Hurricanes of 2005: Performance of Gulf Coast Critical Infrastructure Communications Networks

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The United Telecom Council is a global organization serving all corners of the world and virtually every community in the United States. Our ongoing mission is to create a favorable business, regulatory and technical environment in which all members and stakeholders will thrive. We do this through a variety of advocacy, compliance, technology, information, and education programs. We invite you to explore our web site at www.utc.org and let us know how we can be of further service to you.

The United Telecom Council represents electric and gas utilities, water companies, energy pipelines, and other critical infrastructure companies, as well as their technology partners and other corporate telecom/IT users – all united in their commitment to ensuring the best, most reliable systems and networks critical to their core business and the customers they serve.

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TABLE OF CONTENTS

1.0 Executive Summary

The hurricane season of 2005 resulted in immense damage and tragic loss of life to Florida and the Gulf Coast of the United States. Storms Katrina, Rita and Wilma also pointed out the weaknesses in many of our critical infrastructures, including telecommunications networks, some of which are still recovering months later. **However, in sharp contrast to many commercial wireless, landline telephone and other telecommunications networks, the private, internal networks (radio, microwave and fiber) of electric, gas and water utilities for the most part continued to function throughout and immediately after the storms**. In some cases, it was utility communications networks that provided the only reliable communications among emergency responders and other officials during the first few days after the storms.

The reliable performance of these internal systems was neither unexpected nor unusual; utility communications systems are constructed specifically to withstand major disasters. The United Telecom Council (UTC), the international trade association representing the telecommunications interests of critical infrastructure industries,[1] has conducted informal polling of its members after such emergencies as a major Northeast ice storm in 1998; the huge electric blackout of August 2003; and the hurricanes of 2004, with similar results. However, given the magnitude of this year's disasters and resulting national discussions concerning the survivability of communications networks, UTC felt it imperative to undertake a formal survey of Gulf Coast electric, gas and water utilities of all sizes, to generate data that would quantify our anecdotal information.

Overall findings:

- 86% of impacted CII entities responding reported that their communications networks generally survived the hurricanes and continued to operate well throughout restoration efforts;

- Private land mobile radio (LMR) networks provided critical communications among crews; however, the huge number of responding entities from around the country taxed capacity or could not operate on local systems, pointing up the need for CII interoperability;

[1] UTC's membership consists primarily of publicly-held, municipal and cooperative electric, gas and water utilities and gas pipelines, and Federal power authorities. Through affiliated association members, UTC reaches out to other Critical Infrastructure Industries (CII) as defined by the FCC in Section 90.7 of its Rules (47 CFR § 90.7), including petroleum and oil pipeline companies and railroads.

- Utility fiber and microwave systems survived and generally continued to function; however, this was due in part to built-in redundancies, robustness and recovery mechanisms that would be cost-prohibitive for a for-profit network designed to serve the general public. Therefore, CII entities will continue to require private networks to meet mission-critical needs for the foreseeable future, along with the ability to expand them as needed to meet system growth requirements.

- Unfortunately, there was little or no formal coordination with state or local agencies or public safety organizations during or after the storms. Given the opportunities for improved response communications offered by robust CII systems, and the presence of CII personnel "on the ground" in nearly every disaster scenario, this lack emphasizes that CII MUST be included in emergency response planning at the Federal level.

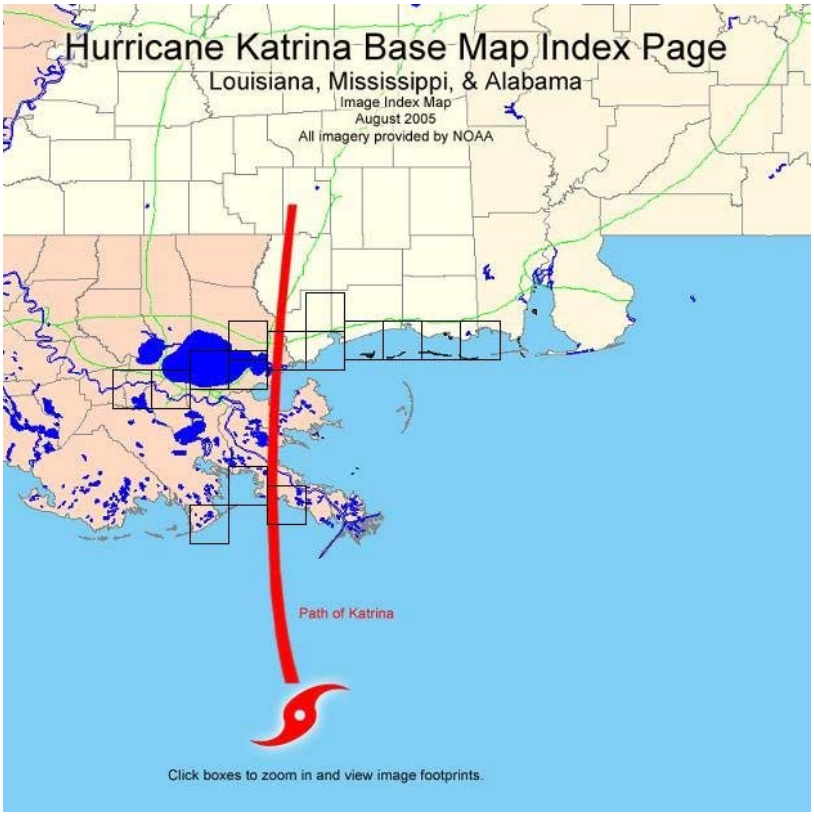
We believe these findings should be of significant importance to Congress and to Federal agencies charged with communications-related Homeland Security responsibilities, such as the Federal Communications Commission and the Department of Homeland Security. UTC and its members look forward to discussing these findings and their implications with policymakers and others.

