed Jan. 11, 2008).

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higher levels of interstate interoperability. For example, the Gulf coast states are looking at interconnecting state networks to help improve traffic flow during evacuations that involve more than one state. In the National Capital Region, multiple jurisdictions currently use common equipment to allow a single radio to connect to as many as nine different networks with the push of a button.<sup>181</sup> This of course requires that each radio be programmed with the latest software for the networks to which it may need to connect.

120. States are implementing a variety of systems from different manufacturers that may use different standards or even be proprietary. Even if their networks are from the same manufacturer or satisfy the same technical standard, it is not automatic that two state networks can interoperate. Systems that claim conformity with P25 appear to have some incompatibilities because interoperability issues are yet to be fully addressed in the interconnect standard, Inter Sub-System Interface (ISSI).<sup>182</sup> Numerous manufacturers, however, already have participated in rudimentary public demonstrations.<sup>183</sup> In particular, at an APCO conference in August of 2007 EADS, EF Johnson, Motorola, and M/A-COM, each having its own ISSI gateway, connected their P25-compatible equipment via a router, thus showing that ISSI connectivity is possible if the manufacturers are willing to address unspecified aspects bilaterally. In the meantime, connections are generally being made using bridges or gateways.

### (iii) Design for Resilience

121. State networks are designed with redundancy wherever practical and incorporate a number of measures to improve reliability and resiliency. Among the steps that state or regional network managers may take include:

- Use of satellite as back-up to backbone or backhaul connections.
- Portable sites such as LMR SOWs and TOWs to replace damaged radio sites or augment capacity when the system becomes overloaded during an emergency.
- Use of mobile communications vans to establish a local command, control and communications presence in an emergency.
- Redundant fiber rings, often using Synchronous Optical Network (SONET) technology.
- Back-up generators.
- Contractual obligations for high reliability backbone services.

As noted above, managers of local municipal networks and single-agency networks may not have the resources and personnel for such activities and investments.

122. These measures provide many states with a sufficient level of confidence in the

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<sup>181</sup> Lt. Chris Johnson, Radio Communications Manager, Montgomery County (MD) Police Radio, meeting with FCC staff preparing the 9/11 Act Report (Nov. 15, 2007).

<sup>182</sup> Telecommunications Industry Ass'n, *Project 25 Inter-RF Subsystem Interface Overview New Technology Standards Project Digital Radio Technical Standards* (Dec. 1, 2003), TIA TSB-102.BACC-A. The ISSI provides a defined standard to interconnect different networks, regardless of frequency band or suppliers, together in such a way to allow roaming (mobility) of subscriber radios between networks; *See infra* Appendix A.

<sup>183</sup> Motorola response to questions from FCC staff preparing 9/11 Act Report (Oct. 25, 2007).

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resiliency of their own network that they do not plan to use any kind of back-up network following a disaster. Further, most states indicated they believe commercial services to be less reliable than their own emergency networks and, even if they remained operational after a disaster, emergency responders would be competing with the general public for their limited capacity.<sup>184</sup>

#### (iv) State Statistics

123. According to Motorola's estimates, thirty-two states have implemented or are in the process of implementing state-wide communications systems for emergency responders. These include a combination of P25 and non-P25 systems. Motorola's data also shows that the large majority of the remaining states are planning (at some level) to deploy such systems, but does not indicate which, if any, of these systems serve only one state agency (e.g., the state police or highway patrol); which serve many or all state governmental agencies, and which serve many or all emergency responders in the state (including county and municipal police and fire departments, as well as the state police).

124. Three states apparently have no plans for deploying either P25 or non-P25 emergency systems.<sup>185</sup> However, one of these three states, Georgia, is deploying a statewide "IP network backbone" that "[a]llows interoperability between disparate radio system technologies."<sup>186</sup> However, since the network continues to use the "existing Radio Frequency infrastructure," it "[w]ill not increase RF coverage, channel capacity, eliminate technology obsolescence" for the connecting RF systems.<sup>187</sup> This is another approach to providing interoperability without absorbing the cost of replacing existing networks or systems.

### 5. Asset Inventory

125. The Nation's domestic all hazards response follows the National Incident Management System (NIMS) and the National Response Framework (NRF). The NRF charges DHS's Federal Emergency Management Agency (FEMA) and the NCS with supporting the communications sector under Emergency Support Function #2. The NCS comprises twenty-four Federal departments and agencies that have critical communications missions. The NCS member departments and agencies, including the Department of Defense, offer personnel and equipment to meet public safety and private sector communications needs when those entities in the impact zone are unable to muster a timely and effective response. The governing policy is to use Federal assets for a short duration and withdraw them when the emergency responder

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<sup>184</sup> Commercial networks are not a direct substitute for emergency responder systems, but those networks and priority access services (GETS, WPS) can augment primary communication services providing capacity that can relieve public safety networks during major disasters. *See supra* Section C.

<sup>185</sup> *See* Motorola, *Emergency Communications*, slide presentation, slide 10, meeting with FCC staff preparing 9/11 Act Report (Sept. 27, 2007).

<sup>186</sup> Douglas Cobb, with slides co-authored by Doug Cohen and Jay Sexton, all from Georgia Tech Research Institute (GTRI), "Overview of Georgia's Interoperable Communications System," originally presented at APCO International Conference, August 5-9, 2007, presentation to FCC staff preparing 9/11 Act Report (Nov. 19, 2007).

<sup>187</sup> *Id.*

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community resumes operations. The resumption of such operations may include assistance and augmentation from private sector resources.

126. The NCS maintains a non-public listing of Federal communications assets that could be used to support public safety and private entities. For the most part, these assets, including those controlled by U.S. Northern Command (NORTHCOM), are subject to multiple taskings and ever-changing deployment priorities.<sup>188</sup> A non-public listing of Federal communications resources most efficiently capable of providing emergency communications is available, but not releaseable.<sup>189</sup> A public listing of private communications resources most efficiently capable of providing emergency communications is found in Appendix C.

