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14. ABSTRACT

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Without question, the relief operation following Hurricane Katrina was a monumental task and performed admirably by all those involved. However, the operation was not a smooth success. The issues of interference, duplication of effort and friction were all realized due to the inability of the JTF-Katrina Commander's staff to effectively manage the electromagnetic spectrum and resolve communications interoperability issues. Furthermore, the JTF-Katrina Commander's ability to exercise command and control and maintain situational awareness was nearly non-existent leading to coordination issues and delays in the relief efforts. Fortunately, these issues can be resolved and lessons can be derived for future disaster relief operations.

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SAY AGAIN? LESSONS FROM HURRICANE KATRINA IN SPECTRUM MANAGEMENT AND COMMUNICATIONS INTEROPERABILITY

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

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Contents

Abstract

SAY AGAIN? LESSONS FROM HURRICANE KATRINA IN SPECTRUM MANAGEMENT AND COMMUNICATIONS INTEROPERABILITY

The concepts of electromagnetic spectrum management and communications interoperability are nothing new or revolutionary. They are core functions that enable successful command and control for the Joint Force Commander throughout the range of military operations. The importance of these functions cannot be stressed enough. When properly planned for and executed, electromagnetic spectrum management and communications interoperability ensure issues such as interference, duplication of effort and friction are eliminated. In the particular case of disaster relief, they become even more imperative since the destruction of the communications infrastructure within a disaster area is very likely. Hurricane Katrina provided perhaps the greatest illustration of this fact.

Without question, the relief operation following Hurricane Katrina was a monumental task and performed admirably by all those involved. However, the operation was not a smooth success. The issues of interference, duplication of effort and friction were all realized due to the inability of the JTF-Katrina Commander's staff to effectively manage the electromagnetic spectrum and resolve communications interoperability issues. Furthermore, the JTF-Katrina Commander's ability to exercise command and control and maintain situational awareness was nearly non-existent leading to coordination issues and delays in the relief efforts. Fortunately, these issues can be resolved and lessons can be derived for future disaster relief operations.

Introduction

Since the feasibility of radio communication was first demonstrated by Italian inventor Guglielmo Marconi in 1896, the electromagnetic spectrum has flourished as an information medium.[1] With the passage of time and the progression of technology, the electromagnetic spectrum has truly become a critical resource. Whether it is a simple system as a handheld push-to-talk radio or the highly sophisticated blue force tracker, the electromagnetic spectrum plays an integral role in supporting both military and civilian operations. One could surmise that in the 21st Century, the Joint Force Commander would be incapable of conducting any type of operation without the use of the electromagnetic spectrum.

The electromagnetic spectrum itself is a "vast band of energy frequencies extending from radio waves to gamma waves, from the very lowest frequencies to the highest possible frequencies."[2] One of the components of the electromagnetic spectrum is the radio frequency band. The radio frequency band spans from 3 Hertz to 300 Gigahertz and includes systems such as High Frequency radios on the low end of the band to Millimeter Wave radars at the highest end.[3]

The narrow radio frequency portion of the spectrum is where the majority of modern systems operate. As such, it is fundamentally important for the Joint Force Commander to have a plan for the use of the electromagnetic spectrum throughout the range of military operations. The *Chairman of the Joint Chiefs of Staff Instruction 3320.01* states:

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[1] Mary Bellis, "The Invention of Radio," http://inventors.about.com/od/rstartinventions/a/radio.htm (accessed 10 April 2010).
[2] Space Today Online, "What is the Electromagnetic Spectrum?" http://www.spacetoday.org/DeepSpace/Telescopes/GreatObservatories/Chandra/ElectromagneticSpectrum.html (accessed 10 April 2010).
[3] Ibid.

