WIRELESS EMERGENCY RESPONSE TEAM
(WERT)

FINAL REPORT

for the

September 11, 2001 New York City
World Trade Center Terrorist Attack

OCTOBER 2001

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WIRELESS EMERGENCY RESPONSE TEAM

On the morning of September 11, wireless communications were used by countless Americans in their *usual* ways.

And then evil terrorists emerged to make their dark mark on human history.

During those same moments, wireless communications were used by brave hostages in the skies to report the hijacking of their planes, then by expectant victims to speak their last "*GOOD BYE*" and "*I LOVE YOU*", and then by rescue teams as they rushed to bring aid.

Wireless devices played a vital role on September 11 because they are popular, are easy to operate, are one of the few items carried everywhere by their users, and can still function when severe damage is done to surrounding infrastructure. Instruments that routinely conducted business and nurtured relationships were now, in their final mission, being used to secure the safety of the United State of America, or bring two individuals together – one in the jaws of death and the other in the comforts and safety of home - together for a final, treasured moment.

That night, news reports stated that cell phones were being used to call for help from the rubble. The vision for a coordinated industry emergency response was instantly conceived. In the following hours and days, an unprecedented wireless communications industry mutual-aid effort sprang into action to support Search and Rescue efforts at the World Trade Center disaster site. The Wireless Emergency Response Team was formed from the organizations on the opposite page.

Although the team was disappointed that we could not rescue a life from the rubble, value was realized in several ways: keeping rescue teams from danger by quickly discrediting false reports, confirming those thought to be missing as safe, and helping to bring closure for family members. Also, this report has documented the key learnings and recommendations, so that this capability can be enhanced and optimized – may it never be needed again.

In response to strong expressions of appreciation and value from various government agencies, industry organizations, and members of the public at large, the WERT capability will be available on a continuing basis. This document is intended as an outline for guidance in moving forward.
To the individuals and their organizations who made this effort possible: On behalf of the assisted families, rescue workers, and for those who may yet benefit from this capability – my profound gratitude. Knowing that we may have been the only hope that some would have, we rightly valued the dignity of human life and did all we knew could be done.

KARL F. RAUSCHER
FOUNDER / COORDINATOR – WIRELESS EMERGENCY RESPONSE TEAM
DIRECTOR – NETWORK RELIABILITY, LUCENT TECHNOLOGIES

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1 EXECUTIVE SUMMARY

This report documents the Key Learnings and Recommendations of the Wireless Emergency Response Team (WERT). The Recommendations are directed to government entities and the wireless industry.

The WERT was established on the night of September 11, 2001 for the purpose of providing coordinated wireless industry mutual aid support for the Search and Rescue effort for possible trapped survivors in the World Trade Center rubble. No trapped survivors were found. However, the WERT response to the September 11 crisis demonstrated that wireless communications can be a highly valuable resource for future Search and Rescue needs. Specifically, the Team provided substantial value in these ways:

- keeping rescue teams from danger by quickly discrediting false reports
- confirming as safe, individuals thought to be missing
- helping family members achieve closure
- assuring the public - both here and abroad - that all known technological approaches were being used to listen for any cellular or pager communication being sent from the rubble.
- spearheading a crisis and exposing many ripe opportunities - documented here - so that this capability can be enhanced and optimized

Here are summary statistics of the WERT effort:

- No survivors were found
- 33 organizations participated directly
- 250+ industry subject matter experts participated
- An additional ~500 volunteers staffed the Public Call Center
- 134 Key Learnings
- 23 Recommendations
- 5,039 calls received in the WERT Public Call Center
- 120 reports of a missing person's use of a cell phone or pager from rubble

The reports of a missing person's attempt to communicate from the rubble were escalated as top priority when they came in. Research and analysis for these cases resulted in final dispositions of: the person is safe and away from site, the report is a false alarm, the cell phone was being used outside of the Ground Zero area, the number reported was for a landline far from Ground Zero site, and the number reported is a duplicate of another report. In addition, the Team's analysis was able to provide authorities with correct information related to inaccurate media reports.