2.0 Background

During the months of August, September and October of 2005, the Gulf Coast of the United States and both coasts of Florida were belted by a series of three devastating hurricanes: Katrina, Rita and Wilma. Katrina put much of New Orleans under water; trees were flattened as well as homes, public buildings and communications towers by Category 4 winds. Loss of life from this storm was tragic, and unusually high. Rescue and restoration effort were severely hampered by the loss of public switched network (PSTN) landlines and wireless carrier communications. Scores of individuals were isolated without power in unsanitary conditions, desperately in need of help, without the means to request it.

Still recovering, Gulf States were again pelted by Hurricane Rita just weeks later and then by Wilma in October. While these storms were not quite as severe as Katrina, the rapid succession tested the limits of overstressed public safety and utility repair personnel. It became clear as response efforts continued that the recovery of nearly all other infrastructures was dependent on electric power restoration. Moreover, all people have a vital need for safe drinking water and public health demands reliable wastewater facilities. Within these industries, as always, coordination of repair crews, rapid restoration and interaction with public safety personnel depends upon working communications channels. As days passed, stories from the utility companies in the area emerged in which it became apparent that the performance of private CII networks was markedly different from the more-publicized state of communications networks in the commercial and public safety sectors.

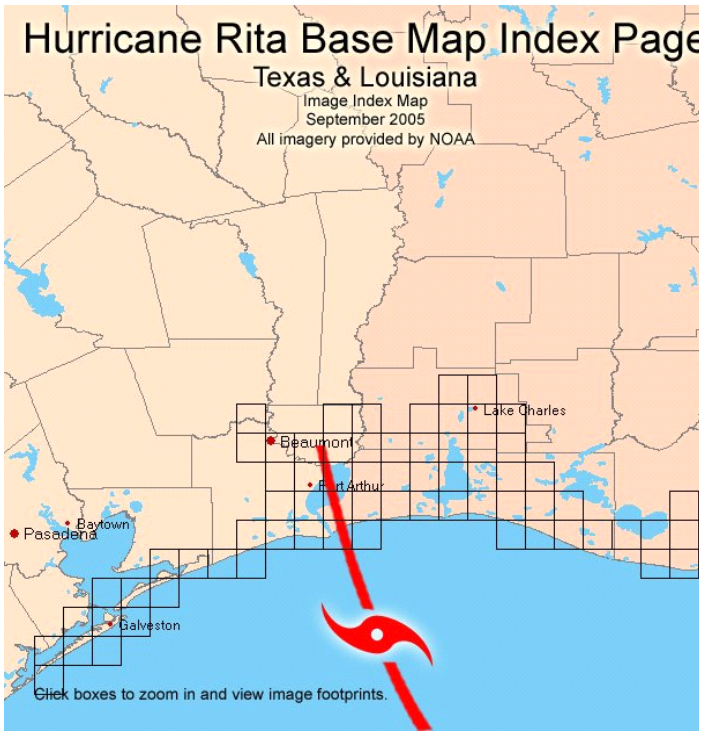
Residents of the Gulf Coast and Florida are served by a wide variety of electric, gas and water utilities, including many small regional cooperatives and municipal power/water authorities whose service territories lie within those of larger entities. These include large, investor-owned electric power companies, electric generating companies and natural gas utilities. The utility service territories most severely impacted by the storms fall around the hurricane storm tracks depicted by the National Oceanic and Atmospheric Administration (NOAA):