> Effective spectrum management (the organized control and use of the electromagnetic spectrum) is fundamentally essential to sound defensive IO [Information Operations] and C2 [command and control] protection, which in turn ensure operations can be conducted with minimal unintentional interference (fratricide) and without negative electromagnetic environmental effects (E3).[4]

The possibility of fratricide or systems unable to operate together on the spectrum creates a tremendous problem at the operational level of war for the Joint Force Commander, especially in the function of command and control. And as stated in Joint Publication 1, "Command and control (C2) is the means by which a Joint Force Commander synchronizes and/or integrates joint force activities in order to achieve unity of command. C2 ties together all the operational functions and tasks, and applies to all levels of war and echelons of command across the range of military operations."[5]

This problem was realized on August 29, 2005, when one of the most catastrophic natural disasters, Hurricane Katrina, struck the United States. Therefore, the purpose of this paper is to explore as an illustrative example the challenges faced by the Joint Task Force (JTF)-Katrina Commander, Lieutenant General Russel Honore, with regards to spectrum management and communication systems interoperability to provide lessons for future domestic disaster relief operations. For in the case of Hurricane Katrina, the lack of spectrum management and communications interoperability further exasperated the breakdowns in both the JTF-Katrina Commander's ability to exercise command and control and maintain situational awareness throughout the disaster relief operation.

[4] Chairman, U.S. Joint Chiefs of Staff, "Electromagnetic Spectrum Use in Joint Military Operations," CJCSI 3320.01 (Washington, DC: CJCS, 1 May 2000).
[5] Chairman, U.S. Joint Chiefs of Staff, *Doctrine for the Armed Forces of the United States*, Incorporating Change 1, Joint Publication (JP) 1 (Washington, DC: CJCS, 20 March 2009), IV-15.

Background

To understand why the breakdowns occurred during Hurricane Katrina, one must first look at how the process of electromagnetic spectrum management and communications interoperability was doctrinally accomplished prior to Hurricane Katrina. Defense support to civil authorities is the official terminology used to describe when active duty forces are deployed in support of a federal disaster whether natural or man-made. As described in the *2005 Strategy for Homeland Defense and Civil Support*:

> At the direction of the President or the Secretary of Defense, the Department of Defense (DoD) provides defense support to civil authorities in order to prevent terrorist incidents or manage the consequences of an attack or a disaster. DoD provides support to a lead Federal Agency. Civil authorities are most likely to request DoD support because the military can provide unique capabilities when civilian responders are overwhelmed.[6]

One of the important capabilities the Joint Force Commander provides is a vast array of communications systems. These systems are used to support the lead Federal Agency, typically the Department of Homeland Security, as called for by the National Response Plan.

The National Response Plan is the overall architecture the Federal government uses to execute disaster relief. Within the National Response Plan there are several annexes entitled Emergency Support Functions (ESF) which outline the response and assistance to be provided by the supporting agencies to include the Department of Defense. The Emergency Support Function which specifically deals with communications support is Emergency Support Function #2. The 2004 Emergency Support Function #2 stated:

> Communications ensure the provision of Federal communications support to Federal, State, local, tribal and private-sector response efforts during an Incident of National Significance. This ESF supplements the provisions of the National Plan for

[6] U.S. Department of Defense, *Strategy for Homeland Defense and Civil Support* (Washington, DC: Deputy Secretary of Defense, June 2005), 14.

> Telecommunications Support in Non-Wartime Emergencies, hereafter referred to as the National Telecommunications Support Plan (NSTP).[7]
>
> Further, ESF #2 coordinates Federal actions to provide the required temporary National Security and Emergency Preparedness (NS/EP) telecommunications, and the restoration of the telecommunications infrastructure. ESF #2 supports all Federal departments and agencies in the procurement and coordination of all NS/EP telecommunications services from the telecommunications and information technology (IT) industry during an incident response.[8]

Overall, Emergency Support Function #2 provided general guidance as to the type of communications support the lead Federal Agency expected.

For specific instructions, the Joint Force Commander must utilize Joint Doctrine. Within Joint Publication 6-0, the Joint Force Commander when tasked with Homeland Security/Defense Communications System Planning must:

> Provide the command and control interface with Federal, state, and local authorities. Interfaces include military web portals accessible by non-.mil servers, unclassified defense collaborative tool suite or similar commercial collaboration tools, JTF-owned deployable commercial voice switching, secure VTC in each governor's office, radio cross-banding so that land mobile radios, tactical satellite radios, high frequency (HF) radios, and cell phones can communicate with each other, and links to national laboratories and other subject matter experts.[9]

The process by which the Joint Force Commander provides communications support is further defined within doctrine.