The report outlines five functions within WERT. For each of these functions, a description is provided of the Sub Teams: Mission, Approach, Key Learnings, Recommendations, and Participants. The five sub teams are:

- Command Coordination Center
- Network Surveillance and Analysis
- Service Provider Intelligence

- Public Call Center
- Ground Zero Locating

The Team recognizes that future disaster sites may have considerably different characteristics. Section 2, *INTRODUCTION*, reviews the relevant characteristics of the World Trade Center site. However, because these WERT Recommendations are presented from the five different functions (e.g., Network Surveillance and Analysis, Ground Zero Locating), recommendations from sub teams may be applicable, even though a future search and rescue effort may preclude the need for all five functions.

The details of these 134 Key Learnings and 23 Recommendations are provided in the full body of the Report. Here are some five examples – one from each of the five functional areas:

Coordination Command Center

> **Recommendation CCC-4**
> **The WERT should determine the most appropriate oversight of its operation. This oversight should ensure appropriate support and cooperation so that its Key Learnings and Recommendations can be properly addressed.**

Network Surveillance and Analysis

> **Recommendation NSA-2**
> **Establish WERT as a permanent entity, with contact names and reach numbers of all carriers.**

Service Provider Intelligence

> **Recommendation SPI-2**
> **The wireless industry should investigate how to make accurate determinations of controlling wireless carriers in a wireless number portability environment (planned for November 2002).**

Public Call Center

> **Recommendation PCC-2**
> **Major communications companies should have a contingency plan to offer a public call center for a mutual aid national crisis.**

Ground Zero Locating

> **Recommendation GZL-3**
> **The wireless communications industry should consider how mobile phones and pagers could operate during an emergency so as to maximize chances of locating survivors while minimizing power consumption.**

Follow-up study groups are planned that will include invitations to other members of industry and other stakeholders. The members of the WERT have agreed to be available to provide this capability on a going-forward basis.

2 INTRODUCTION

At the writing of this report, the United States remains under immediate threats from hostile terrorists. As a result, the Team has worked toward a speedy completion of this document in order to facilitate timely follow-up and implementation of its subject matter. To this aim, this Report has been completed in an aggressive pace, within a four-week interval, via a virtual team environment. Under these circumstances, it reports the most accurate and relevant representation of the Team's work for the benefit of the U.S. Government, communications industry and public.

The Wireless Emergency Response Team (WERT) was formed on September 11, 2001, to coordinate the use of wireless technologies and techniques to support the search and rescue operations underway at the ruins of the World Trade Center in New York. Many organizations and individual experts joined the team to leverage known and new technologies in an emergency response. The team worked side-by-side with traditional emergency personnel to search for and identify victims trapped in the rubble. The value offered by this new capability in emergency operations has been recognized by numerous government entities, including the National Communications System (NCS) and its National Coordinating Center for Telecommunications (NCC).