http://alt.ngs.noaa.gov/katrina/KATRINA0000.HTM

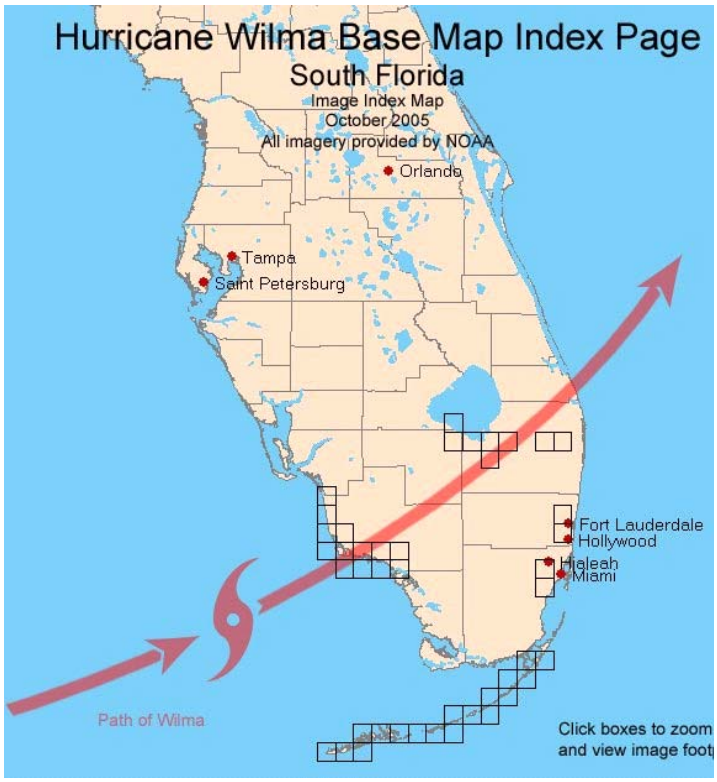
On August 29, 2005, Hurricane Katrina made landfall in Plaquemines Parish, Louisiana, with 140 mph winds. It then continued northward and made a second landfall, on the same day, on the Louisiana/Mississippi border with winds of 125 mph.[2]

[2] http://www.nhc.noaa.gov/archive/2005/tws/MIATWSAT_aug.shtml?



Less than a month later, on September 24, Hurricane Rita made landfall just east of the Texas/Louisiana boarder, near Galveston, with category 3 intensity winds of 120 mph. Rita was reported by the NOAA as having caused devastating storm surges and wind damage in Southwestern Louisiana and the extreme southeastern portion of Texas.

http://ngs.woc.noaa.gov/rita/RITA0000.HTM



Most recently (October 24), Hurricane Wilma made landfall on the western coast of Florida, displaying category 3 wind intensity, near Cape Romano. It accelerated, crossing Florida in just five hours time.

http://ngs.woc.noaa.gov/wilma/WILMA0000.HTM

After hearing a great deal of anecdotal evidence about the performance of member communications systems, UTC looked for as many CII entities as

possible in the most-impacted areas; after identifying 21 utility companies of various sizes in the areas hardest-hit by the storms, we contacted them in order to assess consistently the effects upon their communications systems. The list, while a fairly comprehensive cross-section of utility sizes and types, is not offered as a complete directory of affected entities.

Company	Impacted by Katrina	Impacted by Rita	Impacted by Wilma
Baldwin EMC	●		
Centerpoint (includes Reliant)		●	
CLECO Power	●		
Coast EP	●		
Dixie Electric Power Association	●		
Entergy (Louisiana, New Orleans and Gulf States)	●		
Florida Power and Light			●
Huntsville Utilities	●		
Joe Wheeler Electric Cooperative	●		
Lafayette Utilities Systems	●	●	
Lafourche Parish Water District No. 1	●		
Louisiana Generating LLC	●	●	
Magnolia EPA	●		
Mississippi Power Co. (Southern Company)	●		
Pearl River EPA	●		
Sam Houston Electric Cooperative		●	
Singing River EPA	●		
South Mississippi Electric Power Association	●		
Southern Pine Electric Power Association	●		
Southwest Louisiana EMC	●		
Washington St. Tammany EC	●		

3.0 Survey Questions and Results

The United Telecom Council posed five basic questions to utilities in hard-hit areas to determine how their various communications systems fared during and after the hurricanes, and analyzed the resulting data. Of the 21 electric and water utilities identified and contacted, 14 responded to the survey, a 66% response rate we deeply appreciate given the repair work to infrastructure still underway in some areas. In addition to answering the questions, many respondents offered anecdotal information; this is included as an Appendix at the end of this report to provide additional insights.

3.1 Communications Systems Performance

Most utilities, regardless of service territory size or proximity to the centers of the storms, reported that their communications systems stood up well to the hurricanes. This stands in stark contrast to the public switched network (PSTN) in the region and wireless carriers, who suffered extensive loss of service and slow recovery time. The comparison points to the fact that communications systems, if built extremely well, can withstand the intense wind and/or flooding associated with these events; however, unlike public networks, CII systems' redundancies and robustness can be limited in size and scope, since they are designed and constructed to meet the specialized needs of a single entity or group of companies. Such construction would be cost-prohibitive for a commercial system designed to serve millions of the general public. Thus, in spite of the growth of various commercial communications networks, there will be a continued need for CII entities to maintain their own private communications networks for mission-critical functions, including backbone networks.

Of the fourteen companies responding, twelve (86%) said that their communications systems stood up excellently or well, with only two companies (14%) having serious communications problems.[3] Most companies that suffered damage to their equipment and networks fixed it very quickly, generally within 24-48 hours following the passing of the hurricane.[4] Such repairs were carried

[3] One of these was due to the company's reliance on cell phones; the other company did not specify the reason for its poor performance (see Appendix).