The specific process for electromagnetic spectrum planning and management is developed by the Joint Force Commander's Joint Spectrum Management Element (JSME).[10]

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[7] U.S. Department of Homeland Security, *National Response Plan*, (Washington, DC: Secretary of Homeland Security, December 2004), ESF #2-1.
[8] Ibid.
[9] Chairman, U.S. Joint Chiefs of Staff, *Joint Communications Systems*, Joint Publication (JP) 6-0 (Washington, DC: CJCS, 20 March 2006), III-8.
[10] Ibid., III-13.

The Joint Spectrum Management Element has several responsibilities. The most important are:

> 1) Establish and maintain the common database necessary to plan, coordinate, and control electromagnetic spectrum use. The database should contain electromagnetic spectrum use information on all emitters and receivers as appropriate for the operational area involved.
>
> 2) Analyze and evaluate potential electromagnetic spectrum use conflicts as part of the Joint Operation Planning and Execution System (JOPES), ongoing missions, and training. Support other staff sections with electromagnetic spectrum analysis to minimize electronic fratricide prior to or during operations.
>
> 3) Develop and distribute appropriate electromagnetic spectrum-use plans that include frequency reuse and sharing schemes for specific frequency bands.
>
> 4) Prepare a joint restricted frequency list (JRFL) for approval by the J-3. This is accomplished through membership in the Information Operations (IO) cell, or equivalent, and in conjunction with the joint force J-2, J-3, and J-6.
>
> 5) Receive, report, analyze, and attempt to resolve incidents of harmful electromagnetic interference (EMI).[11]

These responsibilities when properly executed by the Joint Spectrum Management Element ensure that interference, duplication of effort and friction within the realm of command and control for the Joint Force Commander are significantly reduced.

With regards to communications interoperability, doctrine also provides specific guidance for the Joint Force Commander. To achieve interoperability there are four critical factors: commonality, compatibility, standardization and liaison. Commonality refers to equipment and systems that are interchangeable and is the preferred method of interoperability. Compatibility is the condition that allows separate systems to operate in the same electromagnetic environment without interfering with each other. Standardization ensures that future systems are capable of interfacing with each other on the various

[11] Chairman, U.S. Joint Chiefs of Staff, *Joint Communications Systems*, Joint Publication (JP) 6-0 (Washington, DC: CJCS, 20 March 2006), III-14.

networks. Lastly, interoperable systems are not possible unless joint and multinational forces as well as Other Governmental Agencies (OGA) and Non-Governmental Organizations (NGO) liaison with each other to achieve comparable systems.[12] Overall, implementation of these four factors makes communications interoperability attainable.

The Impact of Hurricane Katrina

Hurricane Katrina made landfall on Monday, August 29, 2005, at 6:10 AM as a formidable Category 3 storm.[13] The storm's 130 mph sustained winds stretched over 103 miles from its center, while tropical storm force winds extended 230 miles from its center.[14] In conjunction with these tremendous winds, the storm surge generated by Hurricane Katrina reached twenty-seven feet in Louisiana and Mississippi and flooded nearly six miles inland in many parts of coastal Mississippi and up to twelve miles inland along the many rivers and bays throughout the Gulf Coast.[15] In all, Hurricane Katrina impacted over 93,000 square miles.[16]

Moreover, the loss of life and property due to the storm was devastating. The final toll of Hurricane Katrina included over $96 billion in property damage with an estimated 300,000 homes lost and 118 million cubic yards of debris. This resulted in over 770,000 people displaced throughout the Gulf Coast while 1,330 people lost their lives. The worst losses were felt in New Orleans where 80% of the fatalities occurred while Mississippi lost

[12] Chairman, U.S. Joint Chiefs of Staff, *Joint Communications Systems*, Joint Publication (JP) 6-0 (Washington, DC: CJCS, 20 March 2006), I-8-I-9.
[13] U.S. President, *The Federal Response to Hurricane Katrina: Lessons Learned*, (Washington, DC: White House, February 2006), 33.
[14] Lynn E. Davis et al., *Hurricane Katrina: Lessons for Army Planning and Operations*, RAND Report DAPRR06017 (Santa Monica, CA: RAND, 2007), 1.
[15] U.S. President, *The Federal Response to Hurricane Katrina: Lessons Learned*, (Washington, DC: White House, February 2006), 33.
[16] Ibid., 5.