2.1 Team Organization and Structure

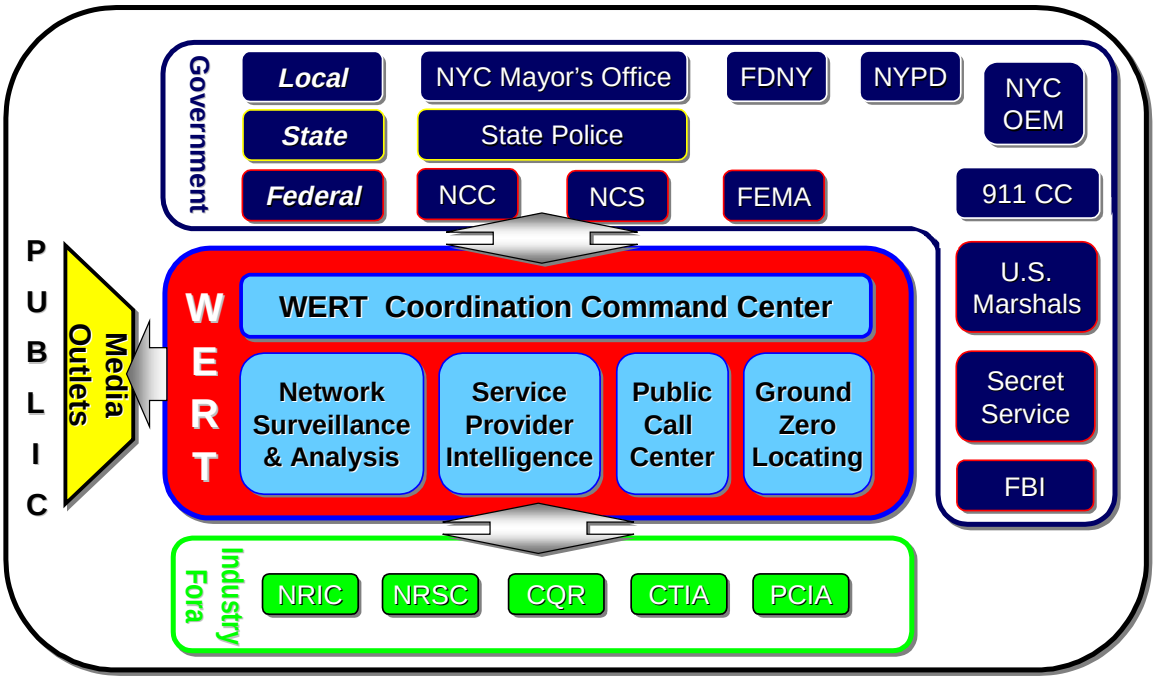

Figure 1. WERT Structure and Interfaces

As shown in Figure 1., the WERT consisted of five functions. The Coordination Command Center was the first function established. It provided leadership for the entire team and included responsibilities for situation assessment for needs and resource assembly, coordination with authorities, encouraging process and other improvements and enhancements, managing media interfaces and facilitating intra-team communications.

The Network Surveillance and Analysis Team analyzed calling patterns and cell registration patterns to assist in locating victims through their personal wireless equipment. The Service Provider Intelligence Team provided near real-time database lookup services. This included matching wireless service provider names, switch addresses, and tandem homing arrangement with identified cellular phone numbers. The Public Call Center managed the traffic call volume and processing of the information provided through the public hotline number. The Ground Zero Locating Team focused on identifying and detecting radio emissions from personal wireless equipment to pinpoint and communicate with equipment owners trapped below the rubble.

