



White Paper on Emergency Communications

Prepared by the Space & Advanced Communications Research Institute
(SACRI)

George Washington University

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***Note:** This White Paper draws a number of sources including presentations at the National Conference on Emergency Communications (NCEC) held at the George Washington University on December 12-13, 2005. This conference featured some thirty different speakers selected from the federal as well as state and local governments, a wide range of industry spokespeople, several professional societies, relief organizations and NGOs, universities, and other interested parties. There were thirty different sponsors. These presentations, the attendees at this conference and the many sponsors of this event are included on the web page www.emergencycomconference.org The sponsors are also listed in the Appendices attached to this report. This White Paper also includes elements drawn from relevant web sites and many other documents prepared by concerned academic, standards and industry organizations who have offered information and recommendations about emergency communications as well as warning and recovery efforts in the wake of Hurricane Katrina, the Pakistan Earthquake and the Asian Tsunami. Although this White Paper has been extensively coordinated with many individuals including speakers at the NCEC and its sponsors the views expressed in this document are solely those of the team at George Washington University that prepared this report.*

Executive Summary and Major Findings

“ The hardest part of improving emergency warning and recovery efforts is changing human behavior. We must concentrate not only on upgrading communications and power systems locally but also on training first responders so that they are familiar with the use of these resources and comfortable on a day-to-day basis in how to use of this equipment. This is key because human and cultural behavior is extremely difficult to change and ultimately all disasters are local and recovery is largely dependent on local first responder capabilities.” **Garry Briese, Executive Director of the International Association of Fire Chiefs.....from keynote address at the NCEC on Dec. 13, 2005)**

“There are special opportunities presented by the increased availability of the 700 MHz band for emergency communications as well as the FCC mandated requirement to deploy by 2013 new radio telecommunications units with narrower band channels. Thus, if steps are taken now, we can ensure the widespread migration in the U.S. to new communications equipment that is interoperable, more multi-band, more power efficient, more easily rechargeable, water proof, and otherwise more flexible and adapted to the needs of modern emergency recovery operations. We need help from industry and governments at all levels to make this happen.” **Glen Nash, State of California and Former President of APCO...from Keynote address at NCEC on December 12, 2005**

“Emergencies are by definition a ‘come as you are’ party and this means that you need to pre-position recovery communications, satellite handsets and power restoration equipment at strategic locations BEFORE the event occurs. Other key steps involve the carrying out of training and simulation events, reserving satellite and other communications capacity and strategic planning for disaster strikes.” **Richard Dal Bello, V. P. Intelsat General....from remarks at NCEC on Dec. 13, 2005**

“Most emergency management training in this country targets first responder training but the State of Virginia EMTAS (Emergency Management Training, Analysis & Simulation Center) targets the operational level—the key level for decision-making, where the tactical response and strategic and political requirements come together” **Governor Mark Warner, State of Virginia...from HS Today Nov. 2005 Vol. 2. No. 11, p. 4.**

“If we learned anything from Hurricane Katrina, it is that we cannot rely solely on terrestrial communications”. **FCC Chairman Kevin Martin...citation is included from part of Satellite Industry Association testimony to U.S. Congress**

Introduction

The nation and the world has recently been beset by national disasters of a magnitude not seen in many decades, leading to a loss of hundreds of thousands of lives, destruction of literally millions of homes and buildings and the complete ruin of critical infrastructure. These tragic events increase our recognition that impaired or lost communications, coupled with a lack of real time access to critical information, can dramatically reduce our ability to recover from such disasters. The National Conference on Emergency Communications (NCEC) was organized to

seek urgent improvements to the U.S. emergency communications response systems, but its purpose was also to look forward rather than look back. As one of the organizer of the NCEC, Frank Prautzsch of Raytheon has said: “Nothing could be worse than to organize and re-equip our first responder forces for another Hurricane Katrina and then find that the next time we need communications systems to respond to the Avian Flu or a Weapons of Mass Destruction event.” After the 9/11 attacks in New York City, information was uncovered with regard to planned attacks by explosives of multiple hotels on the Las Vega Strip, the crashing of planes into the Los Angeles Airport, a derailment of the Atlantic Zephyr AmTrak train and a chlorine gas attack in one of several cities. We are not adequately prepared for any of these events today in terms of prevention, detection and/or recovery. Clearly we need to look ahead to systems that can flexibly respond to any future disaster or pandemic event.

It has been observed many times over the years that a small expenditure on emergency preparations, and especially in the area of information technology, communications and power systems--when made in advance--could do a great deal of good. Such investment could save lives, avoid panic, and help prevent massive loss of property and infrastructure at a later date. In planning for the future we must strive to go beyond the needs of past disasters and the capabilities of a “terrestrial radio push-to-talk mentality.” This means employing the best available technology and train response teams to use these new systems on an ongoing 24/7 basis. In short, equipment, tactics, techniques, and procedures for communications must be tested, maintained and operated, not just during crisis, but rather on a continual basis. Further these emergency communications networks need to be not only protected and secured against attack, but also “regularly stressed” by power failures, call surges and other simulated crises conditions.

This White Paper is the capstone to the National Conference on Emergency Communications (NCEC) held in Washington, D.C. on December 12-13, 2005. This document was developed under the auspices of the George Washington University Space and Advanced Communications Research Institute (SACRI) as based on the presentations at the conference and other research. It is thus not intended to represent the individual views of the sponsors or the participants in the NCEC.

The agenda set forth in this White Paper calls for the more effective training and simulation programs at the both the first responder and the operational and strategic levels. It also calls for the deployment of information and communications technology (ICT) that evolves toward a “balanced, modular, and scaleable architecture” that goes beyond the capabilities of often outmoded emergency communications systems with very limited capabilities that leaves first responders with modest capabilities and even less intelligence. Further there is also a need for changes in regulatory procedures, action on emergency spectrum as recently requested by the FCC, and adoption of interoperability and open gateway standards. It is key to work with professional associations (fire, police, EMT, telecommunications and power companies to develop and promulgate “best practice” guidelines that can be utilized in planning for and responding to disasters—natural and man-made. Finally there is a need for better strategic and coordinated planning and creation of more effective partnerships between different levels of government as well as among and between industry, government agencies, professional organizations, training centers and the academic community.

In many cases low cost and relatively easy to make improvements in process and equipment will result in significant payoffs. Other improvements, involving more sophisticated equipment and standards, may take longer and involve significant capital and operational expenditures, but these are still small in comparison to the longer-term savings that can occur in

terms of lives saved, suffering prevented and critical infrastructure, homes and buildings protected or losses mitigated.

The top five recommendations of this White Paper as developed from the notes taken by the conference organizers and distilled by the team that worked on the Conference at George Washington University are the following:

- **Recommendation No. 1: Priority attention must be given to enhanced training, simulation, modeling, and “broadband information access” programs as reinforced by a uniform national statement of “best practice” guidelines.** All of this training plus information access processes must operate on a day-to-day “train as you respond” basis and in conformance with integrated professionally agreed standards. These training programs must apply to the provision of emergency relief by first responders, operational personnel and relevant strategic planners and decision makers. Professional coordination of best practices among police, fire, EMT and telecommunications, power, infrastructure, and utility personnel plus strategic planners is key.

Recommendation No. 2: There is a need for a federally-led and integrated approach to coordination of emergency communications that ultimately becomes a fully accepted “National Doctrine” for recovery processes based on continually upgraded and improved communications capabilities. In order to be effective this initiative (as coordinated within DHS, NTIA, FCC, DOD and NSTAC) must work in tandem with the professional organizations of fire fighters, police and EMT organizations as well as national associations of U.S. cities, counties, tribes, states, mayors, governors, and other interested entities such as NGOs, etc. (To be most effective a clearer definition of the particular roles within the various U.S. agencies should be clarified by either a Presidential directive or Congressional action. In this process the implementation of Safecom must be accelerated to achieve more rapid implementation. Further, the NTIA ICE demonstration program for emergency communications should be strengthened through additional funding.)