127. FEMA's Mobile Emergency Response Support (MERS) detachments can support multiple methods of communication.<sup>190</sup> The MERS resources, deployed throughout the Nation, are on mobile platforms and are certified for airlift. Among other things, MERS offers satellite, microwave line of sight, High Frequency (HF), VHF, and UHF communications, video teleconference (VTC), and mesh networks for interoperability.

128. The National Interagency Fire Center (NIFC), located in Boise, Idaho, makes available a cache of radios for ESF #2 support, as its mission permits. These radios can be structured into systems that can address command and control, tactical, logistical, air-to-air, air-to-ground, and satellite. NIFC radios come with battery packs and repeater systems for rapid deployment.

129. Of note, DHS's Office of Emergency Communications (OEC) recently conducted a baseline assessment of radio systems that state-level emergency personnel use. Data on more

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<sup>188</sup> The Department of Defense provides Defense Support of Civil Authorities (DSCA), including military forces, the Department's career civilian and contractor personnel, and Department of Defense agency and component assets, for domestic emergencies and for designated law enforcement and other activities. The Department of Defense provides defense support of civil authorities when directed to do so by the President or the Secretary of Defense. The Secretary of Defense authorizes the supporting Combatant Commanders to provide support for planning and conducting DSCA response operations in their respective areas of responsibility.

USNORTHCOM has mission responsibility to support civil authorities by providing specialized skills and assets to rapidly stabilize and improve the situation in the wake of catastrophic events. When civilian responders request assistance, USNORTHCOM will anticipate being directed to provide Department of Defense support and unique capabilities.

USNORTHCOM identifies Command, Control, Communication and Computer (C4) systems required to support its missions, assigned forces and supporting commands, and assigns responsibilities to provide, install, operate and maintain these systems. Upon execution, C4 will be established between USNORTHCOM and the designated Defense Coordinating Officers, Defense Coordinating Elements, Joint Task Force Headquarters, designated Base Support Installations and other Federal and State agencies as required.

<sup>189</sup> The unclassified Federal asset inventory can be found in Appendix B of the Official U.S. Government Use Only version of this document.

<sup>190</sup> See Dep't of Homeland Security, Federal Emergency Management Agency, "Mobile Operations Capability Guide for Emergency Managers and Planners" available at <http://www.fema.gov/emergency/mers/index.shtm> (last visited Jan. 8, 2008) (a public overview of MERS capabilities).

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than fifty-eight urban areas, states, and territories is contained in OEC's non-public Communication Assets Survey and Mapping (CASM) software tool. Access to CASM should speed the deployment of interoperable communications resources and mutual aid with neighboring communities when a rapid response is critical.<sup>191</sup>

**C. A Framework for the Development of a Resilient, Interoperable Communications System for Emergency Responders**

130. While no single solution at present provides an appropriate opportunity for a back-up communication system to support the diverse needs of the communities of emergency responders, it is commonly expected that over the next decade the wireless and wireline commercial communications industry will undergo an unprecedented transformation to multi-service broadband platforms.<sup>192</sup> If accomplished, this would provide emergency responders with an increased range of communication options and commercial services that could augment or back-up primary emergency responder communication services in times of emergency. The converged networking environment driven by broadband technology provides an effective mechanism for economically supporting the diverse service needs of the public safety community and leverages the growing availability of commercial broadband services to provide effective alternative network capabilities for emergency responders.

131. This technology evolution will provide a potential lower-cost path towards implementing services and capabilities that will benefit emergency responders. The unique needs of emergency responders have often resulted in costly specialized and proprietary systems supporting a relatively small base of users. The result, as some emergency responder representatives have noted, is equipment significantly more expensive than their commercial counterparts. The broadband multi-service convergence paradigm occurring now in communications services and products could allow emergency responders to obtain the benefits of COTS systems and services without sacrificing the services and features they need. With careful planning, emergency responders may align their interests with those of commercial service providers resulting in increased choice of service, lower cost and the ability to use commercial services as more effective back-up solutions for their primary capabilities. Integrating commercial solutions with dedicated emergency communication resources will result in a more resilient emergency responder infrastructure by increasing the range and number of communication assets available to emergency responders.

132. Recognizing this opportunity, the Commission ordered that certain spectrum within the 700 MHz band to be awarded by auction include a requirement that the winning bidder must deploy a nationwide broadband network that would support both the commercial

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<sup>191</sup> See Dep't of Homeland Security, "Office of Emergency Communications," available at [http://www.dhs.gov/about/structure/gc\\_1189774174005.shtm](http://www.dhs.gov/about/structure/gc_1189774174005.shtm) (last visited Jan. 8, 2008).

<sup>192</sup> See ITU-T NGN Focus Group Proceedings Part 1, 2005, available at [http://www.itu.int/ITU-T/ngn/files/NGN\\_FG-book\\_I.pdf](http://www.itu.int/ITU-T/ngn/files/NGN_FG-book_I.pdf) (last visited Jan. 18, 2008) and ITU-T NGN Focus Group Proceedings Part 1, 2005, available at [http://www.itu.int/ITU-T/ngn/files/NGN\\_FG-book\\_II.pdf](http://www.itu.int/ITU-T/ngn/files/NGN_FG-book_II.pdf) (last visited Jan. 18, 2008).

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and public safety communities.<sup>193</sup> Built to the higher public safety requirements for reliability and coverage, this “public/private network” will employ commercially based broadband wireless technologies to support both commercial and public safety services. The 10 MHz that will be auctioned will be combined with 10 MHz that had been allocated for broadband public safety use and assigned to a single Public Safety Broadband Licensee (PSBL).<sup>194</sup> Emergency responders will have priority over commercial usage in times of emergency while the winning bidder will be able to use public safety bandwidth on a secondary pre-emptable basis.