[4] Note that repairs to communications networks included ensuring that generators were operational and fully fueled, so that communications facilities operated where no grid-based power was available. In at least one case, electric utility telecom personnel were detailed to an uninhabitable headquarters building the day after Katrina to ensure that all local communications nodes were functioning via generator. In another instance, telecom networks were kept operating by sandbagging a flooded building, keeping water levels down to only six inches in the communications equipment room; the

out according to detailed emergency plans, since communications networks are vital to power restoration and infrastructure recovery efforts being undertaken area-wide.

Across the board, private systems out-performed the commercial. Utilities reported that cell phones and landlines were down, leased lines did not fare well and that satellite communications were choppy at best. One small water district authority that depends entirely on cellular communications suffered serious communications difficulties. The utilities that had the greatest communications difficulties were the smaller cooperatives and municipal authorities. Such performance differences highlight the need to share resources in emergency situations and for interoperability among CII entities. Whereas cooperatives tend to help cooperatives and IOUs help IOUs, currently there tends not to be assistance provided between utility segments.

Lack of interoperability among utilities and between utilities and public safety remains a serious problem that hampers restoration efforts; hurricane rescue and restoration efforts provide an example of the benefit that could be reaped from allocating a small amount of dedicated spectrum for CII, with systems to be built using an open architecture and made available to all emergency responders as needed for disaster recovery.

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associated power generation plant at the same location had been knocked out by storm damage.

3.2 Land Mobile Radio, Backbone Survivor

Without exception, survey respondents that maintain land mobile radio (LMR) systems were pleased with their performance during and after the storms. Unlike most commercial wireless systems, these networks are built specifically to weather such disasters and to continue to operate in extended power outages, in support of restoration crews carrying out extremely hazardous duties.[5] Where possible, LMR networks also support radios brought in by visiting crews from utilities across the region or from other parts of the country. However, the superior performance of individual systems and the industry in general is offset by the lack of interoperability between systems and the lack of dedicated spectrum to share with other utilities and public safety. Where host utilities had no additional capacity, or assisting utilities used other frequency bands, valuable time was wasted in restoration efforts because of the need to work around communications difficulties or use host utility personnel to guide visiting crews without another means of contacting emergency control centers.

LMR is at this time the most critical tool of critical infrastructure communications in emergency situations. It provides for necessary mobility and quality of service as crews travel throughout the damaged service territory. In many cases during events such as Katrina, it provides the only means of wireless communications during the first critical days after storm impact. The overall performance of private utility communications systems during the catastrophic storms, in comparison with consumer networks, reinforces the industry position that private systems must be maintained, and encouraged for emergency response. The emphasis upon reliability for utility operations dictates that critical infrastructure entities not depend upon commercial systems for core communications for the foreseeable future.

However, one downside to the current LMR framework is that responding utilities operate on several different frequency bands: below 100 MHz, 150-512 MHz, 900 MHz and 800 MHz for voice systems alone. This hampers the ability of neighboring utilities to help each other and hamstrings utilities that travel to assist with restoration and recovery efforts. Unlike traditional public safety, energy companies such as electric utilities assume a nationwide response from other entities as part of their emergency response planning. A broad network of mutual assistance contracts is in place across the country, and in severe situations such as the hurricane seasons of 2004 and 2005, other companies also

[5] The job of electric lineman is consistently rated one of the ten most hazardous in the nation based on per capita deaths (Source: U.S. Bureau of Labor Statistics), and visiting crews working long hours under unfamiliar conditions must be considered even more at risk. LMR units are carried and relied upon as safety equipment by field crews, who expect ubiquitous coverage across the entire service territory regardless of terrain or population density.

are contacted for equipment and crews. Assistance generally runs along ownership lines: investor-owned utilities generally come to the aid of other IOUs, while crews from other cooperatives are called to assist impacted cooperative utilities. It is not at all unusual to see crews from 30 or more utilities in convoys of trucks heading for the area ahead of time when a severe event is forecast, or immediately afterward when an unexpected disaster strikes. Outside crew convoys, especially from larger utilities, carry their own supplies and stage themselves near the area of disaster impact. In the case of disasters such as hurricanes, they enter the area and begin recovery work as soon as wind levels fall.

Assisting companies should be able to bring their own radios to the area with the knowledge that they will function on the host utility's system. Where this was possible in some areas post-Katrina (for example, one utility's new 900 MHz trunked system accommodated assisting crews from two other, out-of-state companies), generally host utility personnel carrying local radios must serve as guides and communications links to assisting crews, a waste of personnel and time better spent in recovery efforts. Meanwhile, entities sending crews to assist must obtain emergency Special Temporary Authority from the FCC to use their own, portable equipment in areas where they are not licensed to operate. This is hardly an ideal situation. In order to take full advantage of the robustness of LMR networks, CII companies should have a small allocation of dedicated spectrum on which an open architecture, interoperable system can be built to CII standards. Such a system could ensure reliable wireless communication for emergency response, not only to a large number of responding CII personnel, but to public safety and Federal responders, as well. The storms of 2005, as well as the other disasters of the past and the certainty of more in the future, make a strong case for pursuing this option.