- **Recommendation No. 3: There should be a concerted attack on the continuing unsolved problem of interoperability among first responders, operational personnel and military personnel as well as the issue of spectrum allocations to support emergency communication systems.** This effort must address the issues of spectrum allocation, acceleration of the planned conversion to 700 MHz and narrow-band radio channels, as well as effective switching between and among the legacy emergency communications systems. This effort must also address open and compatible air interfaces standards, open gateway and interoperability standards. Finally it must address the issues of compatibility of Voice over IP as well as “below-IP” network protocols, and incompatible software applications.
- **Recommendation No. 4: It is equally important to develop more effective emergency communications systems to the public.** Such systems need to be flexible, resilient and pervasive. Expanded provision of reliable and up-to-date information can be achieved via wireless systems, WLANS (i.e. Wi-Fi, and Wi-Max), satellite radio and direct broadcasting networks, Internet messages via PDAs and broadcasting wireless systems, conventional radio and television stations and fiber networks, etc. This expanded reach to the public and businesses is essential so that citizens can obtain news and instructions. This will be information that is different from that available to first line responders but still sufficient to avoid panic and allow informed action.

- **Recommendation No. 5: Continue to develop and implement balanced, modular, flexible and scaleable technologies as well as restorable power systems that can significantly improve emergency communications.** This development agenda would include the deployment of cost effective and reliable new 700 MHz, narrow band emergency radio communications systems, easy to deploy VSAT and micro-terminal based satellite communications systems, new ground-based wire and wireless capabilities, airborne relays/cells (on UAVs or HAPS), software defined radios, and hybrid (ground-air-satellite) solutions. This effort must allow a transition to working within universal IP protocol systems and rapid access to interoperability switches. Finally it must address the availability of restorable power systems for emergency communications.



**Experimental Light Weight Inflatable VSAT Used
By the American Red Cross During Hurricane Katrina**

WHITE PAPER ON EMERGENCY COMMUNICATIONS

The Executive Summary and this Full Report set forth a variety of actions--some which can be quickly enacted and others that may take many years to accomplish. The entire program of actions, however, is considered urgent. Indeed we urge local, state and federal government agencies, regulators and legislators to give priority to the five recommendations and 27 findings we set forth in this White Paper as well as considering the detailed discussion items that support these recommendations and findings.

The legend goes that a visitor gave a wealthy man a rare and beautiful tree. He asked his gardener to plant the seedling the following day. The gardener said: "Why hurry, it will take 50 years for this tree to grow to full potential?" The man then said: "Well in that case we had better plant it this afternoon." Improvements in the U.S. emergency communications systems and training will take time, but this is all the more reason to prioritize action in this area and act now, before another disaster occurs.

This White Paper actually proposes an action agenda for local and federal government agencies. It also calls for industry, standards-making organizations, non-governmental organizations (NGOs), academia, and other entities to facilitate making emergency communications more functional, more interoperable, more secure, and less vulnerable to shut

down or destruction during natural or man-made disasters or terrorist attacks. In order to work toward “interoperability”, of course, it is critical to take steps to ensure fundamental “operability” first.

Most importantly this paper attempts to set forth an action agenda to increase the durability, coverage, resilience, flexibility, and effectiveness of emergency communications and related ICT systems. It also calls for increased awareness and more effective training in the use of such equipment and communications systems—for both first responders and operational entities.

As a nation, we must address all the reasons noted by the National Task Force on Interoperability (NTFI) in its February 2003 Report, “Why Can’t We Talk?” The five reasons noted there for the current interoperability issues that was issued well before Hurricane Katrina are:

- Reason 1: Incompatible and Aging Communications Systems
- Reason 2: Limited and Fragmented Funding
- Reason 3: Limited and Fragmented Planning
- Reason 4: Lack of Coordination and Cooperation
- Reason 5: Limited and Fragmented Radio Spectrum

In particular, this White Paper notes the need to integrate these reforms and potential actions into a comprehensive discussion of national emergency communications issues and problems and to find better ways that the federal, state and local jurisdictions can work more effectively together. The current 17 pilot programs being undertaken through funding provided by the Department of Homeland Security under the ICE program is encouraging in that it requires better integration and coordination of local, county and state communications and information systems; these demonstration programs also include emphasis on the introduction of the 700 MHz radio emergency bands, key satellite service components, and sets the requirement for interoperability of communications and information systems among all first responders. This pilot demonstration program not only addresses what State Governors have identified as their most urgent needs for emergency communications and information systems, outside major urban areas, but also can increasingly serve as a practical national resource and laboratory for planning for the future.

It is our hope that the process started by the NCEC, and the many papers on this subject that will be placed on the Space Communications on-line journal as well as located on our web site at www.emergencycomconference.org will constitute an important database for moving forward. The key objective of this process is to recognize the need for a “systems approach” to emergency communications issues and concerns.

Important improvements are possible in the U.S. emergency communications and IT systems. Further, in many cases we believe that other countries around the world should consider parallel or complementary upgrades. These improvements could be accomplished through: (a) national legislation; (b) national technical, building, health or other standards; (c) regulations at the national, state or local level; (d) innovations in business practices and systems; (e) tax incentives; (f) implementation of telecommunications and IT hardware plus computer modeling, simulation or training software.

In coming months we will undertake to determine how the findings from this Conference can be coordinated with the NCS, the NSTAC and its NIPP and COOP efforts. The objective will be to finalize how and where these findings fit into and constructively augment the overall

national planning process. These findings will also be coordinated with state and local entities and standards making organizations to this same end. We hope that all of the findings set forth in the Executive Summary can be reviewed and considered for possible implementation as part of this process. The remainder of this report sets forth on a sector-by sector-basis more detailed elements that seem appropriate for consideration and possible improvement in the months ahead.

Major Findings

There were many points presented at the NCEC on which there appeared to be general agreement and these were summarized and recapped at the final closing session that included the Panel Chairs, speakers and many representatives of governmental industry or academic organizations. The following listing of “twenty seven major findings” attempts to reprise the results of the final discussion as well as highlight major points made by NCEC presenters that seemed to enjoy broad agreement.

Finding No. 1: No Silver Bullet. There is no one single “silver bullet” or magic solution that can provide a cure-all to emergency communications during natural or man-made disasters. There would be merit in developing complementary plans and action agendas that would work toward a wide range of improvements in national, state, and local emergency communications systems. To make this happen there needs to be increased cooperation and coordination between federal, state, tribal, local and military bodies as well as professional groups, private aid agencies, standards-making bodies, the academic community, the private sector and especially the relevant ICT and aerospace industries.

Finding No. 2: National Doctrine for Emergency Response. It is critical to have national and uniform training in the use of communications equipment as well as establishing a common language for communicating among police, fire and EMT personnel. There is, in essence, a need for a National Doctrine for training of first responders to address disasters that is consistent, easily understood and implemented by routine use and in a realistic context rather than only in an emergency circumstance. New equipment and infrastructure WITHOUT training will fail.

Finding No. 3: Training at Strategic and Planning Level. It is also important for training, simulation and strategic thinking to occur at the strategic and planning level as well as that of the first responder. The State of Virginia Emergency Management Training, Analysis, and Simulation Center (EMTASC) and the Pacific Disaster Center as well as web site resources and computer based simulation tools represent useful models that should be emulated and adopted on a broader scale basis wherever possible.

Finding No. 4: The National Security Telecommunications Advisory Committee (NSTAC) process would benefit from an independent assessment initiative. This independent review process would undertake a comprehensive review of all types of telecommunications systems at the U.S. national level in the context of upgrading emergency communications systems and processes. This review would desirably consider the resilience, flexibility, upgrade-ability, modularity and interoperability of:

- Fiber optic networks
- Satellites (fixed, mobile, broadcasting and military)
- Broadband wireless, WLANs, 802.11 & 802.16 systems
- Power Line communications (PLC) systems
- High altitude platform systems (HAPS) and Unattended Aerial Vehicles (UAVs),
- Voice over IP-capable systems

- Emergency communications systems in the 700 MHz, 800 MHz bands, and newly designated 4.9 GHz bands
- Functionality and strategic weaknesses of 911/E911 systems communications switching centers
- All relevant building code requirements
- Backup power and power restoration capabilities
- Relevant telecommunications and Internet regulations
- All relevant ICT and emergency communications standards.