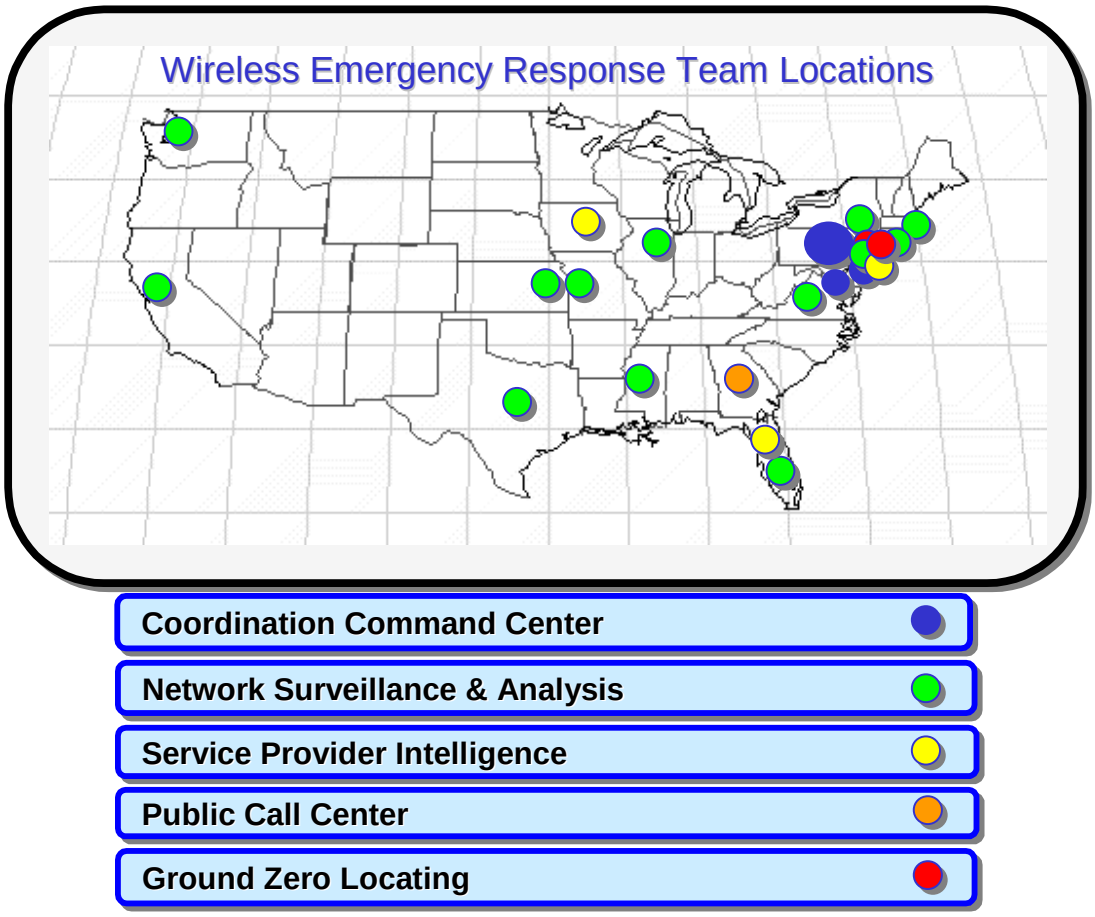

Figure 2. Locations of WERT Operations

The WERT participants operated from many locations throughout the United Sates, as shown in Figure 2.

2.2 Document Organization and Structure

The structure of this report follows the structure of the team. This Report contains a section for each function. Each section follows the following outline:

X. FUNCTION

Mission Statement for function / sub team, and other logistics

X.1 Approach

X.2 Key Learnings

X.2.1 What Worked Well
X.2.2 Areas for Improvement
X.2.3 Areas Requiring Further Investigation

X.3 Recommendations

X.4 Participants

In some instances, multiple sub teams have identified similar key learnings or recommendations. In most of these cases, the repetition has been preserved, in order to document the significance from multiple perspectives.

2.3 Characteristics of the World Trade Center Terrorist Attack Disaster Site

The WERT recognizes that the characteristics of the World Trade Center rubble site may be different from the characteristics of a future disaster situation. For that reason, potentially significant characteristics are listed here:

a. there was no warning before the event
b. there was uncertainty surrounding the possibility of additional attacks (e.g., biological or chemical attacks on water supply, etc.)
c. the disaster site was very large (i.e. 14 acres)
d. the disaster site was very tall (i.e. 7 stories high and extended 7 stories down)
e. there was a large number of expected casualties (i.e. thousands)
f. the weather included moderate days with highs in the 70s and lows in the 50s and colder days with highs in the 50s and lows in the 40s (F); there were also thunderstorms with extremely high winds during some of the early days
g. there was a very strong commitment of support from numerous organizations
h. very hostile radio frequency environment due to dense concrete and metal
i. danger due to fires, smoke, hot metal, sharp objects, dust, ability to contract disease from casualties and other contaminants
j. very limited access and movement; most access was very close to the perimeter
k. the site was served by a limited number of cell sites (3 sites were destroyed, 173 sites were impacted due to loss of network or power connectivity)
l. a large number of rescue personal were using radio devices that used the same frequency spectrum as potential victims
m. the Ground Zero area was declared a crime site

Each of these characteristics was considered and adjustments were made to the extent possible (see Section 8, GROUND ZERO LOCATING). Future efforts need to identify the unique characteristics for those situations.