231 people.[17] To place this in perspective, according to a RAND study, "Hurricane Andrew (one of the costliest U.S. natural disasters before Hurricane Katrina) created $33 billion in property damage, destroyed approximately 80,000 homes, produced 20 million cubic yards of debris, displaced approximately 250,000 people, and killed approximately 60 people."[18] Without question, the unimaginable costs of Hurricane Katrina qualified this storm as the worst natural disaster in U.S. history.

But, the damage to property extended beyond just housing. Hurricane Katrina also destroyed the critical communications infrastructure, telephone service, police and fire dispatch centers, and emergency radio systems across the Gulf Coast.[19] During testimony before the U.S. Senate Committee on Commerce, Science and Transportation, Kenneth Moran, Director of the Federal Communications Commission's Office of Homeland Security, stated, "Hurricane Katrina knocked out more than 3 million customer phone lines in Louisiana, Mississippi, and Alabama area…Of the 41 broadcast radio stations located in New Orleans and the surrounding area, only two AM and two FM stations remained on the air in the wake of the hurricane…Nearly 100 radio and television stations remained off the air."[20] As a result of the widespread destruction to the communications infrastructure, the use of hand-held radios and other devices that utilized the electromagnetic spectrum became absolutely necessary for all those involved in the relief operation.

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[17] U.S. President, *The Federal Response to Hurricane Katrina: Lessons Learned*, (Washington, DC: White House, February 2006), 7-8.
[18] Lynn E. Davis et al., *Hurricane Katrina: Lessons for Army Planning and Operations*, RAND Report DAPRR06017 (Santa Monica, CA: RAND, 2007), 2.
[19] U.S. President, *The Federal Response to Hurricane Katrina: Lessons Learned*, (Washington, DC: White House, February 2006), 34.
[20] Kenneth Moran, "Testimony," Senate, *Hurricane Katrina and Communications Interoperability: Hearing before the Committee on Commerce, Science and Transportation*, 109th Cong., 1st sess., 2005, p. 3-4.

Managing the Spectrum

When Hurricane Katrina made landfall, no one expected or planned for the sheer destruction to the communications infrastructure. As a result, first responders found themselves incapable of providing the needed assistance throughout the many cities affected in the Gulf Coast. For example, in New Orleans the flooding blocked access to the police and fire dispatch centers, while neither the 911 service nor the public safety radio communications functioned properly. Additionally, the entire state of Louisiana's 800 Megahertz radio system, "designed to be the backbone of mutual aid communications", completely failed and repairs to the system were delayed for a considerable time due to the flooding. In all, the complete devastation of the communications infrastructure left responders without a reliable network to use for coordinating emergency response operations.[21]

Another example of the inability of the first responders to communicate adequately was provided in *A Failure of Initiative*, the bipartisan Congressional study in the preparation for and response to Hurricane Katrina. The report found that "at one point, hundreds of New Orleans first responders were trying to communicate on only two radio channels on a backup system, forcing them to wait for an opening in the communications traffic to transmit or receive critical information."[22] The White House's lessons learned summed up the overall situation best with the statement, "the communications problems had a debilitating effect on response efforts in the region and the overall national effort. Officials from national leaders to emergency responders on the ground lacked the level of situational awareness necessary

[21] U.S. President, *The Federal Response to Hurricane Katrina: Lessons Learned*, (Washington, DC: White House, February 2006), 37.
[22] House Committee to Investigate the Preparation for and Response to Hurricane Katrina, *A Failure of Initiative*, 109th Cong., 2nd sess., 2006, 164.

for a prompt and effective response to the catastrophe. This was a recipe for an inefficient and ineffective Federal response."[23]

As a result of these communications deficiencies, several agencies to include the Department of Defense, provided supplementary communications systems as called for in the National Response Plan. For example, under the direction of Rear Admiral Joseph Kilkenny, the Joint Force Maritime Component Commander, JTF-Katrina, the Navy provided the Deployable Joint Command and Control System. This system provided a "standardized, rapidly deployable, scalable, and reconfigurable Joint Command and Control (C2) and collaboration Combat Operations Center (COC) system."[24] On August 31, National Guard Bureau Chief Lieutenant General Steven Blum reported that the Department of Defense was "pushing every communications asset that we have."[25] Additional support for communications systems was provided by the National Interagency Fire Center, which sent over 3,200 handheld radios, thirty-eight satellite systems and several other communication modules in order to supplement the Gulf Coast's damaged communication networks.[26]