This review would also address current and pending upgrades to “best practice” guidelines with regard to professional operating procedures for all first responders. It would also consider current and pending spectrum allocations for emergency communications and power systems, recommendations with regard to interoperability and open gateway standards, and current funding levels for communications upgrades, Safecom, the NCS and the NTIA emergency communications ICE demonstration projects, etc. This assessment would seek to determine particular vulnerabilities, strengths and weaknesses, and needs for training, emergency power, new standards, spectrum allocations, equipment and facilities. This process should be coordinated with the NTSAC review processes (i.e. the NGN NSEP Task Force) to avoid duplication and overlap.

Finding No. 5: Quickly Available and Pre-Installed Response Capability and Equipment.

Disasters are immediate and local. Thus, it is critical to pre-install or pre-position, at quickly accessible distribution centers, backup power generators and uninterrupted power supplies (UPSs), satellite telephones, batteries, water, food, fuel supplies in strategic and protected locations that are quickly accessible after a disaster strikes. Further, going forward, there needs to be planning for earthquake and flood-protected switching and communications centers. Likewise it is key to build police, fire, EMT, hospital and other facilities on the high ground with strict building codes, fire protection, backup power supplies, etc. These must be planned and executed before a disaster strikes. Such an investment pays off perhaps a hundred fold in a disaster.

Finding No. 6: Higher Priority for Emergency Communications.

Clear priorities must be set for critical communications facilities. Leadership is needed from organizations such as APCO, the International Association of Fire Chiefs, AMA, the American Red Cross, etc. to articulate user needs, endorse solutions, and set guidelines for the equipping of first responder sites. Backup power supplies, reliable, up-to-date and interoperable radiotelephones, satellite telephones, and other failsafe communications and redundancies are modest investments in comparison to squad cars, fire trucks and medical operating rooms. Yet, if communications and IT systems do not work during a disaster, then operations fall back to 19th century conditions. (Garry Briese, Exec. Director of the International Association of Fire Chiefs at the NCEC reported the results of a 2002 FEMA and NPFA International study entitled, *A Needs Assessment of the U.S.* This study reported that 57% of U.S. firehouses do not have back-up power. It further indicated that 45% of the fire service emergency responders, on shift at any particular time, lack radios--when looking inclusively at all department types and all population served. In short, these low cost capabilities need to be given much higher priority in the guidelines of national professional organizations representing first responders and owner/operator entities. Further and urgent funding sources need to be found for these critical needs that are modest in comparison to the costs associated with full-scale disaster recovery.

Finding No. 7: Need for RF Spectrum for Emergency Communications.

There is a need for effective access to radio frequency spectrum to support critical disaster recovery. Modern, reliable and interoperable communications are needed to facilitate the coordination of first

responders, utility and telecommunications repair and service people, the National Guard and other key disaster response officials. Improvement efforts might concentrate on narrow band radios (with 6.25 kHz or 12.5 kHz channels vs. today's 25 kHz channels), timely availability of the 700 MHz emergency communications spectrum, low bit rate mobile satellite voice channels in the VHF and UHF bands, use of X-Band satellite systems to support National Guard recovery operations (or embedding National Guard communications units within civilian recovery teams). These are some of the more promising options discussed at the NCEC that can help improve emergency communications services.

Finding No. 8: Need for National Credential System to Aid in Recovery. During a disaster different people from many different sectors (electrical power, natural gas, fire, police, medical, utilities, etc.) as well as from different governmental units, must be available to respond effectively. This means they must have the right access, coordinate their work and communicate. Steps that that might be taken in this respect include:

- (a) Issuance—at the national level—of recognized and federally authenticated picture and badge credentials that allow needed access to impacted areas so that communications technicians, utility and infrastructure repair, etc. can restore critical services. This would allow many different government agencies (local, tribal, county, state, federal, national guard and authorized restoration crews) to respond immediately without receiving local or state credentials;
- (b) Train and “credential” experienced amateur radio operators and radio and television station personnel (at the federal and local levels) in certain key functions, codes and operations so they can more effectively assist with and coordinate disaster recovery operations when other communications resource is not available.

Finding No. 9: Communications and Information Systems Are Needed To Inform The Public. It is crucial to allow first responders and decision-makers to be interconnected to each other AND THE PUBLIC. Many emerging systems and capabilities such as WLANs (i.e. Wi-Fi, Wi-Max), CDMA 2000 ©, Internet and telephone broadcasting, Voice over IP (VoIP), satellite radio systems, mobile device (i.e. PDA) broadcasting, the Public Broadcasting System satellite network, direct broadcast television-sub-carrier systems, cable television network sub-carriers, are potentially available to assist with such information sharing and public alerting. Redundancy of public access information systems is desirable so that even if several systems fail others get through. A set of national “best practice” guidelines that go beyond the national public alert radio system and public television system should be prepared concerning how to broadcast messages to the public in impacted areas. (See Finding No. 7 above). Further, U.S. federal and state officials and professional organizations should explore new satellite receiver technology that allows individual messages to be sent to a particular location with specific information. Other technologies to be reviewed by government recovery agencies are emerging geographic-specific alerting capabilities in addition to the current NOAA capabilities that now exist.

Finding No. 10: Enhanced Ability to Call First Responders. The introduction of Enhanced 911 calling centers and their expanded capabilities represent significant progress. There must be particular vigilance as new information and communications systems are introduced to ensure that these systems work effectively and reliably to meet emergency communications needs. This would include the setting and enforcement of standards so that cell phone systems work with the same 911 code as conventional telephone systems and that they provide clear location information. It also means that GIS locations provide for the Z-axis location for high rises, VoIP systems include functional E911 capabilities, power and performance standards are enforced for Wi-Fi © (802.11 systems) and Wi-Max (802.16) and these concerns are included in the new 802.21 or other applicable standards.

Finding No. 11: Models of Effective Regional Interoperability Should Be Identified and Followed. These models must show how to achieve effective interregional cooperation among first responders, implement effective control centers, provide backup power, exhibit dispatch efficiency, etc. These models should be identified and emulated through “best practice” guidelines and distributed through the Web pages, information channels of federal agencies (DHS, NTIA, FCC), and professional organizations such as APCO, etc. In particular initiatives such as CAP-WIN and demonstration projects under the DHS ICE program, etc. can serve as useful and future-looking models. From the reverse perspective, systems where two or more independent and separate communications units, one operating on a civil and another co-located unit is operating in a military band (such as on a Coast Guard boat)--these should be phased out as soon as possible and replaced by truly interoperable systems.

Finding No. 12: Implement Improved Standards for Interoperability and Open Gateway Architecture. Such new standards allow more systems to operate with one another and eliminate the need to continually buy “black boxes” and rely on proprietary equipment. This objective should be pursued with a new sense of urgency within standards organizations such as the ISO, IEC, and TIA.

Finding No. 13: DHS Should Upgrade Specific “Best Practice” Guidelines and Standards for Emergency Recovery. The efforts of the ANSI-HSSP to identify over 6,500 homeland security standards (for communications, information, and other issues) that could be used in planning responses to disaster events should be continued, further upgraded, and updated with a focused listing of the most critical standards. These standards as well as “best practice” guidelines should be applied in crises and disaster events that draw on, not only the current ANSI-HSSP and TIA, but also the IEEE, the ISO, the IEC, and military communications standards. DHS must consolidate and reduce such information to usable information kits and web site instructions.

Finding No. 14: Need for Specific Guidelines and ICT Tools for Implementing Evacuation and Transportation Controls During Emergencies.

The Department of Home Security in cooperation with APCO and other relevant professional agencies should be tasked with the development of new training and planning tools that will aid in the development of more effective options for evacuation, lane-direction changes, or broadcasting/multi-casting of emergency communications instructions to targeted populations. These should be in place before local, regional or national disasters occur. (These activities could include computer modeling, simulations, gaming and other such capabilities to determine more effective emergency processes to be implemented. Training tools that can be broadly distributed via the Internet, CDs or satellite-based tele-educational networks would be highly desired in this process.)

Finding No. 16: Remotely Addressable Communications Systems.