3.3 Utility Fiber Networks Benefited from Pre-planning

The performance of private and commercial fiber networks during the hurricanes demonstrates that utilities build more reliability and redundancy into fiber networks than their commercial communications networks counterparts. The technology itself offers all system operators multiple opportunities to secure communications through the ability to deploy features such as intelligent, self-healing rings and by burying cables. The different performance levels of private and some commercial fiber networks throughout the Gulf Coast and Florida point to the fact that the entities have entirely different objectives in mind from the onset: utilities build for *reliability* because communications is critical to the functioning of the core business (electric, natural gas or water delivery), while commercial communications companies build for the general population to provide consumer services. While the difference in end-goals is entirely understandable, the redundancy and geographic diversity of utility fiber networks makes them potentially excellent candidates to meet Homeland Security goals of survivable networks.

Responses to the third survey question bear out the conclusion that private fiber networks survived the storms due to pre-planning for worst case scenarios. Respondents owning fiber networks, as would be expected, are generally large in size. All reported that they stood up very well to the storms: where there were problems, they were overcome by inherent features of the technology. These features were pre-planned and built into the networks. By contrast, commercial companies suffered more difficulties with broken cables than private, internal networks and had more difficulty restoring service. Smaller utilities relying upon commercial fiber-based networks reported that it took weeks for service to be restored or that it still was not functioning properly at the time of interview.

In only one case among respondents was significant difficulty by an IOU alluded to by a smaller company sharing the IOU's fiber. It is interesting to note, as stated by a large electric IOU, that more damage to cable was done during the recovery effort by repair crews than by the storms themselves.

3.4 Microwave Systems Stood up to the Storms

Like fiber networks, microwave systems stood up very well to the storms, a somewhat surprising outcome given the intense winds accompanying these events. Overall, some damage to microwave towers and attachments was reported, but this damage was not as extensive as it was to other types of communications towers such as generally taller broadcast towers. Additionally, utilities reported that they employed detailed backup plans, including employing mobile towers and safeguarding communications through redundant links. Any needed repairs, such as refocusing dishes to restore links, were accomplished in the days immediately following the storms.

Some interesting anecdotal information relating to tower repairs included the physical difficulties for crews in reaching the tower sites due to downed trees; also, securing fuel supplies for generators was sometimes difficult. While many CII entities' response planning includes contracting for a reliable fuel supply, the 2005 hurricanes created unusual fuel shortages; in addition, Federal emergency responders often commandeered available supplies in the area, although no respondent to this survey specifically noted this as a cause for a lack of fuel in this case. Again, the Katrina response story among public safety, Federal, state and local officials, and CII entities, along with other industries, points to the need to include all emergency responders in disaster planning.

3.5 Utilities and Public Safety Need Better Coordination

Given the outstanding performance of utility communications during the hurricanes and critical infrastructure personnel's' role as emergency responders, as well as the dependence of all other infrastructures on reliable power (and all people on safe water), thorough Homeland Security planning demands CII participation. A number of Congressional hearings, including testimony by DHS officials on the subjects of interoperability, spectrum management and Incident Command Systems (ICS), took place in the weeks after Katrina and Rita. Much attention was paid to the role and needs of Public Safety (PS); however, in spite of statements noting the reliance of recovery on power restoration, CII entities were largely overlooked in the discussions. To do so deprives policymakers of a prime opportunity to use proven reliability for the good of Americans affected by disasters. Unfortunately, however, UTC's research shows that, for whatever reason, local coordination between public safety and CII is inconsistent and patchy, a situation that must improve to enable efficient emergency response.

The last question of this survey asked about coordination between public safety and CII entities during storm recovery. While utility communications systems fared well during the hurricanes, there was little or no coordination with state or local public safety organizations aside from some informal sharing of resources, such the assistance of a dispatch operator and/or a dedicated E911 line. In the examples given by respondents, the utilities played the role of assisting public safety, and not the other way around. At least one respondent noted that public safety agencies requested use of its communications network; such requests are not uncommon and reflect local understanding of the robustness of CII systems. What coordination existed clearly had been arrived at locally by personnel understanding the need for some form of communications, but with the exception of one statewide network, there was little in UTC's survey responses to inspire confidence in this area.[6] Beside the clear needs of dedicated spectrum for CII and accompanying advancements in communications interoperability, CII entities responding to disasters should be included in any State or Federally developed coordination process.

Post-Hurricane Hearings

During congressional hearings on September 29, 2005, witness David E. Liebersbach of the National Emergency Management Association noted that, "… local gas, electric and oil companies [need] to know exactly where [who] to go to in ICS (national Incident Command System) during emergency response."[7]

[6] Anecdotally, UTC members noted that public safety personnel unfamiliar with some utility truck logos sometimes refused entry to impacted areas by crews seeking to restore power. Such incidents underscore the need for prior planning at a higher level.
[7] House Homeland Security Committee Hearing on Incident Command, Control and Communications during Catastrophic Events, October 19, 2005.

Even with excellent internal utility company emergency response plans, CII should be included in the next step of participating in an area-wide response effort.