2.4 Wireless Devices

There are numerous electronic wireless communication devices in use. These include: cellular telephones, 1-Way Pagers, and 2-Way Pagers. In addition, rescue operations staff such as the FDNY and NYPD use radios. In addition, the Team considered the use of an electronic device not intended as a communication device – the key fob.[1]

To add to this complexity, there are different technologies that can be deployed by these devices. For example, there are five primary cellular telephone techniques for electro-magnetic fields used to carry signals to cellular antennas: TDMA, CDMA, IDEN, AMPS/NAMPS and GSM. In addition, the same technology may operate at different frequencies. CDMA, one of the most commonly used technologies - and hence the one of most interest - is also the most difficult to track because the modulation scheme makes signals indistinguishable from noise using spectral analysis. Assisted GPS, the most accurate positioning technology available today for phone location, is not yet in widespread commercial use; and triangulation techniques for location do not work for cell phones where the distances are relatively short.

Given this complex range of possible electro-magnetic signals, there was a need for different solutions. In fact, Section 8, GROUND ZERO LOCATING, describes a wide range of solutions that were used.

[1] A quick consultation with NYC Fire Department officials confirmed that the commute of many World Trade Center workers included automobile transportation, and thus may likely have a car key fob.

3 COORDINATION COMMAND CENTER

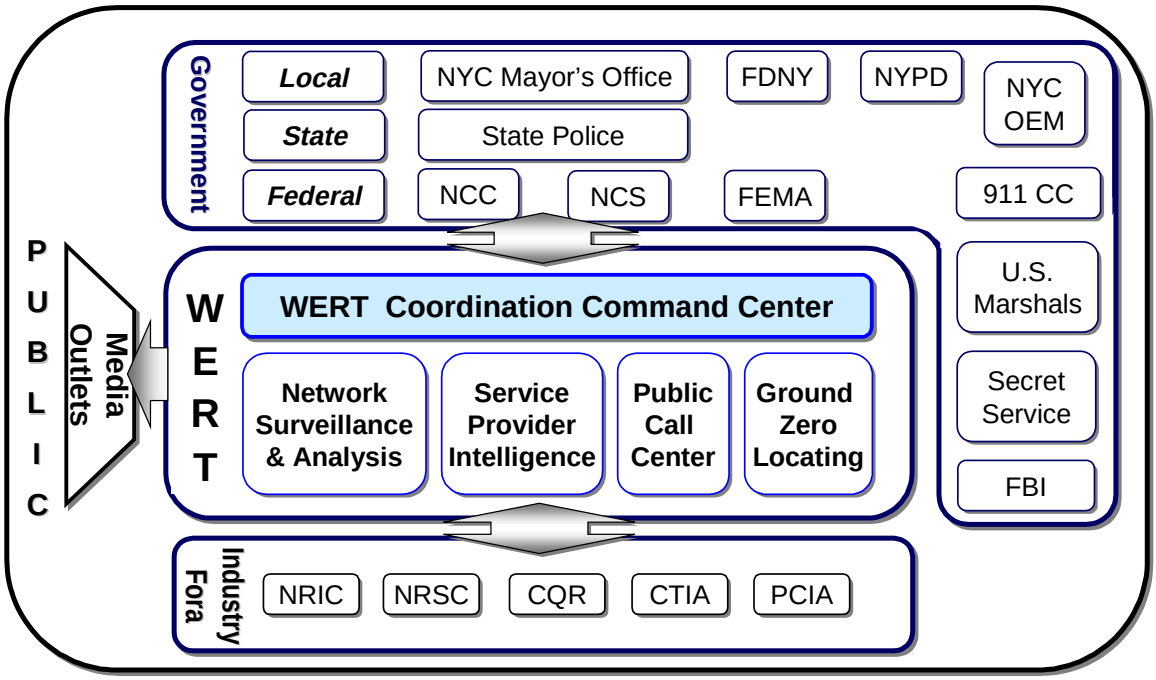

Figure 3. Coordination Command Center

The purpose of the WERT Coordination Command Center was to build a communications industry mutual aid capability to use wireless technology to support Search, Rescue and Recovery efforts at the September 11 World Trade Center Terrorist Attack disaster site.

The Coordination Command Center was located at a virtual office in the Lehigh Valley, Pennsylvania; support staff were located in New Jersey; key coordination contacts were located near Washington D.C.