There appears to be merit in exploring the possibility of more extensive use of SCADA (Supervisory Control and Data Acquisition) technology or individually addressable satellite antenna nodes to facilitate evacuations, early detection of the breakdown or attack on critical infrastructure such as pipelines, nuclear power plants, bridges, etc.

Finding No. 17: Use of UAVs and HAPs for Rapid Restoration of Communications and Assessing Area-Wide Damage. Systems such as Global Hawk, Rover III, aerostat and powered airships that are being developed in the U.S. and abroad can provide very rapid restoration capability. For these systems to be available they will likely need to be owned and operated by

the infrastructure owners and/or U.S. government entities for both homeland defense and disaster recovery. Additionally, new processes should be developed so that air traffic control problems can be addressed and resolved.

Finding No. 18: There Is a Need for “Agreed” Best Practice Guidelines Improved “best practice” recommendations should be developed by the Federal Government, endorsed by advisory bodies (*i.e.* NSTAC and NIAC) and by such standards-making entities such as the TIA with regard to resilient terrestrial, wireless and satellite systems. These recommendations and standards should cover communications switching systems, cable television head-end systems, central offices, major earth station installations, handsets, etc. Facilities should be designed or upgraded to insure that they are built to be fire resistant, to withstand earthquakes, have batteries, generators and possibly solar power systems to provide back-up power, not be in flood plains and be well above sea level, etc. Telecommunications systems in normal circumstances operate with system availability rates that exceed the ISDN standards of 99.98% and in many cases reach 99.9999%. This performance, however, is based on normal conditions rather than the challenges presented by disasters, including congested systems and damaged infrastructure. The revised recommendations need to include normal and disaster conditions.

Finding No. 19: Innovative New Business, Insurance and Risk Management Systems. New approaches to the provisioning of telecommunications and information systems equipment that are resistant to disaster conditions need to be explored as well as new approaches to “insurance” or “incentives” to upgrade infrastructure protection. These possible approaches might: (a) allow for long term “low interest rate” amortization for the purchase of radios, radio handsets, satellite phones, VSAT terminals, switching center equipment, back-up power systems purchases (This might be based on models such as that of Fannie Mae and Freddie Mac as now used to promote lower cost home buying); (b) new types of insurance funds that are a hybrid between governmental and commercial entities that provide tiers of protection with “normal” insurance covering “normal” events, but a “super fund” that could be used for extraordinary disasters; (c) new types of hybrid insurance and disaster mitigation investment funds that would give lower insurance rates for various types of coverage for local “public facilities” such as fire stations, police stations, and hospitals if the local jurisdiction invested in back-up power, built fire-resistant and earthquake resistant structures, and otherwise provided up-to date restoration capabilities;(d) a new business arrangement in the satellite and UAV industry so that businesses, hospitals and others could on a national basis pay a small monthly premium to guarantee that emergency satellite or UAV capacity could be made immediately available in case of a disaster anywhere in the country.

Finding No. 20: Consider Concepts from International Organizations. There may well be merit in several plans and proposals that are currently being considered by the International Telecommunication Union (ITU), the International Red Cross, the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), the United Nations organization and the IEEE. Of particular relevance, as far as communications and information services are concerned, is the concept of adding a new four digit country code that would be used by first responders and disaster officials to undertake disaster relief operations and this service would be freely available to all credentialed relief workers. The new ISO-IEC open standard for interoperability and gateways would also present opportunity for enhanced interconnection by first responders. There should be consistent or coordinated international standards for urban locator devices, for first responders’ radio frequencies, and for over-ride priority systems for first responders using cellular telephone systems or conventional telephone systems, etc. (Note: cellular operators and industry should work with DHS towards new capability standards and

implementation of such priority overrides in routing of first responder calls beyond international standards discussions.)



National Guard troops and Defense Information Systems Agency (DISA) provided Key Support to Relief Efforts in New Orleans in the Aftermath of Hurricane Katrina

Finding No. 21: Utilization of Net-Centric Communications Systems in Times of Disasters. Such systems can effectively supplement conventional civil emergency communications systems. There is a need for additional planning, engineering and standards-related efforts to allow for rapid use of these resources on an “open and transparent” basis during times of national crisis and disaster recovery. In this respect the Defense Information Systems Agency (DISA) plus research support units such as CERDEC (Communications and Electronics Research, Development and Engineering Center) of the U.S. Army and other similar entities could be assigned the task of developing and implementing rapid and effective interoperability between civil and military communications and information systems during a time of disaster recovery. In this respect plans for temporary interconnection and civil support should be developed so that they can be implemented at the local, county, state and national level. X-band satellite systems will soon provide complete U.S. continental coverage.

Finding No. 22: Deployable Resources and Personnel Involving Use of Military Systems. Such a program would involve the deployment of mobile truck-mounted units and associated trained staff. It also requires the implementation of key interoperability and gateway standards so that interconnection is possible between civil and military systems and between new and legacy systems.



Truck-mounted interoperability switching capability

Finding No. 23: Expanded use of software defined radio to support emergency communications. Software defined radio (SDR) has an important and growing role in public safety communications, as evidenced by the on-going work of the Public Safety Special Interest Group (SIG) of the SDR Forum. The advantages of SDR are numerous, not the least of which is its intended use by military (JTRS), commercial, and public safety organizations, thereby facilitating interoperability for emergency communications across a wide user community. The Public Safety SIG within the SDR Forum comprises users, software developers, and public safety vendors. The focus of the SIG is on development of multi-band, multi-service, interoperable, and cost effective radio systems. Technical challenges include the provision of several bands including VHF and UHF in one radio, antennas, weight constraints, and power requirements.

Finding No. 24: Potential of broadband wireless access to support emergency communications. Broadband wireless is a rapidly growing business and technology area that offers many potential advantages for emergency communications and such applications need to be pursued at the federal, state and local levels. Already, numerous local public safety organizations are using IEEE 802.11 for high-speed connectivity, to augment low-speed connectivity based on P25 or on various commercial services (e.g., CDPD, iDEN, and other 2d generation cellular networks). New York City is one of the first large communities to implement a broadband wireless network for public safety. The introduction of IEEE 802.16e and IEEE 802.20 will allow greater data rates and enhanced coverage, in addition to allowing mobility to the user. Although wireless LAN and MAN standards from the IEEE are meant mostly for the unlicensed bands, there is potential use in public safety licensed bands where bandwidths are sufficiently large, such as in the 700 MHz band (i.e. 24 MHz from TV channels 63, 64, 68, and 69) and the 4.9 GHz band (i.e. 50 MHz from 4.94 to 4.99 GHz). At 700 MHz, the FCC channel plan has led to a new wideband data standard, TIA-902, yet to be deployed. Interference from existing TV transmitters may limit the use of these channels in the near term. At 4.9 GHz, the power constraints of unlicensed spectrum are avoided, thereby allowing greater distances and better building penetration. Of course, the introduction of 3G commercial cellular and PCS services also provides broadband data, another option for emergency communications. Issues of priority access, security, push-to-talk, and other public safety features remain to be completely solved with commercial 3G services.

Finding No. 25: Professional and Standards Organizations Should Address Site Selection and Building Standards. Professional organizations such as APCO, standards organizations, as well as local, state and federal governments should address improved building standards and site location processes that apply particularly to sites for hospitals, police and fire stations, emergency control centers, telecommunications switching centers and earth station sites, radio and television stations, power substations, and towers for cellular/PCS/private dispatch services.

Finding No. 26: Emergency Communications System Planning Should Go Beyond Police and Fire. Most efforts related to upgrading national emergency communications have focused on the police and fire-fighting capabilities. There is a need to also develop new national satellite/fiber based communications and ICT systems (i.e. SAFECOM and NCS) to provide immediate interoperability and open gateway standards for use among all the country's military facilities, hospitals, EMT systems, doctors, nurses and medical workers to allow more urgent

communications during a pandemic and to allow more effective spotting of trends and medical incidents in the case of a bio-terrorist attack. Also attention should be paid to emergency communications to utilities and public infrastructure.

Finding No. 27: Examine the Best Ideas From Overseas. It seems prudent to consider the emergency networking systems implemented in other countries, such as Japan, the Philippines, the United Kingdom, which has been subjected to \ disasters or terrorist attacks. This might include the idea of national emergency communications satellite systems that provides universal VSAT connection to all local police, fire and post offices such as has been implemented in Japan. Such a system, to be effective, would need to be used to provide training and other communications on a day-to-day basis but would also be available in the event of natural or man-made disasters or terrorist attacks.