133. A framework to realize the potential of this evolution must set goals and objectives for systems that are achievable over time and aligned with both technology trends and the long-term needs of public safety. The Commission’s 700 MHz Second Report and Order creates this framework for broadband communications in the 700 MHz band in the following manner:

- Selecting a PSBL that is as broadly representative of the public safety community as possible.
- Requiring negotiation of a Network Sharing Agreement between the PSBL and its commercial partner to ensure the shared network meets public safety specifications, including a nationwide level of interoperability and a single broadband standard.
- Achieving a broadband network on commercially derived technologies that will allow emergency responders to adapt commercial innovations deemed desirable to their needs while enjoying the economies of scale typically found in the commercial marketplace.
- Providing an evolution plan for broadband wireline and wireless emergency networks.

### **1. Critical Solutions for an Emergency Communications Framework**

134. For purposes of this Report, the term “critical solutions” is used to identify projects, services or technologies that could have significant influence in shaping the evolution of emergency communication services and infrastructure. Some of these solutions help to frame this evolution by helping to define critical network interfaces and service capabilities. Much as the national Internet provided a framework to define how different networks comprised of different technologies could be integrated into a “network of networks,” the existence of national-scale emergency communication networks could result in development of interoperable services and capabilities leading to an equivalent “emergency network of networks” supporting the needs of emergency responders.

#### **a. National Emergency Broadband Multi-Service Network**

135. The evolution of the emergency responder communities towards an environment of interoperable communications supported by COTS platforms can be accelerated by the deployment of a national emergency broadband network or system of networks. A national

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<sup>193</sup> See 700 MHz Second Report and Order, *supra* note 2.

<sup>194</sup> *Id.*

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emergency broadband network would support emergency communication services across the country and integrate other state and local emergency networks. A national network would foster interoperability through implementation of standard services such a directory, encryption, authentication, identity management and others, that could be used by all emergency responders.

136. The evolution of a national emergency communication network will provide a natural framework for the development of services and technologies required for interoperable communications and serve as a de facto set of standards for how compatible services and devices must be built. Discussion with industry and emergency responder representatives has identified several candidates likely to affect the evolution of nationwide emergency communication capability. As time goes on, additional opportunities may emerge..

**(i) 700 MHz Public/Private Partnership**

137. As described above, the 700 MHz Public/Private Partnership adopted by the Commission will deploy a shared nationwide broadband wireless network utilizing both commercial and emergency responder spectrum. The potential impact of this proposal is manifold:

- The support of the public safety community, the scope of the proposal and its timing will ensure that the Public/Private Partnership will play the predominant role in defining the architecture for the nationwide emergency broadband network.
- The order addresses the wireless broadband needs of emergency responders without burdening the emergency responder community with funding the venture.
- It is a proposal for a nationwide broadband network. As such, it will drive commonality of features on a national scale and require interoperability among both emergency responder communities and applications.
- It is already causing emergency responders to envision the impact of broadband convergence and the opportunity afforded by multi-service platforms.
- The vendor community is beginning to react to the need to develop COTS-based technologies for the emergency responder community, which should be less expensive for emergency responders.<sup>195</sup>

**(ii) National Command and Coordination Capability (NCCC)**

138. NCCC is a Federal initiative, under DHS, to connect all state EOCs in a reliable wireline broadband network supporting secure command, control and coordination functions including voice, video, and data communications. It would establish for the first time, a national high capacity wireline broadband network linking state and federal emergency agencies and would therefore complement the deployment of the 700 MHz broadband wireless Public/Private Network.. The initial phase of the project extends existing federal command, control and coordination functionality to state EOCs. A later phase would leverage the broadband

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<sup>195</sup> See *Recommendations of the Independent Panel Reviewing the Impact of Hurricane Katrina on Communications Networks*, Notice of Proposed Rulemaking, 21 FCC Rcd 7320 (2006) (*Katrina NPRM*).



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infrastructure to define common services and capabilities that would support the needs of the emergency services enterprise communities and develop opportunities to more economically extend a broadband wireline network to other public safety groups within the state.<sup>196</sup> Its existence as a national resource with bandwidth to support enterprise applications could further accelerate the identification and development of services required to support interoperability among emergency responder agencies.

**b. Commercial Solutions**

139. The evolution of commercial wireless systems to 3G and 4G broadband multi-service platform provides a rare opportunity to redefine commercial capabilities in support of emergency responders. Key trends include the following:

**(i) NCS WPS**

140. The NCS, working with commercial service providers, has defined both GETS and WPS as commercial service offerings that ensure priority access to commercial communication services for emergency responders. While implemented in the context of the legacy wireline and wireless networks, NCS experience has been that these services allow emergency responders to use commercial wireline and wireless PSTN services with a high degree of assurance during an emergency when LMR access may not be available due to overload or other disruptions.

141. Recently the NCS has undertaken a program activity to evolve GETS and WPS priority treatment voice capabilities, as well as begin to offer broadband priority services, based on the Internet Protocol Multimedia Service (IMS), the wireline/wireless joint industry architecture framework for broadband services. The initial program activity extends the voice capability of GETS and WPS into the domain of IMS and will allow GETS and WPS carriers to offer voice priority services across their IMS next generation networks.<sup>197</sup> IMS is a broadband architecture supporting both voice and data capabilities. The follow-on stage for the NCS is to extend WPS to data services, as well. During an emergency, emergency responders would have priority access to deployed broadband commercial services.<sup>198</sup>

142. In the long-term, the NCS work could be extended to make priority services such as WPS fully transparent to first responders by supporting critical LMR features and by integration of first responders using WPS with LMR systems via standard gateway interfaces.<sup>199</sup>

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<sup>196</sup> Dr. Peter Fonash, Chief Technology Officer, Cybersecurity and Communications, Dep't of Homeland Security, interview with FCC staff preparing 9/11 Act Report (Oct. 9, 2007).