The Coordination Command Center was successful in quickly assessing and responding to the situation, coordinating with government authorities, assembling essential industry parties and equipment, managing logistics in escorting expertise and equipment to the World Trade Center rubble, managing media interfaces, and maintaining team communications. Key Learnings and Recommendations are documented in the following pages.

3.1 Approach

3.1.1 Situation Assessment

On the evening of September 11, news reports stated that cell phones were being used to make calls for help out of the rubble. This information led a communications industry employee to take the initiative to make sure that everything possible was being done to "hear" such calls for help.

In the following hours, the beginning of an industry-wide Wireless Emergency Response Team was formed. It began with a swift situation assessment of the needs and capabilities.

Needs Assessment

- The cellular communication networks infrastructure was affected by the building collapse, so the ability to pick up cell phone and pager signals was likely impaired.
- Multiple wireless communications technologies are used by wireless service subscribers in the area; each technology uses different types of electro-magnetic signals, requiring a complex set of equipment to listen to all possible electronic devices.
- Any survivors may be injured or trapped.
- The size of the WTC rubble was very large – locating a survivor would be extremely difficult.
- The WTC Ground Zero area was very dangerous: fires, instability, hot metal, sharp objects, smoke, etc.
- The rescue teams faced an unprecedented organizational challenge.
- The battery life of electronic devices faded as each hour passed.
- Cell phone and pager signals may be the only hope that some survivors may have.

Capabilities Assessment

- Wireless service providers can monitor their networks to determine activity of specific handsets.
- Service providers and equipment suppliers have 24 hour customer technical support centers.
- Electromagnetic cell and pager signals can be detected by frequency analyzers with antennas.
- The communications industry was intensely engaged in emergency response.
- Because many members of the public carry cell phones or other electronic devices with them and use them frequently, the subscriber population understands the concepts of battery dissipation and signal strength variation.

The above assessment was conducted with the help of Lucent Bell Labs and AT&T Wireless expertise on the night of September 11. Based on this assessment, a decision was made to move forward quickly with an emergency response.

3.1.2 Coordination with Authorities

The WERT worked closely with numerous government entities. This section summarizes key relationships.

NCS / NCC, FMEA

An initial step of the Situation Assessment during the night of September 11 was to contact the Operations Center of the National Communications System's National Coordinating Center for Telecommunications (NCC) to advise of the emergency response proposal and to request assistance. NCS has the emergency support function for communications (ESF-2) under the Federal Emergency Management Agency (FEMA) Federal Response Plan; and the NCC, a part of the NCS, is a joint government and industry collaborative body that assists in the initiation, coordination, restoration, and

reconstitution of national security/emergency preparedness telecommunications services or facilities.

The NCC Emergency Operations Team (EOT) readily agreed to introduce the WERT offer to emergency management officials, and to facilitate efforts where ever possible, and also recommended that the initial WERT team proceed towards Manhattan while the coordination process was taking place. The NCC EOT coordinated the WERT offer with the New York State Emergency Operations Center (OEC), the New York City Office of Emergency Management (OEM), and the Director of Emergency Management Cell, who quickly accepted the offer, made contact with the WERT coordinators, and provided escort for a team already en route.

During the following days, the NCC Manager, NCC EOT, and the NCC liaison at the FEMA Emergency Support Team (FEMA / EST) also assisted the WERT with coordination with FEMA Headquarters and the new FEMA Disaster Field Office (DFO) in Manhattan.

New York City 911 Command Center
Arrangements were made with the NYC 911 Command Center to immediately contact WERT with relevant information when a call concerning a trapped survivor was received.

WERT provided guidance to the 911 center to assist them in handling calls from trapped survivors (see Appendix A.)

Department of Justice, United States Marshals Service, Electronic Surveillance Unit.
The WERT agreed that the ESU would be beneficial in supporting the effort at Ground Zero and U.S. Marshal Ron Libby, of the Electronic Surveillance Unit, proceeded to communicate its expert opinion to the WERT and other government entities. The WERT continued to work closely with the experienced ESU staff. At ESU request, the WERT nominated and selected a single point of contact at Ground Zero. The WERT agreed that Gee Rittenhouse (Lucent Technologies) would represent the team at Ground Zero.