The above twenty-seven findings represent the more important points that have been developed from our review of emergency communications systems in the United States and especially from the presentations and discussions held at the NCEC. Although most of the above findings derived directly from presentations made and discussions held at the NCEC, others came from other sources or from suggestions made by attendees at the Conference. Further, there are a number of White Papers that originated from the aftermath of Hurricane Katrina, other natural disasters and from a review of homeland security related issues. We have also listed in Appendix 2 to this report some of the studies and web sites that we feel represent useful sources of information and additional recommendations that should be considered in on-going efforts to upgrade American preparedness for the next natural or man-made disaster.

Clearly we are not going to achieve improved emergency communications within the United States overnight—perhaps not even in a decade. We will not get to an improved system, however, unless we have a clear and detailed plan based not only on needs, but also from an awareness of the problems to be overcome and issues to be addressed. The following detailed elements, as outlined below, support the recommendations in the Executive Summary and the above listed findings. Collectively the five recommendations plus the 25 findings and the supporting material below indicate ways to improve the U.S. emergency communications systems. These are important components that must be considered in developing a comprehensive and overall plan. These elements when combined with the work of the many agencies (federal, state, local, professional, NGOs, standards making group, industry, etc. could eventually help to devise what might be called a “National Doctrine” for emergency communications. At the national level the NSTAC process is already coordinating and addressing many of these elements in some depth in cooperation with industry as well as in concert with the F.C.C., the Department of Homeland Security (particularly Safecom and NCS), the Department of Defense, the National Telecommunications and Information Administration, and other federal agencies. At the State and Local levels, however, efforts are today less coordinated, except in a few notable exceptions such as the CAP-WIN system that exists in the national capital region and a few other areas where many different jurisdictions come together.

We recommend that efforts to improve capabilities and information and communications systems, coordinate human and equipment resources, enhance training, upgrade standards, improve regulations, provide wider distribution of “best practices” and plan for the future be undertaken in the following areas.

- ❑ Training of first responders and simulation exercises as well as improved strategic planning at the operational level.
- ❑ Power availability and reliability
- ❑ Fiber optic networking design, installation and operation
- ❑ Satellite communications networks and user terminals
- ❑ Broadband wireless systems
- ❑ Broadcasting systems (radio, television, and IT systems)
- ❑ Special issues related to VoIP systems, universal 911 capabilities, Global Information System (GIS) location capabilities, a urban locator systems
- ❑ New telecommunications systems (power line communications (PLC), UAVs, HAPS)
- ❑ Upgraded and better protected switching and networking centers
- ❑ Interoperability and gateway standards (and future-proofing of black boxes)
- ❑ Emergency interconnection of military, National Guard and civil emergency response communications and information systems.
- ❑ Override and priority access for first responders.
- ❑ Enhanced building codes and regulations (particularly with regard to power & communications systems)
- ❑ New business operations, insurance concepts, and contingency planning
- ❑ Access to relevant information and updating of planning processes and manuals
- ❑ Changes in public policy and regulation at the local, state, federal and international level and achieving a better overall planning, funding and implementation program related to communications and IT to support and survive natural disasters, terrorist attacks and pandemic conditions.

In short, it is particularly desired that this White Paper will be widely read and considered by both decision makers, legislators, technical standards bodies, government officials at all levels, and first responders. We hope that this White Paper will serve to highlight our perception that communications and information systems that support emergency response will continue to be upgraded, improved and made more resilient through new technology, better training, improved standards and/or altered public policy. In particular, it is hoped that there will be a deeper recognition of the existing problem of “stovepipe” systems that do not completely and full interconnect with one another, as well as the need for “systems level” planning to find an integrated solution to improve emergency communications systems and their supporting infrastructure such as power systems.

We believe that the detailed elements noted below provide additional substance to the more specific actions needed in developing a comprehensive and overall policy in this area. At the national level, the NSTAC is addressing many of these matters in cooperation with industry and the F.C.C., the Department of Homeland Security, the Department of Defense, the National Telecommunications and Information Administration, and other federal agencies. At the State and Local levels, efforts are today less well coordinated, other than some notable exceptions such as the CAP-WIN system now in place in the national capital region and a few other locations where jurisdictions overlap and solutions to interconnectivity found.

White Paper Distribution and Efforts to See Recommendations Implemented

Quite simply, improvements are possible in U.S. emergency communications. In many instances, parallel or complementary upgrades should also be made in international systems as well. These national improvements can be accomplished through: (a) national legislation; (b)

upgrades of technical, building, health or other standards; (c) improved regulations at the national, state or local level; (d) innovations in business practices and systems; (e) tax incentives; (f) implementation of telecommunications and IT hardware and computer modeling, simulation or training software. The key elements identified in the National Conference on Emergency Communications and the various presentations can be found at the following Web site address www.emergencycommunications.org

In coming months, the findings from this Conference will be coordinated with the NCS, NSTAC, NIPP and COOP efforts to see how and where these findings fit into and may constructively augment the overall national planning process. They will also be coordinated with state and local entities and standards making organizations. We hope that each of the findings set forth in the Executive Summary and in this report will be reviewed and considered for possible implementation. The remainder of this report sets forth on a specific sector basis elements that are deemed appropriate for consideration and possible improvement in the months ahead.

Key Sectors Requiring Improvement

A. Training of first responders and Operational Entities

One of the consistent themes heard during the National Conference on Emergency Communications was the need for training. This missing element arises time and time again in almost all studies that have been undertaken on how to improve emergency communication systems. Training is needed for first responders, for operational personnel and for strategic planners. Training is also required with regard to process and consistency of language. There is an associated need for interoperability, interconnection and credentials for all types of first responders (police, fire, EMT, utility repair and installation, dispatchers) on an on-going basis so that the same codes and instructions mean the same thing to all responding entities. There are numerous ideas for using simulation and modeling including exercises that can be distributed via electronic means. One of the keys is to make sure that emergency communication systems are available on a routine basis and that first responders and operational personnel are comfortable with the use of the equipment and have used it many times before an actual disaster strikes. Training needs to be provided beforehand with regard specialized equipment. This includes: satellite telephones, VSATs, high altitude platforms or UAVs, solar power generators, Uninterrupted Power Supply (UPS), and special mobile switching centers for interconnectivity. Alternatively, trained support people, who are skilled in the set up and operation of this equipment, must be available on the scene on a very rapid deployment basis. On the job training is simply not practical during a disaster where lives count on professional and rapid capability of first responders. Good models from such sources as the CAP-WIN project in the Washington, D. C. area and the Pacific Disaster Center www.pdc.org should be identified and emulated.

B. Power availability and reliability

Another consistent message from the NCEC, based largely on the Katrina analysis, was that when power runs out, communications stops. A single important step toward preventing the types of communication failures that occurred during Hurricanes Katrina and Rita is the availability of generators and supporting fuel or solar power generators at such critical locations as police and fire station facilities, hospitals, and EMT dispatcher stations, Vats, and other communication switching centers. The batteries of cell and satellite phones can only hold a charge for a few hours. After that, it is important that all first responder vehicles be equipped with cell and satellite phone re-chargers so they can maintain connectivity. In limited power supply conditions, where all power is being supplied from emergency gasoline or solar power generators

or back up batteries, there is a need to prioritize power allocations with the first priority being given to ICT systems, limited lighting and life support systems. Training exercises should simulate the absence of normal electrical power and tests should be run to ensure that priorities are enforced with regard to the allocation of limited power supply and to ensure that fuel storage to support power generators is adequate to sustain operation until re-supply can be instituted.

C. Fiber optic networking design, installation and operation

When AT&T and GTE had a virtual monopoly on the supply of long distance telecommunications services in the United States, the U.S. military could make arrangements for the “hardening” and security protection of many critical “trunking” and backbone links in the United States. Today, in the age of telecommunications competition, a much greater degree of redundancy of backbone facilities are now in place. In many communities parallel fiber systems are deployed by cable television (with two-way repeaters) and by telecommunications carriers. Thus, on the one hand much greater diversity has been added, while on the other “hardening” or secure routing of fiber systems is now replaced by the lowest cost and most “efficient” deployment patterns. Resiliency is also being enhanced by the transition to IP. Consideration should be given by the DHS-HSSP to encourage diversity of routing in the deployment of backbone fiber networks.