According to National Fraternal Order of Police President Chuck Canterbury, most communities use some form of the ICS system [this is not the case for utilities], but a national plan is required. During Katrina there was a situation of "self-dispatching" [for public safety], "and where there is a virtual destruction of the local command center – there needs to be a backup (national) command structure.[8] As industries with thousands of personnel moving through the area in recovery efforts, CII entities need to be a part of this development.

During the House hearings Chief William D. "Bill" Killen, President of the International Association of Fire Chiefs, stated that in order to be successful a national ICS needs the following:

1. DHS to require everyone to take an online course
2. NIS security requirements
3. DHS must offer resources to communities that submit a mutual aid plan
4. Congress must fully fund ICS[9]

CII entities are deeply involved with DHS, especially in the areas of critical infrastructure protection and cybersecurity, because of large enterprise IT networks and critical control systems such as Supervisory Control and Data Acquisition, or SCADA. However, CII must be included in interoperability efforts, as well. Following an announcement by FCC Chairman Kevin Martin, Ken Moran, Director of Homeland Security for the FCC, stated in post-hurricane Senate hearings that a working group has been formed to study communications and specifically, ways to fund interoperability development**.** CII has a significant contribution to offer to such efforts, and must have a presence in these discussions.[10] Equipment that is not dependent on frequency assignments is extremely important to both CII and public safety, while again, unlike traditional public safety, CII has no dedicated spectrum on which to operate a next-generation communications system. This definitely is a long-term effort and one that will require massive investment by all parties concerned in new infrastructure and new user equipment.

[8] *Id.*
[9] *Id.*
[10] Senate Commerce hearing on Communications Interoperability, October 19, 2005.

4.0 Summary of Utility Communications Performance Issues from 2005 Hurricanes

Utilities and other critical infrastructure companies along the Gulf Coast have a great deal to be proud of in their response to the catastrophic hurricanes Katrina, Rita and Wilma. The massive responsibility of power restoration depended on a number of factors; chief among them was the necessity of functioning communications systems. Utilities are traditionally conservative in planning communications networks, placing heavy emphasis upon reliability. Thankfully, redundancy and contingency planning paid off for all but the hardest- hit in these industries.

Survey questions posed reveal several important points:

- In sharp contrast to commercial wireless, landline telephone and other telecommunications networks, the private, internal networks (radio, microwave and fiber) of electric, gas and water utilities for the most part continued to function throughout and immediately after the storms;
- Interoperability among utilities and between utilities and public safety remains a serious problem that hampers restoration efforts.
- CII needs a small spectrum allocation to make possible a tough, resistant, interoperable network, whether to be used by CII alone or made available to other emergency responders in such situations.
- Given the good performance of utility communications and our role as emergency responders, as well as the dependence of all other infrastructures on reliable power (and all people on safe water), our members should be included in Homeland Security planning.

UTC recognizes the immense efforts undertaken by utilities facing the challenges of restoration and recovery. On many levels, a fine spirit of cooperation, selflessness and courage emerged during our conversations with the men and women operating utility communications systems along the Gulf Coast and Florida. UTC encourages readers of this report to review the individual responses provided in the attached Appendix – you will hear in that text both their concern for the devastation they witnessed, and their pride in maintaining systems vital to restoration of their communities.

The aim of this report is to bring to the attention of CII entities the need for active engagement in government discussions regarding the role of communications during emergency response. Through this small study, UTC also hopes to emphasize to policymakers the rich resource of robust infrastructure, emergency planning and commitment to community that CII entities can bring to emergency response planning and interoperability efforts. UTC and its members will continue to stress the key role of both the restoration of the services we

provide and the value of our robust internal communications networks during such emergencies, to make sure that our specialized needs, and ultimately the interests of the American public, are addressed.

APPENDIX – QUESTIONS AND RESPONSES

Q1: Overall, how well did your utility's communications systems stand up to the storm(s)?

Excellently or Very Well	Fine, with a few problems	Very Poorly	Impacted Primarily by:	Anecdotal Information
●			Rita	I would say excellent but there was a problem with a couple of MW systems that lost dishes. This knocked out SCADA and a high-end communications center.
●			Katrina Rita	Newly installed 900MHz trunked radio system replaced a low-frequency radio system (a single channel which everyone shared) June of 2005. New radio system was the only communication system working in the parish. This was critical - performed exactly as designed for emergencies. Landlines and cell phones went down and since satellite depends on landlines, it was impacted. Satellite coverage was marginal (not sure why), and conversations were choppy.
	●		Katrina	LMR worked fine but was extremely congested at times with the amount of traffic. Cellular phones were completely out for the first 5 or 6 days, gradually improving … Landlines (telephone), as expected, were knocked almost completely out. We had service at 2 of our 3 offices but only within local calling areas, mainly out of the same central offices. That was also gradually restored over a period of about a week for the 2 offices that had service. The 3rd office received service after about 2 weeks. We ended up purchasing several Southern LINC radios to use between offices and a few in the field to alleviate some of the radio congestion and to use to call long distance, since that was the only way of doing so at the time.
	●		Katrina Rita	In New Orleans, many communications sites and substations were underwater and were not immediately restored since the population has not returned to those areas. Following Rita, 90+% of the TX sites were functional.
●			Wilma	This is inclusive of not only the Private Wireless Systems but also includes [of our] WAN and PBX infrastructures. There was recovery required to some degree for all systems but the networks are designed with a high level of redundancy so recovery was very prompt following
	●		Katrina	No effect from storms
●			Katrina Wilma	Did not lose any communications at all- it was up completely and continuously throughout. In the middle of both Katrina and Wilma but most effect was upon the electric lines, about 3 days work restoring service.