<sup>197</sup> The success of this program activity will be dependent upon adequate funding considerations.

<sup>198</sup> Vernon Mosley, Chief Engineer – Wireless Priority Service, Dep't of Homeland Security, interview with FCC staff preparing 9/11 Act Report (Oct. 2, 2007).

<sup>199</sup> At the 2007 APCO annual conference, vendors demonstrated the ability of the ISSI interface to integrate voice communications from different systems with for example Cisco demonstrating its capability to link radio devices with non-radio devices. See Glenn Bischoff, "APCO: Cisco Demonstrates Ability to Link Disparate Devices," *MRT*

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**(ii) 3G and 4G Commercial Evolution**

143. Commercial wireless service providers are undertaking an evolution of their networks towards broadband infrastructures that will support both voice and data services. Elements of this evolution are underway today and the auction of 700 MHz spectrum is expected to further accelerate its pace. This evolution could redefine commercial capabilities to better support the needs of emergency responders. A key element in this plan is the IMS architecture, which has broad support among industry groups representing the key cellular wireless technologies. IMS supports a number of capabilities important to the needs of emergency responders including:<sup>200</sup>

- An ability to support multiple services: voice, data on a single infrastructure;
- A capability to assign different priorities and quality of service to each service type; and
- A capability to support gateways to other networks that could include dedicated emergency responder networks.

144. Next generation commercial networks, if planned appropriately, could provide emergency responders with the voice and data capabilities they require, complementing dedicated emergency communication systems in place, but greatly expanding the capacity that would be available to emergency responders in those areas where commercial service is available.<sup>201</sup> Commercial communication standards groups such as the Alliance for Telecommunications Industry Solutions (ATIS—US), European Telecommunications Standards Institute (ETSI—Europe), and the International Telecommunications Union (ITU—International) among others, have recognized that future broadband multi-service networks must be capable of supporting the unique needs of emergency responders and are incorporating emergency responder needs in their next generation requirements.

145. Realization of these capabilities will require work, such as that ongoing within the NCS, which defines emergency responder requirements for commercial networks. Realization of the opportunity will require a reformulation of emergency responder requirements for support by COTS technology and commercial platforms.

**(iii) Broadband Convergence**

146. As noted, trends in broadband technology are fundamentally reshaping both the wireless and wireline commercial communication industries as they evolve towards a multi-service platform environment. The long-term future of emergency responder communications is

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*Magazine*, Aug. 10, 2007, available at [http://mrtmag.com/project25/news/cisco\\_disparate\\_devices\\_081007/](http://mrtmag.com/project25/news/cisco_disparate_devices_081007/) (last visited Jan. 13, 2008).

<sup>200</sup> Jim Bugel, Vice President, AT&T, interview with FCC staff preparing 9/11 Act Report (Sept. 27, 2007); *see also* 3GPP TS 22.228, Service requirements for the Internet Protocol (IP) multimedia core network subsystem (IMS); Stage 1, available at <http://www.3gpp.org/ftp/Specs/archive/22%5Fseries/22.228/> (last visited Jan. 16, 2008).

<sup>201</sup> Jim Bugel, Vice President, AT&T, interview with FCC staff preparing 9/11 Act Report (Sept. 27, 2007).

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also expected to organize around a broadband core, both to realize economies from the commercial technologies and to enhance emergency communications capabilities. Wireless broadband has received the greatest attention, stimulated both by the wide commercial availability of broadband services and by the recent focus on the 700 MHz Public/Private Partnership opportunity.

147. Availability of wireline broadband solutions for first responders is, in large part, dependent upon the availability of commercial wireline broadband solutions. Commercially available broadband services are typically digital subscriber line (DSL) service, high-speed cable modem services, fiber optic (fiber to the home), and broadband over power lines. Deployment of these services has grown significantly in recent years; however, commercial broadband deployment, which focuses on residential and business subscribers, is not, in and of itself, sufficient to meet the specific needs of first responders. This is particularly true in more sparsely populated areas, where robust high speed broadband networks supporting multiple applications and simultaneous users are less likely to exist.

148. To address this issue, some states have deployed state-wide broadband networks to address governmental needs, including supporting emergency communications. The Commission recently took action to support the deployment of regional broadband solutions for healthcare providers across the country, awarding more than \$417 million dollars for the construction of 69 state-wide and regional broadband healthcare networks in 42 states and 3 U.S. territories. The networks will connect over 6,000 healthcare facilities across the country, including hospitals, clinics, public health agencies, universities and research facilities, behavioral health sites, community health care centers, and others.<sup>202</sup> These networks will enable healthcare providers to better respond to emergencies, delivering critical patient information instantaneously, supporting telemedicine applications, and exchanging critical information in real time.

149. Despite these and similar initiatives and the availability of commercial broadband services – or, perhaps, in light of the availability of a variety of solutions – there is no vision of a “one-network” wireline broadband solution that would meet the needs of all emergency responders nationwide.<sup>203</sup> It is imperative, therefore, that as the commercial communications sector has visions of future evolution, emergency responders should take pains to understand the opportunities afforded to them and establish their own vision of the future. Elements of a plan should include:

- The impact of possible transformative elements such as the 700 MHz Public/Private Partnership and NCCC network.
- Resources that need to be administered across agencies and states to support increased interoperability of communication solutions.

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<sup>202</sup> See Rural Health Care Support Mechanism, WC Docket No 02-60, *Order*, 22 FCC Rcd 20360 (2007).

<sup>203</sup> Jim Bugel, Vice President, AT&T, interview with FCC staff preparing 9/11 Act Report (Sept. 27, 2007); Michael Maiorana, Vice President, National Government Operations, Verizon, and Nicola Palmer, Vice President, Network Operations Support, Verizon, interview with FCC staff preparing 9/11 Act Report (Nov. 9, 2007); Lynn Starr, Vice President, Qwest, interview with FCC staff preparing 9/11 Act Report (Oct. 25, 2007).

