RADIO INTEROPERABILITY: ADDRESSING THE REAL REASON WE DON'T COMMUNICATE WELL DURING EMERGENCIES

Susan G. Hutchins[1] and Ronald P. Timmons[2]

[1]Naval Postgraduate School
Monterey, California
[2]Public Safety Communications
Plano, Texas

Radio Interoperability: The Problem

- **Superfluous radio transmissions contribute to auditory overload of first responders**
  - **Obscure development of an accurate operational picture for all involved**
  - **Radio spectrum is a limited commodity — once it's full, it's full.**
- **Practical limit to number of people who can operate on a common platform before quality of communications deteriorates**
- **Policies and practices need to be reexamined to develop new strategies which will facilitate effective communications**

Radio Interoperability: Understanding It

- **Interoperability – a catch-all phrase to describe a multitude of issues surrounding emergency scene communications**
- **Does it refer to:**
  - **Police officers being able to talk to firefighters at the same incident; local fire officials talking to neighboring fire agencies?**
  - **Federal agencies with radio connection to state and local officials?**
  - **Implemented at the scene, command post, or Emergency Ops Ctr?**
  - **Provided for every responder, or command-to-command, only?**
  - **Wider issue of radio system coverage, frequency spectrum capacities, technology piece ergonomics, and alternate (non-voice) communications methods?**
- **A larger, unacknowledged and unaddressed human factors issue is the need for new procedures in the communications process.**

Radio Interoperability: Defining It

- Configuring a radio to talk to any other radio that may be present at the scene of an emergency response?
- At the same traffic accident, state police, local police, ambulance and fire personnel may be present.
  - Are we advocating all of them hearing each other, interactively sending voice radio messages to one another?
- One definition, pre-dating 9/11, came from a cross-section of industry professionals assigned to the Public Safety Wireless Advisory Committee.
  - "An essential communication link within public safety and public service wireless communication systems which permits units from two or more different agencies to interact with one another and to exchange information according to a prescribed method in order to achieve predictable results."

Radio Interoperability: Command-to-Command Use Only

- **Command-to-command use only**
  - **Much more feasible than trying to commingle all of the responders on a single channel**
  - **Segmented channels frequently become contentious during such incidents; with so many units talking they cover one another, hampering effective communications**
- **What will the exponential loading of the channel be like if four busy channels, loaded with agency-specific conversations are mixed on the same radio platform?**
- **Far more desirable to keep agencies on their routine operating platforms, clearing non-incident chatter on other incidents to separate channels.**

Establish an Incident-Specific Common Command Channel

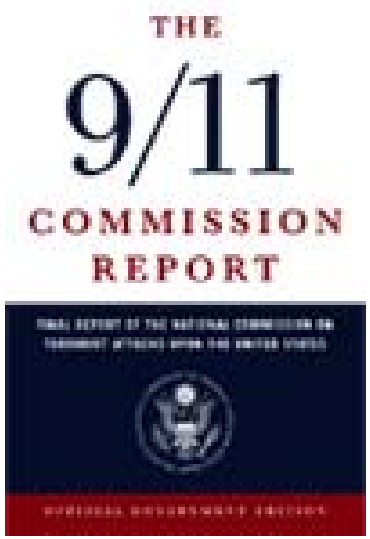
- Incident-specific common command channel among all agencies responding to the critical incident, but it
  - Must not be used as a poor substitute for a sound incident command system
    - Senior command personnel, as dictated by policy, will congregate at a single incident command post, to, communicate coordinate, and collaborate with their own personnel
    - National Incident Management System (NIMS) included this recommendation, is supposed to be universally understood and applied, nationwide, as a condition for continued grant funding
- Reasons for slow adoption of NIMS policy
  - Resistance to change
  - Denial of the possibility that a large-scale emergency can happen in any given jurisdiction
  - Reluctance to answer the "who's in charge?" question withi historic turf battles, especially relating to police vs. fire depa rivalries, and/or squabbles between various levels of government