		●	Katrina	Extremely poor - We use cellular phones w/direct connect features for communication.
	●		Katrina Wilma	Our company owned communication system stood very well during and after hurricanes Katrina and Rita. Leased services did not fare well and were out up to a month after the storms.
	●		Katrina	Our system worked well for the amount of damage we had.
●			Katrina	Anything that was lost was repaired within 24 hours. This includes LMR, MW, radio, satellite…Towers are built to withstand hurricanes. Some landlines went down.
	●		Katrina	VHF radio system survived almost completely intact. One problem we did have was with rented data lines (control circuits) to our repeater sites. We worked around this by using mobile radios with power supplies to work as base stations. We also had damage to our antennas and coax lines but that did not stop our system from working. We have implemented repairs.
●			Katrina	Communications were never lost during the storm, which involved redundancy due to one tower failure.
		●	Katrina	Overall, the utility's communications systems did not stand up the storm at all.

Q2: What effect was there on your Land Mobile Radio (LMR) system (on what frequency band(s)), and how well did it function to support restoration?

LMR worked well	LMR problems	Freq. band used	Impacted Primarily by:	Anecdotal Information
●		800 MHz	Rita	No problems with LMR. We use 800MHz for personal communications.
●		900 MHz	Katrina Rita	New 900MHz trunked radio system and …critical tower site (are) configured with four channels for voice communications - a four-fold increase in user communications occurred, without talking over each other. Separation of voice and data allows the service crews to continue communicating, uninterrupted by data ... Portable "walkie-talkies" were critical.
●			Katrina	There were no ill effects on the LMR system itself, just the congestion problem.
●		800 MHz	Katrina Rita	Performed) very well, particularly following Rita. After Katrina, we had about 90% of our radios sites back on line by Tuesday. Only 1 radio site … was off line for an extended period of time due to high water in the area. (Use) 800 MHz Motorola Smartzone. Additional portables were acquired and used by the incoming (non-company) crews. We also added repeaters to sites where traffic was high to reduce traffic congestion.
●		900 MHz 450 MHz	Wilma	(We use) a 900 MHz M/A-COM Trunked Radio System for voice dispatching and a 450 MHz DataTAC System for field data communications. … Although the network connecting the tower sites is dependent on the local telco providers (we) created highly redundant network with contingencies to address losses in both telco and electrical service.
●		450 MHz	Katrina	Without this system it could have taken several weeks to restore power… (instead of 3-4 days).
●			Katrina Wilma	No effects
●		150 MHz	Katrina	We operate a high band repeater system from towers. We had to install generators at the tower sites as no power was at location for days. We had communication to all trucks throughout the storm.
●		800 MHz 450 MHz	Katrina	LMR stood up very well. We use 800 MHz Southern LINC radios (Motorola) and some 450 MHz in add hoc places. Radios were used at capacity of course, since they were being shared with people coming in to help
●		800 MHz	Katrina	The system functioned excellently … We sustained damage due to water in only one location.
	•		Katrina	There was virtually no voice communication and cell phones … being used…were not fully functional at all times.

Q3: What was the effect on fiber networks?

Fiber Network worked well	Damage or poor performance	Impacted Primarily by:	Anecdotal Information
●		Rita	Fiber is 97% buried so there were no cable breaks, no problems.
●		Katrina Rita	Limited impact to company dependant communications. Although we had multiple fiber optic breaks, due to fault tolerant redundancy, most systems remained functional. Leased circuits were more difficult to restore and took more time. Leased circuit providers were unable to provide repair dates. In Texas, during Rita, Fiber breaks near Lake Charles caused 2 sites to be off the air for a few days but overlapping coverage limited impact and fault tolerance fiber rings limited impact to other company systems. We have an extensive fiber system over a four state area most of which is carried in the static shield wire on transmission lines. During the storms, many transmission lines were damaged. Sometimes the fiber remained in service on a downed line but even when it was broken, the redundant rings limited impact to company dependant communications including radio, voice, and data
●		Wilma	(We utilize) a ringed architecture for (the) Fiber Network. Although there were breaks in the Fiber system the alternative routing provided by the ringed architecture provided continuity of service. In the 2004 Hurricane season there were breaks in the Fiber Network that resulted in loss of the primary and secondary paths. (We were) prepared to make immediate temporary restorations and most critical services were restored within 24 to 36 hours.
●		Katrina Wilma	No effects
	●	Katrina	We have none but the telephone system in the area had big problems and is still not working like pre-Katrina.
	●	Katrina Wilma	We do not own a fiber network however, we do share in the use of the (larger IOU) fiber system. This fiber system was broken in several places following Hurricane Katrina. It took several weeks to restore.
●		Katrina	Rings are intelligent, self-healing rings so even though there were fiber breaks, there was no significant loss of traffic. We actually had more breaks after the storm when the repair crews were working than during…
	●	Katrina	The effect on (commercial) fiber networks was such that telephones were considered to be null and void. Some areas are just beginning to receive telephone service, while other areas still don't have it. But it is slowly coming back.