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- Identification of gaps in commercial systems and technologies with potential for use by emergency responders.
  - Service requirements for future commercial networks that would better support the needs of emergency responders.
  - Hybrid solutions incorporating dedicated and commercial system elements that may better leverage scarce funding resources.
  - Interoperability needs of the different communities encompassed by emergency responders.

**c. A Rural Emergency Communications Plan Is Required**

150. The Commission's 700MHz Second Report and Order specifically addressed the needs of rural areas requiring that at full deployment the network cover 99.3% of the US population, including consideration of towns in excess of a population of 3000 people and that major highways and interstates. Furthermore, individual public safety entities have options to extend coverage via deployment of compatible network infrastructure should they deem it necessary.

151. The evolution of emergency communication services has already expanded beyond simple voice communication services and now includes transmission of data directly to first responders and emergency communication support services that are dependent upon commercial data services. Emergency communications will inevitably follow the path of evolution of commercial networks towards a converged broadband environment where access to broadband capabilities will enable the development of critical services for the emergency responder community. This evolution will, however, also make the emergency responder community dependent upon high speed digital service for overall effectiveness.

152. The broadband evolution will, at best, extend in a more limited fashion to the rural areas of the country offering less capability and less reliability than in more populous areas. Extension of critical services to less populated areas will require different technologies, architectures and economic incentives to overcome these disparities. Terrestrial wireless technologies may be used in conjunction with satellite backhaul to link rural first responders to emergency communication networks.<sup>204</sup> Broadband distributed architectures could support network resiliency for remote PSAP functions in an isolated community.<sup>205</sup> Other solutions and technologies may play a role in the evolution of rural communications. Planning must be based on the reality that the emergency communication challenges in rural areas will be distinctly different and more challenging than for more populous areas.

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<sup>204</sup> Mike Alagna, Vice President, Integrated Solutions, Motorola, interview with FCC staff preparing 9/11 Act Report (Sept. 27, 2007).

<sup>205</sup> See US Dep't of Transportation, Intelligent Transportation Systems, *Next Generation 9-1-1 System Initiative, Concept of Operations, version 2.0* (Apr. 6, 2007), available at [http://www.its.dot.gov/ng911/pdf/NG911ConOps\\_April07.pdf](http://www.its.dot.gov/ng911/pdf/NG911ConOps_April07.pdf) (last visited Jan. 8, 2008).

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#### d. Risk

153. The opportunity over the next decade for aligning commercial network services and technologies with the needs of emergency responders is unprecedented. However, if unplanned the evolution of network capabilities may not naturally address the needs of emergency responders. In the past, emergency responders and commercial service requirements have been defined independently of each other. The opportunity presented by the convergence of technologies will require a more collaborative approach. The work of the 700 MHz Public/Private Partnership to support the deployment of a broadband wireless network, will need to be extended to the wireline domain to define the services and capabilities required by the entire emergency responder community that can be supported by commercial technology and services. This issue has been recognized by members<sup>206</sup> of the emergency responder community.

154. The Commission received strong input that any commercial services or technologies developed to support emergency responders must match or transparently complement the highly specialized services that have evolved over time to support the emergency responder community. To fully accomplish this, commercial vendors will require a precise understanding of the needs of the emergency responder community. Specific goals need to be established that include:

- Definition of services
- Timelines for deployment
- Standards requirements
- Regional strategies
- Funding initiatives

155. The Commission's 700 MHz Second Report and Order is a significant step in addressing these needs. The Commission specified basic elements of a shared broadband multi-service network capable of meeting the needs of emergency responders.<sup>207</sup> Moreover, the Commission required that the PSBL and the service provider for the 700 MHz Public/Private Partnership complete a Network Sharing Agreement (NSA) specifying the rights and obligations of both parties and the specific needs of the public safety community. In this respect, the NSA will represent a watershed in emergency responder communications. For the first time, a set of requirements addressing the needs of the first responder community for communications capabilities that can be supported by a commercial platform will have been developed. This event can be extended outside of the 700 MHz Public/Private Partnership as the basis of a dialogue between emergency responders, commercial technology vendors and commercial services providers to better align the needs of emergency responders with the evolving capabilities of the COTS technology community and the commercial service provider community.

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<sup>206</sup> Roger Hixson, Technical Issues Director, NENA, Presentation to FCC staff preparing 9/11 Act Report (Nov. 9, 2007). See also David Alyward, COMCARE and Patrick Halley, NENA, *Emergency Communications and Interoperability: An Update and Action Plan*, presentation to NSTAC, (June 7, 2007).

<sup>207</sup> See 700 MHz Second Report and Order, 22 FCC Rcd at 15434 ¶ 405.

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#### IV. CONCLUSION

156. In conclusion, the Commission wishes to emphasize the fundamental connection between emergency planning and emergency preparedness, particularly as it relates to large-scale disasters that call on multiple, possibly geographically disparate, jurisdictions for a response. In a large-scale emergency there is likely to be no shortage of back-up emergency communications capabilities offered. Some of these will be very familiar to emergency responders; others will be unfamiliar to them. Although emergency responders are accustomed to operating effectively in emergencies, large-scale disasters introduce a new dimension of complexity and intensity that reduces the amount of time the emergency responder has to become familiar with new equipment and procedures. In conditions like this, back-up communications capabilities are useful only to the extent that they are usable by emergency responders with very little training on the scene. Advanced planning, complemented by rigorous incident management, is vital to success.