There should be independent reviews of fiber and terrestrial coax cable deployment for backbone networks between major cities as well as of terrestrial networks within towns and cities to see if there are particular hazards in the deployment plans in terms of flood plains, lack of diversity in terms of not deploying restorable cable ring architecture, etc. Every city that has a security operations center should be provided a “best practices” guideline for conducting such a telecommunications network review. In rural areas (especially in hurricane coastal areas and earthquake prone areas) where limited resources exist, alternative routing and protection of terrestrial networks is the most difficult. In these areas wideband wireless systems, satellite systems, or hybrid satellite and Wi-Max networks--as an alternative source of communications to terrestrial systems--may constitute the most secure way of providing emergency communications.

D. Satellite communications networks and user terminals

After Hurricane Katrina, the Chairman of the FCC noted that the U.S. couldn't rely exclusively on terrestrial networks for emergency and disaster communications. Fiber and coaxial cables can flood or be snapped by earthquakes. Terrestrial wireless towers, especially those mounted on buildings can come down during earthquakes or terrorists attacks. This was the case with the wireless systems on top of the World Trade Centers. Mobile communications satellites, that operate directly with handheld units (Iridium, Globalstar, Inmarsat, and Mobile Satellite Ventures, for instance) or direct broadcast and fixed satellite systems that point to a very large number of terrestrial locations can avoid the impact of disasters that occur at the earth's surface if the small user terminal or VSATS and their power supply are not damaged. Battery powered hand-held mobile satellite units are thus particularly resilient to disaster damage.



Satellite Micro-terminals That Can Support Disaster Recovery Continue to Shrink in Size

Japan, in the wake of the Kobe earthquake, installed a complete national VSAT network that covers each post office on all of its islands to support routine as well as emergency communication. In earthquake, hurricane and other disaster situations, satellite communications have often represented lifeline communications. The Tampere Convention was put into place to accelerate the import of VSATs and handheld transceivers to be used in cases of major disasters.

The idea of a national federal communications network that can be used for routine communications but also serve as an emergency lifeline service to all parts of the United States is a concept worthy of implementation. Such a system can be structured in a way that the wideband satellite capacity and terminals at federal locations are paid for by the U.S. government, but police, fire stations, hospitals, and other public users are plugged into the network when local or state governments have paid for the local equipment and its maintenance. This network would serve a variety of training purposes for government employees when the network was not being used for emergency conditions. An override capability would give communications and information access priority to areas that are declared national disaster areas.

Commercial satellite operators have generously made capacity as well as VSATs and hand-held units available in disaster areas, as was seen in the case of Hurricanes Katrina and Rita. Intelsat, SES-Americom, PanAmSat, and Loral Skynet each supported the restoration of communications services via satellite. In the mobile satellite Iridium, Globalstar, Mobile Satellite Ventures, and Inmarsat among others provided sector support. This ad hoc approach is really not sufficient, however. When human lives and the preservation of vital infrastructure are at stake, it is not appropriate to rely just on charity and spontaneous contributions by satellite operators and/or earth station and handset suppliers to make satellite system capabilities available.

A fully deployed and operational federal communications system would extend the current National Communication System. First responders, military personnel and federal government workers would gain day-to-day experience and familiarity with the networks that will be needed in emergency situations. Whether this extended emergency service would be provided on a military frequency band such as X-band, or the UHF or VHF mobile satellite bands, or one of the commercial satellite bands would have to be worked out. A dedicated emergency communication system would have the advantage that it would be designed on the basis of new IP standards and with the use of the new open interoperable applications and gateway standards (i.e. ISO-IEC 18012 and 15045) in place. If a multi-channel approach were taken, restoration of service using national military and civil satellite services could access a variety of spectrum bands.

Further R&D is needed on more flexible satellite ground systems and their rapid deployment. The experimental inflatable earth stations used by the Red Cross and other relief agencies is one good example of how better technology might be developed to respond to emergency communication needs.

E. Broadband wireless systems

Another crucial step in insuring national emergency service and communications interoperability during national disasters is in the design and engineering of broadband wireless

systems to provide redundancy and resilience so that access and connectivity can be maintained in emergency conditions—at least to a much higher degree that is currently the case. Key steps in this regard would include: (a) design and engineering of mobile telecommunications switching offices (MTSOs) and cellular telephone towers to much higher standards for survivability, access to emergency power generators and UPS to restore service, (b) cellular antenna coverage, designed for redundancy in urban areas, so that if one or more tower should fail, that service can still be maintained, even if at a lower grade of service; (c) priority override for first responders to be able to use commercial cell phones to support disaster operations. In the past cellular operators have provided “priority service” to all customers without a national guideline or standard for override capability being in effect. One of the purposes of the national “credentials” process would be to assign priority status to emergency first responders and disaster oversight administrators.

F. Broadcasting systems (radio, television, and IT systems)

Even if the issues associated with providing communications services to first responders and disaster oversight administrators can be solved, there remains the issue of providing communications and instructions to the general public. People need to know exactly how to prepare for disaster conditions and when and where to evacuate. The existing emergency broadcasting system over radio and television represents a first-line capability for providing to provide up-to-date information to the general populace. It is critical that emergency power generators and UPS systems are in place at all radio and television stations across the U.S. and that there are people at each station trained to respond and to relay emergency codes and instructions. Secure lines of communication should be established to such state and federal disaster coordination centers as the Department of Homeland Security (FEMA/NCS/Coast Guard), State Highway Patrol, Disaster Coordination Offices and local hospitals.

XM-Radio, Sirius, and Worldspace are new types of satellite based radio systems that can send out warnings, recovery and evacuation notices. Omni-sat, among others, is developing ultra-low cost receivers that are individually addressable. This could insure that individuals near “emergency address” terminals could know exactly what to do and where to go, including being provided with evacuation routes down to a block-by-block basis. These same individually addressable receivers can be used to change light signals or lane-control signals on streets and bypasses. Although low in cost and highly efficient, these individually addressable receivers are not widely available. With sufficient demand, this capability could be inexpensively added to satellite radiotelephones, even conventional car radio systems and home radio sets.

The widespread availability of individually addressable satellite transceivers that could broadcast tailored evacuation and recovery messages would require some form of national guideline or emergency recovery best practice, which could originate with NSTAC or DHS-HSSP or a Congressionally adopted mandate or guideline or Executive Order.)

Internet connections, Wi Fi, Wi-Max and emergency broadcast messaging via telephone represent new technical capabilities that can also send messages via 802.11 and 802.16 systems via wireless enabled laptops, Blue Tooth, Blackberry and other wireless enabled personal data assistants. Again, these are cases where millions of dollars spent prior to a disaster might save many lives or save a huge amount in terms of preservation of infrastructure, commercial property and housing.

G. Special issues related to universal 911 capabilities, Global Information System (GIS) location capabilities, VoIP systems, and urban locator systems

Today's technologies can provide new service capability, lower service rates and innovative information and communication combinations. In some cases, new technologies can also introduce discontinuities in communications systems or disruptions in emergency communications systems such as 911 services. It is important for these problems to be identified and solved. Some of these gaps can be resolved by mandatory regulations from the FCC or even new laws. There has been good progress in requiring that all terrestrial telecommunications networks and all cellular telephone systems implement a universal 911 number for calling for emergency assistance and progress is being made to ensure that 911 calls on cellular systems provide reasonably precise GIS locations for 911 calls. Progress is also being made providing 3-dimensional location information to first responders, so they can locate 911 calls originating from high rises. Meanwhile, the FCC, NTIA and DHS-HSSP should continue to monitor 911 calling and dispatch services to improve connection and location abilities. Finally as space navigation systems are upgraded with the addition of improved tracking capabilities added to GPS, Galileo and the Glonass systems, then emergency personnel should be equipped with receivers to use this capability.