Traditional Tendency: Devise Hardware Solutions

- **Tendency in organizations to devise hardware solutions for a whole range of challenges, instead of addressing human engineering issues.**
  - **A turnkey solution is hoped for—purchase and delivery of new equipment signals tangible evidence that something is being done.**
  - **Difficult for new equipment to get a proper test, even in the most realistic training exercise environment.**
  - **"Police and other emergency agencies responding to Hurricane Katrina were plagued by the same communications problems exposed by the World Trade Center bombing in 1993, yet a solution is still considered years away."**

Homeland Security Evolution

- Radio interoperability is one of many areas where homeland security is evolving so fast that it is outrunning the research.
- Rush to answer allegations of inefficient on-scene radio communications reported in the 9/11 Commission Report has led to the purchase of hundreds of millions of dollars of hardware, yet
  - Much of the problem is behavioral and is likely to be exacerbated by patching radio users together
  - Instead of achieving the intended outcome, which is to actually facilitate communication
  - New patching equipment is being deployed nationwide, with little, or no, guidance nor consensus on proper use.
  - Due to the nature of radio system architecture, patching equipment actually makes previously "guarded" or well-managed systems vulnerable, because for the first time, their airtime can be impacted by users outside of their system.



Standards on Emergency Scene Operations

- Deployment of NIMS and the formation of a center to create and issue standards on emergency scene operations, including communications (NIMS, 2004)
- National Fire Protection Association (NFPA) Standard on Disaster/ Emergency Management and Business Continuity Programs (Standard 1600), released in 2004
  - Currently undergoing debate at the committee level, and will likely undergo significant update and modification within its three-year review cycle
- 9/11 Commission Report focused considerable attention on dysfunctions present in the first responder community (National Commission on Terrorist Attacks, 2004). It should continue to be a catalyst for change for many years to come.
  - Attracting a lot of attention to the subject of standards, as evidenced by the designation of interoperability as being the top priority for grant proposal evaluations.

Radio Interoperability: Training

- **Starting to see inclusion of funding for training accompanying interoperability grant programs, signaling some recognition of the importance of attention to non-hardware solutions**
  - **Specific examples of actual training applications are difficult to find**
  - **What constitutes interoperability training is vague, leaving room for requesting jurisdiction to include training in their grant application without actually specifying what training will entail.**
  - **Little recognition of the need for improved human interoperability communications procedures, as agencies presumably expect an out-of-the-box solution, based on patching radio systems together.**

Common Themes

- Need better definition of issues associated w/ radio interoperability and more enlightened approaches for emergency scene communications
  - Interoperability problem ill-defined and the term was misapplied to include non-technical challenges
  - Solution to emergency scene communication generally equates to a technical treatment of how to patch one system to another, the larger question remains:
    - What behavioral components (i.e. procedures, training) are required as a necessary adjunct to hardware interoperability communications solutions?
    - Emergency scene communications issues a moving target.
- Experiences of Hurricane Katrina produced additional lessons learned.
  - In both man-made and natural disasters, infrastructure will be damaged, by whatever catastrophic event has occurred
  - Communications will be limited by the amount of radio traffic squeezed onto whatever radio spectrum remains operational.
    - Hospital in Gulfport, Mississippi

Case Study from a Regional Fire Training Exercise

- **Transcripts from critical incidents involving combinations of fire, police, medical, local, and mutual aid units, were analyzed**
  - **Coded incident transcripts from Sept 11, 2001, for timely and effective delivery of messages**
  - **Scoring criteria included successful message delivery, economy of wording, number of times a message went unacknowledged, and number of times it was necessary for a message to be repeated.**
- **Communications from a series of training exercises north of Dallas, TX**
  - **Working with other agencies, scripted series of actions in simulated multiple-alarm structure fire**
  - **Tactics/operational objectives**
  - **Not knowingly engaging in study on communications: Using radios as normally would at a building fire, with several separate agencies working together.**