The WERT sent the material it collected from its activities to the Department of Justice U.S. Marshals Service Electronic Surveillance Unit.

Unfortunately, some people were making what appeared to be false reports about trapped survivors for amusement. Such cases were presented to law enforcement authorities. More commonly, there were sad cases from family members who reported with certainty that the “noise on the other end of the phone” or “the telephone that rang once – but was not answered on time”, meant that their husband, son, wife or daughter had called. These cases were confirmed by data from network surveillance and analysis as **not** being calls from the Ground Zero area. In some cases media coverage of such reports were corrected after being determined to be inaccurate.

Coordination with Other Authorities
The WERT also worked closely with various rescue parties at Ground Zero, including the FDNY, NYPD, and numerous other teams and individuals. In addition, the Coordination

Command Center made arrangements for State Police Escorts for equipment and expert personnel.

3.1.3 Resource Assembly

AT&T Wireless offered a pre-established 24-hour technical support bridge for the WERT. This bridge was used as the central communications post. Wireless service providers operating in the area were contacted to join the bridge: Nextel, Verizon Wireless, Sprint PCS and VoiceStream. Pager companies – Arch Wireless, SkyTel and Metrocall were identified and contacted through the PCIA. Equipment suppliers were also invited and joined, as well as other organizations with critical roles. Some service providers were reached through their known contacts of their equipment suppliers.

As previously mentioned, various government entities participated. These are mentioned throughout the report.

3.1.4 Request for a Public Call Center

Because the national crisis had significantly impacted communications carriers operating in the greater New York City and Washing ton D.C. areas, as well as other businesses (e.g., travel) across the nation, identifying a call center capability required mutual aid within the communications industry. In addition to speed and competency, the WERT leadership prioritized other factors, including: degree of isolation from the September 11 crisis, emergency response experience, communications industry expertise, size of organization, public perception of trustworthy reputation, and the expectation to respond to pleas for mutual aid support. BellSouth volunteered and quickly committed to fulfilling WERT's request. Section 7, Public Call Center, describes the approach taken, key learnings and recommendations.

3.1.5 Continuous Situation Assessment and Capability Enhancement

The Wireless Emergency Response Team was formed in a real-time moving forward fashion. As such, it required periodic adjustments in order to increase its effectiveness.

Improved Processes

The team continued to evaluate and improve processes as new ideas and team members were introduced. Additional changes were made as the response team grew in size and complexity.

Resources

Additional resources were added as needed. These resources included subject matter expertise, equipment for use by the Ground Zero team, intelligence related to subscribers and communications networks, and team communications capabilities (e.g., back-up 24-hour conference bridge).

3.1.6 Managing Media Interfaces

Media interfaces were managed by the Coordination Command Center.
The primary need for the media outlets was to push the toll free number for the Public Call Center.

Four public release statements were prepared for FEMA. These contained the core message for the media communications. These statements are provided in Attachment B. The NCS coordinated the interface between the WERT and FEMA. These

statements were provided to the FEMA Public Affairs Office. The NCS indicated that public and media inquiries should be referred to the WERT leadership directly.

National and local television, radio and newspaper outlets published the toll free number and instructions for who should call. Some of these media outlets ran stories on the WERT effort. Some examples of these stories are provided in Appendix C.

3.1.7 Team Communications

The Coordination Command Center also managed communications for the team. Team communications consisted of a 24-hour conference bridge (provided by AT&T Wireless), a Web site (provided by Lucent), Email, 2 way pager messages and offline telephone calls. A back-up telephone bridge was established for redundancy.

For the first week of operation, the Coordination Command Center received telephone calls on the order of hundreds, and Emails on the order of thousands.

3.2 Key Learnings

3.2.1 What Worked Well

The following fourteen items have been documented as potential best practices for a Coordination Command Center for a wireless emergency response for this type of crisis.

1. Clear center of coordination

2. Real-Time engagement of expertise and capabilities

3. High level of expertise for functions

4. Ability to conduct rapid research (FCC Labs insight into Key fob frequencies, specific mobile handset model lab testing for key strokes, etc.)