Although the response to bolster communication capabilities was tremendous, it still lacked the requisite spectrum management resulting in substantial problems. For example, as noted in the National Guard Bureau's After Action Report, "National Guard and DoD active duty helicopters were conducting rescue missions over New Orleans with no preplanning for command and control. The different helicopters had different radios and used different

[23] U.S. President, *The Federal Response to Hurricane Katrina: Lessons Learned*, (Washington, DC: White House, February 2006), 41.
[24] U.S. Department of Defense, "What is DJC2?" https://www.djc2.org (accessed 10 April 2010).
[25] U.S. President, *The Federal Response to Hurricane Katrina: Lessons Learned*, (Washington, DC: White House, February 2006), 41.
[26] Ibid.

frequencies, creating a dangerous situation for mid-air collisions in an area with little or no air traffic control."[27]

Another example provided in the National Guard Bureau's After Action Report discussed the spectrum management issues faced by the 35th Infantry Division upon arrival to the Joint Operations Area on September 6th. The 82nd Airborne was tasked by the JTF-Katrina Commander to provide the 35th Infantry Division with frequency management support. However, after the arrival of the 35th, "there was still confusion over what frequencies to use because many systems were already using the assigned frequency. The 35th Infantry Division did not have the proper equipment to de-conflict the frequency use, and could not obtain it until September 12, almost a week later."[28] This type of delay due to poor spectrum management plagued and severely hindered the relief efforts of the JTF-Katrina Commander.

Overall, the Joint Spectrum Management Element could not keep up with the deconfliction requirements due to the vast numbers of communication systems being pushed in the Joint Operations Area. As a result, problems such as interference and friction were a common occurrence. The consequence of poor spectrum management during Hurricane Katrina was that the JTF-Katrina Commander did not have a clear picture of what was really happening. This, in turn, significantly impacted his ability to exercise command and control and ensure a coordinated relief effort of the active duty forces employed.

Furthermore, in the instances where spectrum management was applied for the assets being pushed into the Joint Operations Area the results did not provide a large enough impact. One particular example of the JTF-Katrina Commander's attempt to manage the

[27] House Committee to Investigate the Preparation for and Response to Hurricane Katrina, *A Failure of Initiative*, 109th Cong., 2nd sess., 2006, 221.
[28] Ibid.

spectrum was the use of the Navy's Afloat Electromagnetic Spectrum Operations Program (AESOP). Used by the Naval Surface Warfare Center's Spectrum Engineering Group, AESOP "coordinated spectrum use for U.S. Navy ships and U.S. Coast Guard vessels, in conjunction with the National Guard; FEMA; and other federal, state, and local authorities."[29] However, due to the sheer volume of communications assets entering and exiting the operations area, AESOP could not keep up with the deconfliction of the electromagnetic spectrum. Nonetheless, the support provided by the AESOP team was invaluable for without that support, "the situation, as bad as it was, could have been exponentially worse."[30]

Communications Interoperability

Of the four principles of communications listed in Joint Publication 6-0, interoperability is the first and classified as the "key" to ensuring success in joint operations.[31] Therefore, within the context of Hurricane Katrina, it is not surprising that the lack of communications interoperability was a significant factor in the breakdown of command and control and situational awareness of the JTF-Katrina Commander. The considerable destruction of both the landline and cellular communications infrastructure as noted before, forced the units supporting the relief effort to rely on external communications systems brought in through the various supporting agencies; the Department of Defense being the biggest contributor of equipment.