Regional Fire Training Exercise

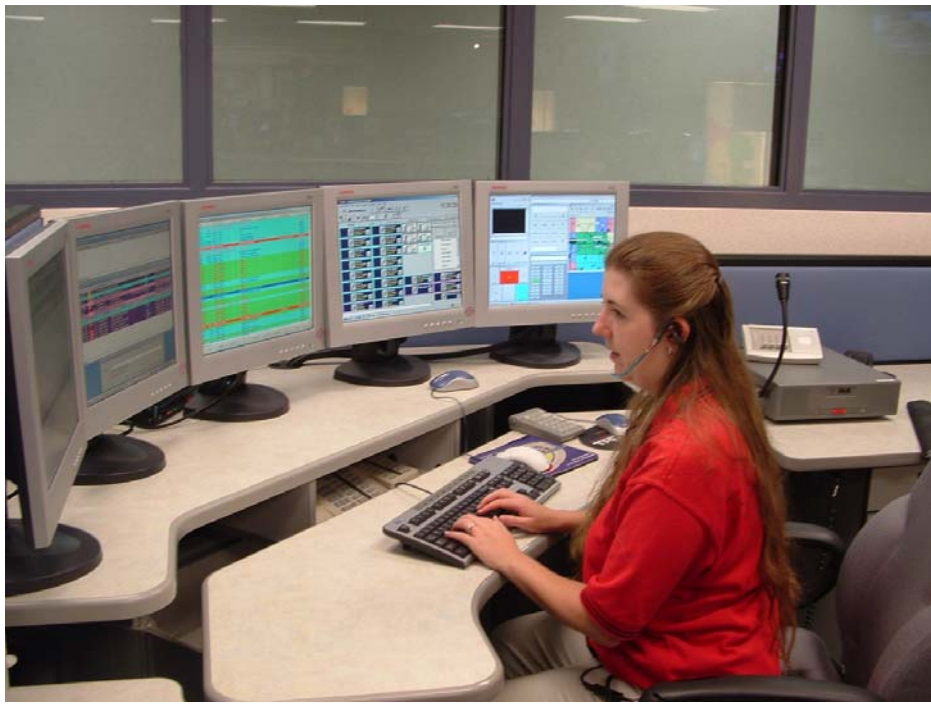
Number of Fire Departments Participating	**5**
Number of Engine Companies	**6**
Number of Truck Companies (or Engines w/Elevated Streams)	**5**
Medical Units (Ambulances)	**2**
Duration of the Exercise in Minutes	**62**
Communications Coding Analysis	
Number of Communications Turns	**428**
Average Length of Each Message in Seconds	**7**
Number of Words Broadcast	**3556**
Average Number of Words/ Communications Turn	**8**
Average Number of Words per Minute	**57**

Communications Anomaly Summary

Anomaly Type	Number of Turns	Percent of Turns
Unacknowledged Message	51	11.9%
Needed to be Repeated	21	4.9%
Confused/Unclear/ Questionable Value	11	2.6%
Exclamatory/ Excited Message	5	1.2%
Total	88	19.4%

Documented Communications Problems

- Common communication impediments were noted in several transcripts of emergency recordings
- Responding units tended to stop at first injured person encountered at periphery of incident and call for an ambulance, even when it was obvious that a mass casualty incident was underway, involving dozens, or even hundreds of victims.
- Communications became clipped into ineffective bits, to the where difficult to tell who talking to whom.
- If a field unit expressed excitement in their voice, the dispatcher's voice tended to also rise in pitch a and pace, but not to full extent of field users'
- Dispatcher plays key roll in keeping everyone calm by the use of a controlled voice inflection and in exuding a stoic confidence.



Documented Communications Problems

- Units prefacing their transmissions with key words, such as “urgent,” “priority message,” or “emergency traffic,” got greater attention than those continuing to speak unacknowledged and without preface, even if they conveyed urgency in the pitch and pace of their speech.
- Many incidents eventually got to the point where dispatchers and incident commanders tried to control and reduce volume of radio traffic by limiting who was talking. Requests such as “all units stand-by” and “command officers only on this channel” were commonly heard.
- A relatively small number of units dominated a majority of the airtime, often with non-critical matters, while many units said nothing.
- Channel loading unevenly skewed to a small portion of those present.