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## V. APPENDIX A – TECHNICAL TUTORIAL

### A. Land Mobile Radio (LMR)

157. There are many different types of Land Mobile Radio (LMR) systems and no single handset can be used on every LMR system in operation today. The handset that can be used with a particular system depends on many factors related to the system's design. These factors include frequency band, type of system (conventional, trunked, analog, and digital) and type of technology (proprietary or standardized). A basic understanding of these factors is important to understanding the limitations on radio communication across different LMR systems.

158. Existing LMR technology is designed to work within specified frequency ranges. Today's systems use primarily the VHF, UHF, 700 and 800 MHz bands.<sup>208</sup> Handsets must operate on the same frequencies to communicate. A handset operating on a specific frequency in the UHF band will not be able to directly communicate with a handset operating on a different UHF frequency or on a VHF, 700 MHz or 800 MHz frequency. Dual-band handsets are available that can operate on both the 700 MHz and 800 MHz bands. Handsets capable of operating across larger frequency ranges that encompasses VHF, UHF and 700/800 MHz are not currently available. Therefore, an agency operating a UHF system can only directly establish communications with another agency operating a UHF system. Generally, multiple radios must be carried to allow direct communication with radio systems operating on VHF, UHF, and 700 MHz and 800 MHz bands.

159. Generally, lower frequencies in public safety bands have better coverage for a given power level, so VHF signals can generally be received over longer distances than UHF signals. This makes VHF useful in suburban and rural areas. Since lower frequencies have a larger coverage area, they require fewer towers per square mile of coverage than higher frequency systems; however, for the public safety land mobile frequency bands, higher frequencies have better building penetration.

160. In addition to operation on different frequency bands, LMR communications systems can operate using different technologies. LMR systems can operate in simplex (operating on a single frequency) or duplex (operating on a paired frequency) mode. Duplex systems are generally classified as either conventional or "trunked" systems.

161. Simplex operation does not rely on any infrastructure, such as repeaters or base stations, for communication. In this mode of operation, as long as handsets are tuned to the same frequency they can communicate with each other on a single frequency. This is commonly referred to as "talk-around" or "car-to-car" communication. Simplex operation only provides coverage over flat terrain for a very limited distance (such as a few miles).

162. A conventional LMR system is a duplex system that typically consists of one or more channels each consisting of a pair of frequencies (input and output) in which a user selects

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<sup>208</sup> VHF radios operate in the 152 – 162 MHz range and UHF radios operate in the 406 – 512 MHz range.

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the frequencies on which to communicate by changing the radio channels. These systems can be analog or digital and generally have dedicated frequencies assigned to individual groups of users. When a user makes a call, other users can not use the channel without causing interference until the call is over. It may be difficult to access the channel when there are a large number of users present. In order to add a radio to a conventional system, the frequency has to be programmed into the handset itself. The network itself does not need to be modified to allow the radio to communicate on the system.

163. In contrast, trunked LMR systems, which can also be analog or digital, allocate pools of frequency channels for use by multiple individuals. A computer connected to a control channel manages the operating frequencies. When a call is made by a user on a trunked system, an available channel is automatically selected from the pool of channels leaving the remaining channels available for others. Talk groups specify users that need to talk to each other, and all users in the talk group are moved to the available channel for the conversation. Trunked systems can support many more users than conventional systems. These systems are also more complex and require more work to add radios. Not only do the handsets need to be programmed to operate on the system's frequencies, but data specific to the network on which the radio will be operated needs to be programmed into the radio. Permissions and talk groups must be set up to accommodate the additional handsets.

164. Many manufacturers have developed multi-mode handsets capable of operating on different types of public safety systems. In most cases, these handsets are capable of both digital and analog operations.<sup>209</sup> Many can also operate on both conventional and trunked

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<sup>209</sup> Some examples of radios that are capable of both analog and digital operation in some form, and are capable of both conventional and trunked operation, are the EF Johnson 51SL Series, 5100 Series, and 5300 Series radios. See, e.g., EF Johnson, "51SL Mid-Tier Portable Radio," available at <http://www.efjohnson.com/products/51SL.asp> (last visited Jan. 15, 2008); EF Johnson, "5100 Series Portable Radios," available at <http://www.efjohnson.com/products/5100.asp> (last visited Jan. 15, 2008); EF Johnson, "5300 Series Mobile Radio," available at <http://www.efjohnson.com/products/5300.asp> (last visited Jan. 15, 2008); Motorola, "XTL 2500," available at [http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/productdetailpage.aspx?navigationpath=id\\_803i/id\\_1387i/id\\_2354i/id\\_1645i](http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/productdetailpage.aspx?navigationpath=id_803i/id_1387i/id_2354i/id_1645i) (last visited Jan. 15, 2008); Motorola, "XTL 5000," available at [http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/productdetailpage.aspx?navigationpath=id\\_803i/id\\_1387i/id\\_2354i/id\\_1556i](http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/productdetailpage.aspx?navigationpath=id_803i/id_1387i/id_2354i/id_1556i) (last visited Jan. 15, 2008); Motorola, "XTS 2500," available at [http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/productdetailpage.aspx?navigationpath=id\\_803i/id\\_1388i/id\\_2354i/id\\_1673i](http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/productdetailpage.aspx?navigationpath=id_803i/id_1388i/id_2354i/id_1673i) (last visited Jan. 15, 2008); Motorola, "XTS 5000," available at [http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/productdetailpage.aspx?navigationpath=id\\_803i/id\\_1388i/id\\_2354i/id\\_1670i](http://www.motorola.com/governmentandenterprise/northamerica/en-us/public/functions/browseproduct/productdetailpage.aspx?navigationpath=id_803i/id_1388i/id_2354i/id_1670i) (last visited Jan. 15, 2008); M/A Com "P3300 Portable VHF UHF," available at <http://www.macom-wireless.com/products/p25/datasheets/ECR-7441D.pdf> P5100 and P7200 Portables, (last visited Jan. 15, 2008); M/A Com "P5100 Portable VHF," available at [http://www.macom-wireless.com/products/p25/P5100\\_VHF.asp](http://www.macom-wireless.com/products/p25/P5100_VHF.asp) (last visited Jan. 15, 2008); M/A Com "P5100 Portable UHF," available at [http://www.macom-wireless.com/products/p25/P5100\\_UHF.asp](http://www.macom-wireless.com/products/p25/P5100_UHF.asp) (last visited Jan. 15, 2008); M/A Com "P5100 Portable 800 MHz," available at [http://www.macom-wireless.com/products/p25/P5100\\_800MHz.asp](http://www.macom-wireless.com/products/p25/P5100_800MHz.asp) (last visited Jan. 15, 2008); M/A Com "P7200 Portables 700/800 MHz," available at <http://www.macom-wireless.com/products/opensky/P7200.asp> (last visited Jan. 15, 2008).