Another matter arising from emerging ICT technology is that of Voice Over IP (VoIP) service. Internet telephony has proven to be very cost efficient and is being broadly implemented in businesses and many private homes along with wireless Local Area Network services. These VoIP and Wireless LANs, however, have several problems when it comes to emergency services. Unlike conventional telephone systems, there is no emergency power supply for VoIP. Also, VoIP is not able to provide 911/E911 dispatchers with GIS coordinates of callers, and Wireless LANs have similar problems. The FCC, NTIA, DHS-HSSP, NSTAC and others must urgently address these 911/E911, power loss, and other problems related to VoIP and wireless LAN systems and come up with solutions as quickly as possible.

Further, it should be noted that urban locators that detect the emissions from cell phones for people trapped in buildings after a natural disaster or terrorist attack have capabilities that should be upgraded. Users have no clear-cut and consistent national instructions as to how to most effectively signal their location (i.e. conserving energy in their batteries by turning their phone on or off at intervals to alert rescuers, if they are not able to complete a connection.) These issues need to be addressed by a task force set up within the U.S. government with participation from APCO, TIA, DHS-HSSP and State and Local entities.

H. Emerging wireless systems: Unattended Aerial Vehicles (UAVs)/ High Altitude Platform Systems (HAPS)/Aerostats

The big three options in telecommunications are terrestrial wire systems (copper wire, coax and fiber optic cable), terrestrial wireless systems and satellite communication systems. In the last few years, a new set of options have been added in the form of high altitude platforms and unattended autonomous vehicles that operate as mobile telecom providers, mostly operating from medium altitudes up to 65,000 feet above earth. The origin of the HAPs, UAVs and aerostat vehicles was principally with the military systems but some of these systems are being spun off as commercial operations, both in the U.S. and overseas.

The FAA blocked the deployment of lower altitude UAVs (such as the Rover III that might have assisted with the recovery from Katrina) due to concerns about air safety. The issue of how such aerostats, powered lighter than aircraft, UAVs and HAPS systems might be used to supplement communications and air surveillance during emergencies should be examined and resolved by the Department of Homeland Security and the FAA. It would appear that "near

space” platforms might be safely deployed at altitudes in the 60,000 to 65,000 feet range, but lower altitude systems would also be highly useful.

I. Upgraded and better protected switching and networking centers

Terrestrial systems can fail due to flooding or earthquake damage to fiber or coaxial cable. Even more critical, however, is the protection of signaling and switching facilities at central offices of telecommunications organizations and the head-ends of cable television systems that offer telephone and data services. Enhanced building codes to protect such facilities, site selection to ensure that these facilities are in the safest locations, and insuring that adequate backup power is available, are important considerations. If possible switching systems, network routers and other critical facilities should be located in “earthquake protected” locations that are out of flood plains and otherwise sited to protect against disasters. Such facilities should be linked via VSATs or broadband wireless systems so that incoming and outgoing communications can be linked to other parts of the public switched telecommunications network (PSTN) where parts of the networking center or cable infrastructure fail.

J. Interoperability and gateway standards (and future-proofing of black boxes)

Interconnection of diverse networks operating at different frequencies can be patched together by such methods as putting two or more satellite terminals on a coast guard ship, but efforts to achieve full interoperability between diverse public and emergency communications systems should be pursued as a priority. The deployment of interoperability and open gateway standards such as the ISO-IEC 15045 and 18012 standards and development of chipsets (with needed firmware) and black boxes that are designed to accommodate open gateway and interoperable telecommunications standards is a needed goal. Interconnection of diverse civil and defense related communications systems can provide not only for enhanced interoperability but also can help “future proof” emergency, defense and civil communications systems against the need to continually update the “black boxes” that provide interconnectivity in the home, the office, first responder facilities, or military bases.

K. Emergency interconnection of military, National Guard and civil emergency response communication and information systems.

The various military and defense related communications systems should be designed in such a way that various branches of the military as well as first responders from the Department of Homeland Security and other federal, state and local agencies can communicate together. It is possible with open gateway technology and mobile switching centers to allow the interconnection of VHF, UHF, L-band, C-band, X-band Ku-band and Ka-band systems. The cost of trying to re-equip millions of radio-telephone units deployed for emergency communications so that they could operate from 400 MHz through 14 GHz would be too great. It would be possible, however, to redesign switching centers and to deploy black-boxes of a new type that would allow on demand interconnection of diverse systems at police and fire stations, hospitals and other critical locations. Such deployments could be achieved within a matter of years and at affordable cost. Such a redesign should accompany the shift of emergency systems to 700 MHz and the conversion of emergency radio channels to 12.5 kHz. Specific national objectives, such as to allow the flexible interconnection of military X-band satellite systems with 700 MHz emergency mobile radio systems that could last for the duration of a declared national emergency should be set as soon as possible.

L. Override and priority access for first responders.

It has been suggested that it would be simpler for first responders to use the existing civilian wireless mobile telephone and Wi-Fi / Wi-Max facilities in disaster situations, or just to use the public telecommunications networks. The problem with this approach is that during a crisis there is a dramatic increase in communications use with family members trying to confirm that their loved ones are secure. The key need is thus to ensure that “certified and credentialed” first responders be able to use these facilities on an override basis following some form of coded priority. The problem is that cellular and PCS providers have tended to give all of their users high priority status and in the process have eliminated the ability of first responders to have the override access that they need to get through to relief agencies.

NSTAC and DHS should explore finding a way to ensure that all “credentialed” first responders are systematically given codes that they can dial to get their messages through. Adaptation to the NCS’s GETS- and TSP programs should be considered. The International Telecommunication Union has been studying the idea that there could be a new country code that might be assigned exclusively for disaster recovery needs. First responders could be trained to use such a special country code and perhaps given an additional code number so that such calls would be either “free” or charged to a special state or national account established for disaster recovery. Again the purpose would be to give such calls priority at switching centers so that they would take priority over regular telephone traffic.

M. Planned development and regulations against building in hazardous locations

There is evidence that as increased population tends to build in flood plains and earthquake prone areas and as warming of the atmosphere due to “greenhouse gases” occurs during the 21st century, disaster events may become more common, more destructive and last longer. This is to say that the scope of natural disasters could increase in coming years. There is also the possibility of terrorist attacks of greater magnitude. If this scenario proves to be true, then more steps to mitigate the impact of such attacks may be necessary. Steps that might be taken in this respect could include:

- (i) Modeling and simulation programs (such as that developed by the Pacific Disaster Center) that can show city and local zoning authorities the impact that might be made by a tsunami, seismic-generated wave, a 50 year flood or a volcanic eruption, with the idea that future building in particularly hazardous areas can be prevented.
- (ii) Setting particularly strong building standards for areas prone to hurricanes and floods and strengthening the building code requirements for telecommunications switching centers, teleports, power plants, police and fire stations, hospitals and to position these facilities away from flood zones and other known hazards.
- (iii) Discouraging over-concentration of people and infrastructure and move to more diversity with regard to critical infrastructure. Military bases, police and fire stations and power plants can now be efficiently interconnected via electronic and communications grids rather than concentrated in a single location.

N. New business operations, insurance concepts, and contingency planning

Many of the concerns with regard to emergency communications, networking and power systems can be addressed via better training, new equipment, better operational planning, implementation of new standards and the adoption of “best practices.” To a great extent,

however, natural disasters and terrorist attacks can be anticipated. To mitigate and better prepare for these disasters, new modes of business operations, insurance funds and contingency planning appears warranted.

One idea is that of a special national disaster insurance fund. Such a fund could be paid into by private citizens (\$5 dollar tax check off), businesses (\$100 tax check off), federal, state and local governments, as well as insurance companies (\$10 million required contribution) that would create over time a pool of resources as a hedge against a particularly devastating disaster. This fund would be set up on a tiered basis with only a small percentage of the fund paid out for medium sized disasters but would be available for a very sizable payout in the case of a truly devastating disaster. An assessment process might also be created within the DHS to identify areas of strategic weakness and develop a ranking system that might be used to address these issues on the basis of one dollar out of the fund for every five dollars of local funds up to a limit of say \$100 million. This approach might have a component that relates to emergency communications and power capabilities. The details of how this might be structured are worthy of study by the U.S. Congress and DHS. The one thing that is clear is that the U.S. Government is not adequately prepared for truly catastrophic disasters. Thus some form of stockpiling of additional emergency resources (financial, communications, UAVs, and so on) over time is prudent.