Positive Practices

- Most assiduous dispatchers/ commanders tried to anticipate things the field users might ask, and
  - Broadcast a summary of information, before asked for, in an effort to preempt use of the radio channel for repetitious information requests: Best access routes, staging areas, triage points, command post locations, and brief situational updates.
  - This relatively small list of variables made up a disproportionate number of repetitious/ superfluous radio transmissions.
- Timed milestone updates gave the most even flow of information
- Many dispatch computer systems have automated features to trigger prompts to the dispatcher at timed intervals, i.e. every 10-20 minutes.
  - Dispatcher-initiated requests for updates from incident commanders, at timed-intervals, aids dev't of an operational picture for those at the scene, and for support players off-site
- Not possible to eliminate all distractions/ simultaneous demands placed upon those operating at emergency scenes, great value would be derived if sensory input was managed and limited.

DISCUSSION

- Operating practices and regional variations make it difficult and undesirable for the thousands of police/ fire departments to operate in exactly the same way.
- Despite minor regional differences, overriding need to cooperatively work together, in the spirit and intent of homeland security initiatives dictates development of common practices and policies that will help first responders bridge regional differences.
- One aspect of needed common practice and policies involves new procedures for use by first responders when using radio equipment designed to improve interoperability.

Training

- Training on prioritization of radio messages and introduction of the concept of communication alternatives, other than public safety radio.
  - Face-to-face communication and sector-level task coordination are ex's of ways to achieve objectives without use of radio resources.
  - Unacknowledged messages to the incident commander is an area of concern, and was noted in other un-scored exercises in this series, as well in the recordings studied from actual emergencies.
  - Further research is needed to fully assess predominant reasons for such inattention, since radio problems and clarity of the message were not noted on the recording. Incident commander was presumably attending to something else at that instant.
- Have personnel at the emergency scene assigned exclusively to facilitate communications support for the incident commander.
  - Some large first responder departments have such scene-based communications capabilities (aides, chiefs' drivers, etc).
  - Other agencies should seek creative ways to develop such expertise, such as detailing first-arriving support personnel who often self-dispatch to large-scale incidents. Greater operational efficiency, enhanced crew safety, and reclamation of scarce radio airtime can be expected if communications support personnel operate inside a quiet environment, at the command post, with the incident commander. Communications specialists should be supplied with adjunct devices, such as headphones and visual displays, allowing them to pay close attention to radio traffic and assist the incident commander in communications continuity.

Changes to Radio Procedures

- Changes to radio procedures are needed to
  - Manage/ reduce the amount of radio transmissions
  - Establish procedures and policies for treatment of large numbers of casualties without the need to call for help individually for each one
  - Command and control from a detached perspective to improve the quality of the information provided and control the vocal tone of those transmitting.
- Goal: Divert dominant focus from technology and devise a template for agencies interested in optimizing their mission-critical communications.
- Better, more realistic expectations, and more effective communications within the limits of public safety radio infrastructure.

Changes to Radio Procedures

- A set of new procedures were drafted for first responder agencies at the author's [Timmons] city (Plano, TX), home to 250,000 people.
- Public Safety Communications, is responsible for the receipt of 911 calls and dispatching of the police, fire and medical units. The department also operates the radio infrastructure for seven growing cities, covering over 250 square miles.
- As is the case with many public agencies, equipment purchased with homeland security grants has begun to arrive from a number of sources.
- Little has been said about how to use it: The assumption has been that interoperability starts as soon as the boxes are opened. To overcome the inherent limitations of radio system patching of multiple units onto a common operational platform, a new procedure is proposed which prioritizes the use of limited radio resources by controlling the flow at the source.
- Procedural recommendations are based on a review of numerous critical incidents involving various combinations of fire, police, medical, local, and mutual aid units, responding to single and multi-jurisdictional incidents, which revealed a common pattern of influences.