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systems.<sup>210</sup> Most public safety handsets are defined by software rather than hardware, which allows these handsets to be programmed quickly using computer based programming tools.<sup>211</sup> Some manufacturers even allow for over-the-air handset reprogramming. This allows the update of radio personality, features, and operating software over the air.<sup>212</sup>

165. Interconnect systems, such as gateways, can allow communication between radio systems that are otherwise incompatible because they operate on different frequency bands or using different technologies. A gateway can bridge one or more radios systems by receiving a signal on one connected system and translating it so it can be transmitted to any of the other connected systems. One primary advantage is that a gateway can be deployed without major changes to an existing radio system infrastructure. Since each system is communicating independently with the gateway, the transmission will occupy separate frequency channels on each system which can be inefficient.

166. Since 1989, emergency responder communities have been working together on the development of a digitally trunked radio system specification to support public safety needs. This effort, called Project 25 (P25), is a suite of standards that define standardized interfaces for an emergency responder LMR system. The objective is to maximize spectrum efficiency, ensure competition in life-cycle procurements, ensure interoperability, and provide “user-friendly” equipment and operation. The common air interface (CAI) standard has been defined and numerous handset manufacturers provide products compliant with the Project 25 CAI standards.<sup>213</sup> The intent of the standard is to afford agencies the flexibility of purchasing radios for a P25 system from any manufacturer with P25 compliant equipment.

167. The cost of public safety handsets tends to be significantly higher than the cost of its European public safety equivalent and standard commercially available equipment.<sup>214</sup> Some of this may be because emergency responder handsets need to be sturdier and more reliable than most commercial equipment. The equipment needs to be hardened to withstand severe conditions, such as a fire, and capable of maintaining reliable operations at very high speeds,

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<sup>210</sup> *Id.*

<sup>211</sup> EF Johnson radios can be programmed using its PCConfigure™ application. See EF Johnson, “PCConfigure™ Programming Software for Portable and Mobile Radios,” available at <http://www.efjohnson.com/products/pconfigure.asp> (last visited Jan. 15, 2008).

<sup>212</sup> Motorola indicates that over-the-air reprogramming is available. Motorola, meeting with FCC staff preparing 9/11 Act Report, (Oct. 2, 2007). M/A Com states that its P7200 Portable handset can be reprogrammed over the air. See “P7200 Portables -700 MHz/ 800 MHz,” available at <http://www.macom-wireless.com/products/opensky/datasheets/ECR-7303E.pdf> (last visited Jan. 7, 2008).

<sup>213</sup> The common air interface (“CAI”) is the interface between the handset and the base station.

<sup>214</sup> See Glenn Bischoff, “Interoperability might be a technology play after all,” *MRT - Newsletter Commentary*, Aug. 9, 2006, available at [http://mrtmag.com/commentary/newsletters/interoperability\\_rauter\\_apco\\_080906/index.html](http://mrtmag.com/commentary/newsletters/interoperability_rauter_apco_080906/index.html) (last visited Jan. 7, 2008) (“Of course, P25-compliant radios also are quite expensive -- as much as \$5000 per radio -- which puts them out of the financial reach of many agencies. [Mr. Steve] Rauter, [chief of the Lisle-Woodridge Fire Department in suburban Chicago], told his audience of a United Kingdom-based vendor that has produced a TETRA-compliant radio -- the European equivalent of P25 -- that costs only \$300. ‘What are we doing wrong?’ Rauter asked rhetorically. ‘Why do I have to spend \$5000 for a fully loaded P25 radio.’”).

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such as in a police chase. Vendors have also noted that part of the high cost results from the relatively small market base represented by first responders.

## **B. Satellite Communications Services**

### **1. Mobile-Satellite Service**

168. The Mobile-Satellite Service (MSS) licensed by the Commission is typically used for satellite telephone service and other portable and mobile voice and data services. Hand-held satellite telephones have the advantage that they do not require any local terrestrial infrastructure to function. Due to the requirement for line-of-sight propagation of the signals traveling between the satellites and the satellite handsets, they usually require outdoor antennas in order to work from inside a building. To overcome this problem, one MSS provider, Iridium, markets an indoor repeater that permits up to three of its handsets to be used indoors at any given time without wired connections.<sup>215</sup> Both Iridium and Globalstar offer fixed phones that can be mounted on the outside of a vehicle or building. These require a wired connection to the handset.

169. There are currently four companies providing MSS satellite telephone service to the United States. These companies are Globalstar, Inmarsat, Iridium, and Mobile Satellite Ventures (MSV). The Commission has authorized the following two additional companies to begin providing MSS service in the near future: TerreStar (authorized to operate two geostationary satellite orbit (GSO) satellites) and ICO (authorized to serve the United States through a single GSO satellite).