But, this created a problem as not all the systems brought to assist the relief efforts could operate together. Many times emergency responders, National Guard and active duty

[29] Margaret Neel, "Support to Hurricane Katrina Disaster Relief Operations," *Leading Edge* 7, no. 1, 106, http://www.navsea.navy.mil/nswc/dahlgren/Leading%20Edge/default.aspx (accessed 10 April 2010).
[30] Ibid.
[31] Chairman, U.S. Joint Chiefs of Staff, *Joint Communications Systems*, Joint Publication (JP) 6-0 (Washington, DC: CJCS, 20 March 2006), I-8.

military forces were using different equipment which could not communicate with each other. For example, many of the Police Officers throughout New Orleans were carrying handheld Motorola radios while the active duty military units were using secure Single Channel Ground and Airborne Radio System (SINCGARS) radios. As a result, efforts could not be coordinated at the tactical or operational level.[32]

Even Lieutenant General Blum was quoted, "one critical area where we lack integration is in interoperable communications. National Guard units do not have the equipment necessary to effectively share information with Title 10 forces. This caused significant challenges on the ground that then bubbled up the chain."[33] The Adjutant General for Mississippi, Major General Harold Cross, stated that due to the lack of interoperable communications systems, he utilized runners between units as was used during World War I.[34] These types of challenges and rudimentary means of communications certainly led to the breakdown in command and control for the JTF-Katrina Commander, as there was an inability to effectively coordinate the relief efforts.

Even the attempts at integrating the various communication systems deployed proved ineffective. For example, the Federal Emergency Management Agency (FEMA) deployed mobile communication vans called Mobile Emergency Response Systems (MERS). These units provided the capability to rapidly integrate multi-media communications, information processing, logistics and operational support to federal, state and local agencies.[35]

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[32] U.S. President, *The Federal Response to Hurricane Katrina: Lessons Learned*, (Washington, DC: White House, February 2006), 191.
[33] House Committee to Investigate the Preparation for and Response to Hurricane Katrina, *A Failure of Initiative*, 109th Cong., 2nd sess., 2006, 226.
[34] Scott Shane and Thom Shanker, "When Storm Hit, National Guard Was Deluged Too," *New York Times*, 28 September 2005, http://www.lexis-nexis.com/ (accessed 10 April 2010).
[35] House Committee to Investigate the Preparation for and Response to Hurricane Katrina, *A Failure of Initiative*, 109th Cong., 2nd sess., 2006, 168-169.

However, in a Government Accountability Office (GAO) report on Hurricane Katrina, it found that these measures were not enough. The report stated, "while the military and civilian agencies deployed mobile communication vans that were able to connect different communication systems that are normally incompatible, the placement of these vans was not coordinated and some areas had multiple systems while other areas had no systems at all."[36] Michael Brown, the FEMA director at the time of Hurricane Katrina, stated in Congressional testimony, "I prepositioned [the MERS units] in all three states so that we would have communications wherever we needed it. I eventually sent one of those command units…into New Orleans for Mayor Nagin to use. In retrospect, I wish I'd done that four days earlier."[37] Although, assets were used to facilitate communications interoperability, in the end these systems did not provide the support the JTF-Katrina Commander truly needed.

The results for the JTF-Katrina Commander due to the lack of communications interoperability were just as similar to those due to the lack of spectrum management. His ability to exercise command and control and maintain situational awareness throughout the relief effort was severely degraded. Duplication of effort was also a common occurrence as first responders and active duty forces would often conduct search and rescue efforts through the same neighborhood but miss other ones entirely. It was stated within *A Failure of Initiative*, "Massive interoperability – failed, destroyed, or incompatible communications systems – was the biggest communications problem in the response to Katrina."[38] In all,

[36] U.S. Government Accountability Office, *Hurricane Katrina: Better Plans and Exercises Needed to Guide the Military's Response to Catastrophic Disasters: Report to Congressional Committees* (Washington, DC: GAO, 2006), 25.
[37] House Committee to Investigate the Preparation for and Response to Hurricane Katrina, *A Failure of Initiative*, 109th Cong., 2nd sess., 2006, 169.
[38] Ibid., 163.

communications interoperability proved to be a critical weakness for the JTF-Katrina Commander.

Conclusions and Lessons Learned

The concepts of electromagnetic spectrum management and communications interoperability are nothing new or revolutionary. They are core functions that enable successful command and control for the Joint Force Commander throughout the range of military operations. The importance of these functions cannot be stressed enough. When properly planned for and executed, electromagnetic spectrum management and communications interoperability ensure issues such as interference, duplication of effort and friction are eliminated. In the particular case of disaster relief, they become even more imperative since the destruction of the communications infrastructure within a disaster area is very likely. Hurricane Katrina provided perhaps the greatest illustration of this fact.