Q4: How well did your microwave links/communications towers withstand the hurricane?

MW performed well	N/A	Impacted Primarily by:	Anecdotal Information
●		Rita	Lost no towers. Just lost 2 or 3 dishes that affected 2 major SCADA systems. Everything was repaired in 48 hours.
●		Katrina Rita	Aug. 29th Telecomm crews erected a new 100' mobile tower . . . in the Service Center. The mobile tower was the only communications system operational in the parish for the first 12 hours. Our core microwave system sustained no damage and was unaffected by the storm. We had about 3 spread spectrum links (2.4GHz) that had dishes moved off-path, but those were corrected rather quickly. We've also added stiff arms to those sites, so this should not be a problem in the future. The biggest problem was clearing the trees off of the road to get to the tower site. We used our 100' crank-up tower for the first 12 hours until we could get to the main tower site to turn it back on.
●		Katrina	All 4 towers fared well.
●		Katrina Rita	NO towers received significant damage beyond turned dishes & loose feedlines. Katrina, minimal damage except for (one) site... Rita, numerous dishes in TX were turned by the wind but most paths remained in service with reduced quality. All were returned to normal or service rerouted within 5 days. One of the most difficult issues was keeping our communications generators running and fueled.
●		Wilma	(We) did not experience the loss of any communication towers/structures in the 2005 Hurricane Season. In 2004 … lost 1 light duty tower that was over 30 years old.
●		Katrina	The storms did not effect our microwave links
●		Katrina Wilma	No effects
●		Katrina Wilma	MW links and towers withstood the two hurricanes very well. Two emergency generators experienced problems; however, they were dealt with effectively.
●		Katrina	Towers withstood damage at our location.
●		Katrina	We did not lose any MW towers at all, only facilities at the base. Some transmission equipment was lost.
	●	Katrina	We have no microwave but our communications towers withstood the storm very well. Interoperability with cooperative crews and contract crews would have been of use.
●		Katrina	One of the four microwave links failed. The operation suffered little due to redundancy.
●		Katrina	The towers are good; they withstood the storms fairly well. However, over 80% of the grid – electrical power – had to be replaced. Neighboring (utility) had problems with that (too).

Q5: What coordination did you have with local or state public safety, and how should this be improved?

Any Coordination with public safety?	Should coordination be improved?	Impacted Primarily by:	Anecdotal Information
●	●	Katrina	The Department of Transportation and Occupation, Safety & Health [OSHA] touched base, but there wasn't any other coordination. With the magnitude of what happened and the damage, not sure how any system could improve the coordination. "Nothing could've helped." Further west wasn't as bad, but here in this location the trees were down and the power lines were out.
●		Rita	We were talking to city officials 3 or 4 times daily. We had problems with blocked roads and I think the decision to evacuate needs to be made more judiciously. Not everybody had to leave town.
	●	Katrina Rita	Even state police was down during the initial assessment phase (I don't have an exact time on how long they were down).
●	●	Katrina	There was some coordination but probably not to the extent that you would like to see. I'm not sure what the best way to improve that coordination would be, but having at least one common method of communications besides land lines and cellular phones between ourselves and public safety would be (desirable).
		Katrina Rita	At my level, minimal. I did volunteer our communications towers and AC power when requested.
●	●	Katrina	We give the local 911 offices an unlisted phone number so they can get through to our dispatcher. This works OK, we sometimes think we need an extra person to take these calls so the dispatcher can focus on getting crews to outages
●		Katrina Wilma	We are linked into E911 systems at the state level. We have our own Emergency Management system that coordinates with the state. Everything worked well.
	●	Katrina	There was none. They had their own problems.
		Katrina Wilma	We did not have much, if any, coordination with state or local authorities. (We) not own transmission lines and do not have the work crews that other utilities have. Our work force is small, since we maintain substations and not lines.
●		Katrina	We had direct lines to ones that had phone lines plus we monitored their freq. and radio traffic. We maintained phone service in our [illegible] south of the coast by 150 miles

			maintained phone service in our area as we are north of the coast by 150 miles
●		Katrina	Public Safety folks called to ask how to get on our systems and how they could work with us. There was no formal process… in most cases PS knew people within the IT department.
●	●	Katrina	During the first two weeks after the storm there was a lot of confusion from all parties. We did work things out with emergency officials but had no direct communications via radio with any one other than our local G&T [generation and transmission provider].
●		Katrina	Coordination with state public safety etc. was done on dedicated phone lines and not thru any radio link. The communication to my knowledge did not suffer any major problem.