170. Special MSS terminals exist that can provide backhaul for picocell cellular base stations and low-to-medium-speed data networks. These terminals can be used to re-establish cellular telephone functionality as well as data transmission capability after a disaster that disables the terrestrial networks. For example, Inmarsat offers a service called BGAN, which stands for "Broadband Global Area Network." BGAN terminals are about the size of a notebook computer and provide IP connectivity at up to 492 kbps, streaming IP that can be used for real-time video transmission at up to 256 kbps, voice telephony capability, and text messaging capability. Inmarsat's BGAN service is currently the highest-speed MSS offering available in the United States. BGAN terminals could be used to provide picocell backhaul, Internet access, and secure VPN access with very little equipment setup required. Thus, they can be used to restore communications to the outside world following a disaster that disables or destroys the terrestrial infrastructure normally used to provide these types of communications.

### **2. Fixed-Satellite Service**

171. The Fixed-Satellite Service (FSS) licensed by the Commission is used for networks of Very-Small-Aperture Terminals (VSATs), television signal distribution, electronic news gathering, and similar applications. This service is intended for use by satellite terminals at fixed locations with directional antennas that are pointed at the satellite with which they are

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<sup>215</sup> See "Satellite Media Access Extender (SatMAX®)," available at [http://www.eaglebroadband.com/sate\\_comm.asp](http://www.eaglebroadband.com/sate_comm.asp) (last visited Jan. 8, 2008).

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intended to communicate.<sup>216</sup> The most common type of VSAT provides data communications capability including Internet Protocol (IP) and often legacy serial protocols. As such, VSATs can carry a variety of IP-based traffic, including VoIP and Internet traffic.<sup>217</sup> Due to the relatively small size of a VSAT antenna and the corresponding indoor electronics, they can be deployed in a short period of time. VSAT terminals are available in “fly-away” configurations that are packaged in a rugged shipping container for safe transportation. VSAT terminals are also becoming increasingly available on mobile platforms with motorized antenna mounts that can automatically move from a stowed position to point to the desired satellite.

### 3. Satellite Communications Cost and Availability

172. MSS operators have told Commission staff that satellite handsets are too costly for them to maintain a cache in the event of an emergency;<sup>218</sup> yet in the days immediately after Hurricane Katrina, MSS providers deployed over 20,000 satellite handsets to the Gulf Coast region.<sup>219</sup> Iridium’s handset manufacturer moved to a 24/7 production schedule to keep up with demand. The cost of satellite handsets and airtime and the limited utility of satellite handsets as compared to ordinary cell phones for in-vehicle and in-building use may deter many potential users from acquiring them to have available for use as back-up emergency communications assets.<sup>220</sup> The cost of FSS satellite access may deter users from leasing it to have it available in case of emergency as well, reducing their feasibility as back-up emergency communications capabilities.<sup>221</sup>

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<sup>216</sup> Amendment of Parts 2 and 25 of the Commission’s Rules to Allocate Spectrum and Adopt Service Rules and Procedures to Govern the Use of Vehicle-Mounted Earth Stations in Certain Frequency Bands Allocated to the Fixed-Satellite Service, *Notice of Proposed Rule Making*, IB Docket No. 07-101, 22 FCC Rcd 9649 (2007).

<sup>217</sup> Some VSATs offer integrated VoIP capability by providing an RJ-11 telephone jack on the indoor unit and appropriate interface, speech codec, and VoIP protocol capability. Others carry VoIP traffic and other IP traffic as data provided by and to other equipment.

<sup>218</sup> Mobile Satellite Ventures (MSV), meeting with FCC staff preparing 9/11 Act Report (Oct. 1, 2007); Iridium Satellite, LLC (Iridium) meeting with FCC staff preparing 9/11 Act Report (Oct. 22, 2007).

<sup>219</sup> *Public Safety Communications from 9/11 to Katrina: Critical Public Policy Lessons, Before the Subcomm. on Telecomm. and the Internet of the H. Comm. on Energy and Commerce*, 109<sup>th</sup> Cong. (2005) Written (statement of Tony Trujillo, Chairman, Satellite Industry Association), available at <http://republicans.energycommerce.house.gov/108/hearings/09292005Hearing1648/Trujillo.pdf> (last visited Jan. 8, 2008).

<sup>220</sup> Iridium meeting with FCC staff preparing 9/11 Act Report (Oct. 22, 2007). The Commission has taken steps to help stimulate potential economies of scale in terms of satellite handset and service costs by requiring that handsets capable of operating in the 700 MHz band also operate on certain satellite frequencies. See *700 MHz Second Report and Order*, 22 FCC Rcd at 15434 ¶ 405.

<sup>221</sup> In fact, FEMA reported having less than 3.1 MBPS of satellite capacity available to it as of November 6, 2007.

**VI. APPENDIX B – FEDERAL EMERGENCY COMMUNICATIONS RESOURCE  
INVENTORY (FOR OFFICIAL U.S. GOVERNMENT USE ONLY/NON-PUBLIC)**

**REDACTED**

**VII. APPENDIX C – PRIVATE EMERGENCY COMMUNICATIONS RESOURCE INVENTORY**

**Table 1 - Private Emergency Communications Resource Inventory**

LMR Handsets
Cell Tower on Light Truck (COLT)
Cell Tower on Wheels (COW)
Commercial Broadband Internet Protocol (IP)-enabled services
Commercial Mobile Radio Service (CMRS) (e.g., Code Division Multiple Access (CDMA) and Global System for Mobile Communications (GSM))
Line-of-Site (LOS) radio communications
Mobile Control Units (MCUs)
Mobile Switching Center (MSC)
Satellite Communications (e.g., satellite phones, Very Small Aperture Terminals (VSAT))
Site on Wheels (SOW)
Truck-mounted back-up generators
Wireless Fidelity (Wi-Fi) – (wireless local area networks (LANs) )employing an 802.11 standard developed by the Institute of Electrical and Electronics Engineers, Inc. (IEEE))
Worldwide Interoperability for Maximum Access (WiMAX) – wireless access technology that based upon the IEEE 802.16)