Without question, the relief operation following Hurricane Katrina was a monumental task and performed admirably by all those involved. However, the operation was not a smooth success. The issues of interference, duplication of effort and friction were all realized due to the inability of the JTF-Katrina Commander's staff to effectively manage the electromagnetic spectrum and resolve communications interoperability issues. Furthermore, the JTF-Katrina Commander's ability to exercise command and control and maintain situational awareness was nearly non-existent leading to coordination issues and delays in the relief efforts. Fortunately, these issues can be resolved and lessons can be derived for future disaster relief operations.

The first operational lesson derived from Hurricane Katrina is that the existing communications infrastructure cannot be relied upon for use following a disaster. As a

result, a tremendous inflow of dissimilar communications systems will be sent to the Joint Operations Area. Therefore, the Joint Force Commander must be prepared to process and redistribute these systems to all those involved in the relief operation to ensure coordination while minimizing delays.

A method to accomplish this requirement is through the immediate establishment of a central processing and distribution location for communications systems within the Joint Operations Area. By having a single distribution hub for all the communications systems that are sent from the various agencies assisting in the relief operation, the Joint Force Commander can ensure that requirements such as frequency deconfliction have been accomplished prior to the allocation of equipment. Additionally, the Joint Force Commander has the opportunity to verify that interoperability issues are resolved or ensure that systems such as the Deployable Joint Command and Control System or the Mobile Emergency Response System are capable of integrating those communications systems which are not interoperable. Overall, centralizing the distribution of communications systems provides the Joint Force Commander a credible way to mitigate both spectrum management and interoperability issues.

The second operational lesson is the need to create and train towards a regionally focused spectrum management plan well prior to the actual occurrence of a domestic disaster. It is apparent from the examples of frequency interference issues faced by the first responders, the National Guard and the active duty forces in the Joint Operations Area that the radio frequency plan was neither sufficient nor practiced. For future disaster relief operations, the spectrum management plan must take into account the sheer volume of communications systems that will be brought to assist in the relief operation that do not

normally operate in that region. Moreover, the plan cannot remain static. It must be continually assessed and determined if it is still feasible or needs to be updated accordingly. The Joint Force Commander cannot worry about electromagnetic spectrum availability or interference issues during the relief operation itself, a regional plan must be developed well prior so that it is ready for execution when the need arises.

A third lesson for the Joint Force Commander is that standardized communications equipment is the ideal way to ensure communications interoperability, but the most difficult to achieve. Nonetheless, the need to convey information as well as have a clear picture of the situation makes interoperability an absolute necessity. Therefore, measures must be taken prior to a disaster to mitigate this issue.

One method to achieve interoperability that can be applied to domestic disaster relief was created by former Director of U.S. Pacific Command's Command, Control, Communications, Computer Systems Directorate (J6), Brigadier General Ronald Bouchard. He provided a six-step process to achieve interoperability:

1) Validate interoperability requirements
2) Apply appropriate military standards to release a standard
3) Verify standard implementation via one-on-one conformance testing
4) Validate interoperability through combined interoperability testing
5) Demonstrate interoperability through exercises
6) Use interoperability to improve warfighter lethality and effectiveness during operations.[39]

Although interoperability requirements amongst state and local officials cannot be mandated by the Joint Force Commander, by identifying what systems are utilized by all involved the Joint Force Commander can then plan ways to mitigate potential problems. Moreover, the need to test systems against each other whether in a controlled environment or during an

[39] Henry S. Kenyon, "Information Sharing Crucial to Asian Operations," *Signal* 63, no. 2 (October 2008), 27-28, http://www.proquest.com/ (accessed 23 April 2010).

exercise will help the Joint Force Commander understand how to best overcome interoperability issues.

The final operational lesson learned from Hurricane Katrina is that spectrum management and communications interoperability are prerequisites to successful command and control for the Joint Force Commander. Without either of these critical requirements, the Joint Force Commander will not be able to execute his mission. Due consideration must be given to these factors, as the possibility of greater loss of life and property is exponentially increased when they are neglected.

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