O. Access to relevant information and updating of planning processes and manuals

The degree of training and the ability to access the latest information on emergency communications on the part of first responders varies widely around the nation. It is important that such organizations as APCO, police and fire stations and hospitals carry out assessments of training, equipment and communications and power resources. This process would certify on a location-by-location basis the readiness and adequacy of each local facility in terms of survivable telecommunications and backup power, for instance. Professional associations as well as DHS, NCS and FEMA should maintain up-to-date web sites, sponsor regional training programs, and otherwise contribute to the upgrading of facilities and capabilities.

There is likewise a need to better prepare the public. The resources of the public radio and TV broadcasters (PBS and NPR), the DBS and DARS satellite organizations (DirecTV, Dish, XM radio, Sirius, and Worldspace) can help to create public awareness.

Final Conclusions

The White Paper has sought to summarize some of the best thinking on the topic of national preparedness using existing and improved emergency communication systems. What is clear is that we are not really prepared for another major natural disaster like Hurricane Katrina or from another major terrorist attack such as 9/11. We hope that the discussions and analysis started with the NCEC process will be taken up and extended by policy-makers, federal, state and local officials, industry, professional associations, relief organizations, and those in the academic community. We further hope that the larger community will provide us advice as to how this report and our findings might be improved or amended to be more complete and useful. Even more so, we hope that some of these findings will be found helpful and that in one form or another they might be implemented.

To improve U.S. emergency communications there is much to be done. We see the need for expanded training and simulation programs at the federal, state and local level. We foresee the need for changes in public policy, “best practices” and regulation. It is important to recognize that

if there had been better training and equipment in place lives and infrastructure could have been saved.

Unless some sense of URGENCY about improving our emergency communications is achieved NOW, the opportunity to make things better will be lost. We cannot simply wait until the next disaster to show us that communications must be improved, interoperability needs to be achieved and first responders better trained. We cannot achieve these needed improvements without better overall planning, increased funding at all levels of government, and willingness not to let Katrina-like failures to occur again. With greatly improved communications and IT infrastructure to support our first responders, there is a much greater chance that we can better survive the next man-made or natural disaster, or pandemic conditions. Good communications are always desirable, but in the case of a true disaster emergency communications represent the first line of defense for survival.

Appendix 1

NATIONAL CONFERENCE ON EMERGENCY COMMUNICATIONS NCEC-2005

Gold Level Corporate Sponsors

Bearing Point Corporation
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Intelsat
Northrop Grumman Corporation
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IEEE-USA
International Space University
Ohio University
Satellite Industry Association (SIA)
Society of Satellite Professionals International (SSPI)
Telecommunications Industry Association (TIA)
U.S. Chamber of Commerce—Space Enterprise Council
Universities Space Research Association (USRA)
Washington Space Business Roundtable (WSBR)
World Teleport Association (WTA)
Women in Aerospace

George Washington University-Space & Advanced Communications Research Institute

Appendix 2

BIBLIOGRAPHY ON EMERGENCY COMMUNICATIONS

ANSI Homeland Security Standards Database www.hssd.us

ANSI Homeland Security Standards Panel, www.ansi.org/hssp

ANSI HSSP Workshop on Emergency Communications

http://www.ansi.org/news_publications/news_story.aspx?menuid=7&articleid=1109 APCO Project 25 Web site <http://www.apcointl.org/frequency/project25/information.html>

DHS SAFECOM Interoperability Basics documents and guides. URL:

<http://www.safecomprogram.gov/SAFECOM/library/interoperabilitybasics/>.

DHS SAFECOM Interoperability Case Studies. URL:

<http://www.safecomprogram.gov/SAFECOM/library/interoperabilitycasestudies/>.

“Disaster Relief: Improving Response and Long Term Recovery” White Paper and Report by the U.S. Chamber of Commerce and Booz Allen Hamilton, July 11, 2005 www.boozallen.com

Federal Communications Commission (FCC) Report to Congress, Spectrum Requirements for Emergency Communications, December 2005. www.fcc.gov

Federal Communications Commission (FCC), Wireless Telecommunications Bureau, Public Safety and Private Wireless Division. For spectrum-related information, hot topics, Public Safety National Coordination Committee information, regulatory actions and decisions, Public Safety Wireless Advisory Committee information, national/regional plan action, radio services and licensing information, frequency coordinator information, spectrum reform, and FCC rules, call 202-418-0680 or visit www.fcc.gov/wtb/publicsafety/.

GETS Web page <http://gets.ncs.gov/>

National Institute for Urban Search and Rescue www.niusr.org

National Law Enforcement and Corrections Technology Center (NLECTC), a program of the National Institute of Justice. *“Why Can't We Talk? When Lives Are at Stake”* video (NCJ 172213), call 800-248-2742. For more information on public safety radio spectrum and interoperability issues, including the AGILE program, call Tom Coty at 202-514-7683, or visit the NLECTC World Wide Web site at www.nlectc.org.

National Public Safety Telecommunications Council (NPSTC). For information on NPSTC, a federation of 11 associations that acts as a resource and advocate for public safety telecommunications issues, visit www.npstc.org.

National Telecommunications and Information Administration (NTIA) Spectrum Management Division—Public Safety Program Office, U.S. Department of Commerce. The Public Safety Program was established to coordinate the various spectrum and telecommunications-related activities and programs within the Federal Government as it relates to public safety. Call 202-482-1726 or visit www.pswac.ntia.doc.gov/pubsafe/.

National Task Force on Interoperability: *“Why Can't We Talk? Working Together To Bridge the Communications Gap To Save Lives.”* Guide for public safety officials. February 2003. URL:

http://www.safecomprogram.gov/NR/rdonlyres/322B4367-265C-45FB-8EEA-BD0FEBDA95A8/0/Why_cant_we_talk_NTFI_Guide.pdf.

Project 25 Technology Interest Group <http://www.project25.org/>

Project MESA www.projectmesa.org

Public Safety Wireless Network Program (PSWN), a joint program of the U.S. Departments of Justice and the Treasury. An initiative established for the planning, development, and implementation of an intergovernmental wireless network for all types of local, State, and Federal public safety agencies. For information, call 800-565-PSWN or visit www.pswn.gov.

“Satellite Industry Response to Hurricane Katrina”, Satellite Industry Association, Fall 2005, www.sia.org

“Special Edition on Mobile Satellite’s Role in Hurricane-Hit United States” Mobile Satellite User’s Association, Volume 14, No. 5, Oct. 2, 2005, musa@msua.org

“Testimony on behalf of the Satellite Industry Association by Tony Trujillo, Exec. V.P. of Intelsat”, Hearing on Public Safety Communications on 9/11 to Katrina: Critical Public Policy Lessons, U.S. House of Representative, Committee on Energy and Commerce, Subcommittee on Telecommunications and the Internet, Sept. 29, 2005.

TIA CIP/HS and Public Safety Web site <http://www.tiaonline.org/standards/cip/index.cfm>

TIA Project 25 Web site http://www.tiaonline.org/standards/project_25/

TIA Web site www.tiaonline.org "Toward a Next Generation Strategy: Learning from Katrina and Taking Advantage of New Technologies," White Paper by Dale Hatfield and Phil Weiser, University of Colorado-Boulder, Prepared on behalf of Mobile Satellite Ventures <http://www.msvlp.com/nextgen/vision/papers.cfm>.

2001 TIA Standards and Technology Annual Report. “*Emergency Responders Depend on Public Safety Radio Standards to Save Lives and Safeguard Property.*” Pages 10-15. URL: http://www.tiaonline.org/standards/star/STAR_2001.pdf.

“2011- What We Still Haven’t Learned” *Atlantic Monthly* January, 2005

“Why Satellite Communications Are an Essential Tool for Emergency Management and Disaster Recovery” Joint White Paper by the Futron Corporation and the Global VSAT Forum info@futron.com

WPS National Communications System Web page <http://wps.ncs.gov/>