New Procedure Proposed

- **Policy draft presented to the Plano Fire Department, by Timmons, reads in part:**

  It must be recognized that significant single or multiple events can create a communications system overload situation that negatively impacts scene operations. The expected, and understandable, emotional state of radio system users, combined with the shear number of units transmitting on a system, will frequently contribute to a disaster scene communications breakdown. There has been a tendency by some agencies to fragment operational groups at the same incident, onto different radio system talk-paths (talkgroups, channels, frequencies). While assigning additional talkgroups to sectorized functions provides some buffering, it must be remembered that it will become difficult for dispatchers and incident commanders to effectively monitor and control multiple talkgroups. Moreover, there is a practical limit to the number of simultaneous conversations possible on systems that typically are shared by several agencies, and routine radio traffic, will continue, in addition to the specific incident.

New Procedure Proposed (cont'd.)

- Policy draft presented to the Plano Fire Department, recommends:
- Dispatch will announce, "The Priority Dispatch Policy is now in effect."
- A periodic, soft beeping tone will automatically be played on the channel as a reminder of the special condition.
- Dispatch will answer with, "(Unit #) go ahead with priority traffic."
- Units operating on the channel will suspend routine traffic
  - calling en route,
  - requesting assignments
  - repeating size-ups, etc
- To support this step, dispatch will endeavor to broadcast (and periodically repeat) staging area locations, known hazards, triage area, and best access information.
- Calling dispatch on the phone should be avoided since the incident itself is likely to stretch 911 Center capacity. The computer system should be used to achieve silent unit status change notification.

New Procedures

- **Unit-to-unit traffic must be reduced, condensed and prioritized, in the interest of system capacity conservation.**
- **Transmission of “Maydays” and “Emergency Traffic” receives highest priority.**
- **Whenever possible, transmission on the radio should be limited to command officers only.**
- **Formation of self-contained task forces, based on alarm levels, moved-up from staging, offer the greatest opportunity for task assignment and accomplishment, with minimal radio transmissions.**
- **Face-to-face communication with sector officers, after assignment from staging, provides the greatest prospect for member safety and operational objective achievement, without the use of radio narration typical at routine incidents. *In this mode, the radio becomes a receiver of critical information, only broadcast upon for immediate, life safety issues.***

New Procedures (cont'd.)

- **During peak system loading, it will be necessary to suspend or significantly abbreviate the fire department SOP Section 303.XII.A.7 (It states: When Incident Commanders issue assignments face-to-face, those assignments shall also be announced over the radio to insure that everyone at the incident is aware.)**
- **Wherever practical, staging and sector officers will issue verbal, standing orders to be followed, until objective accomplishment, or until further notice.**
  - **This will reduce the tendency of units to use airtime for task-related information, distracting to the overall operational picture.**
- **At some point in all mass casualty incidents, it becomes impractical to make individual requests for ambulance responses, to specific victim locations.**
  - **Whenever possible, low priority patients should be directed or assisted to a triage area, instead of requesting ambulances over the air to specific locations.**
- **Within the limits of existing policy, patient reports to the hospital, broadcast on the radio system, should be appropriately abbreviated and standing orders implemented wherever practical.**

Homeland Security Grant Focus

- Interoperability – as top grant funding priority – made it easy for agencies to select equipment without thought or due diligence
- Pressure to make improvements in Homeland Security posture
  - Radio patching equipment procured w/o forethought on
    - How it will be used
    - Who will operate it
    - Potential security vulnerability it may create
    - Deleterious effect it may have on communications networks
- Easier to access funds, process encouraged haphazard requests and development of unrealistic expectations
- Equipment affords potential to improve emergency scene comm's
  - Only if new equipment is deployed properly and users modify radio habits
  - Lack of training and modified procedures will hasten collapse of comm's networks (due to overload)