5. High Commitment of professionals and their organizations

6. Pre-established federal coordination function of NCC

7. Brainstorming for 911 Command Center suggestions (conserve battery, etc.)

8. Brainstorming for development of call center queuing announcement and operator script

9. Agreement on priorities

10. Respect and professionalism of participants

11. Mutual aid cooperation among parties

12. Overall access to government and industry critical points of contact

13. Advise the supervisors of Ground Zero volunteers that appropriate preparation and debriefing should be conducted.

14. Virtual team operation with geographically-distributed locations

3.2.2 Areas for Improvement

The following sixteen items have been documented as areas that can be improved in providing a Coordination Command Center for a wireless emergency response for this type of crisis.

1. While the team moved forward as a life and death situation demands, a pre-established legal framework should be developed for such disaster wireless emergency responses.

2. Better coordination is needed with wireline service providers to provide consistent, quick information for landline terminations.

3. Pre-defined processes would likely further improve the efficiency of operations.

4. Pre-defined status definitions and templates for various team tasks would improve efficiency and communication.

5. Earlier identification of all service providers involved would allow for even quicker assembly of all critical industry parties. Need to determine method: from FCC, from other website, roaming databases, etc. – source needs to be most accurate and most comprehensive

6. A pre-defined list of company contacts should be developed; with 24 hour reach information. (reference CTIA).

7. Documentation should be available for participants with specific responsibilities (e.g., network surveillance and analysis, ground zero locating, etc.).

8. Bridge discipline: A single bridge number was used to coordinate the activities between all the sub teams. At times there was confusion as sub groups were trying to communicate with one another. The bridge requires a full time chairperson to direct conversations, track members as they join and leave, and record essential information, such as MINs, called numbers, case numbers, etc. There were no cases where we had to actively direct the ground zero teams into a victim. It would have been difficult to do so on a single bridge and continue to track other calls. The situation calls for the ability to set up a number of bridges.

9. PSAP guidance for the victim: An ad hoc guidance document was provided to the PSAPs (Appendix A). This gave the operator instructions on what to tell the victim. The aim was to preserve battery life, but at the same time allow Search and Rescue to contact the victim. The guidance was created quickly, and needs to be reviewed for accuracy and completeness. One challenge will be to establish guidelines that are simple, yet applicable to all voice technologies, such as analogue, GSM, IS136 TDMA , IS95 CDMA, and IDEN.

10. A pre-defined list of desired equipment would improve the speed of getting that equipment to the site.

11. Establishing a public call center more quickly.

12. Quicker industry awareness of the WERT bridge.

13. Travel authorizations for mobilizing people and equipment.

14. While NCC coordination was effective, better Ground Zero logistics access is needed – suggest template for NCC to gain authorizations.

15. Need access to language translation capabilities.

16. Develop a list of handset and other devices used – complete with battery life, SMS capabilities and other critical characteristics (see CTIA Certification Program).

3.2.3 Areas Requiring Further Investigation

The following fourteen items have been documented as areas that require further investigation in order to provide a Coordination Command Center for a wireless emergency response for this type of crisis.

1. Guidance to 911 Command Centers should be based on the specific attributes of the crisis at hand. A procedure to quickly address unique situations and make appropriate modifications in 911 Command Center guidance, should be developed and available.

2. An evaluation should be made to determine the proper Coordination Command Center communication resources (e.g, people skills, web site, Email alias, telephones, fax machines, wireless devices, etc.).

3. Security measures appropriate for participating locations.

4. Media interfaces – gaining access to reports of potential trapped survivors.

5. Guidelines for appeals to industry (request to BellSouth for Public Call Center).

6. Various terminology related to process dispositions.

7. Guidelines for what should be said to a trapped survivor between detection and location.

8. Possible guidelines for public use of wireless communications resources in crisis.

9. Further investigation is required in the area of wearable emergency beacons considered for rescue personnel working in a disaster area; GPS capability should be consider if possible; low frequency – perhaps low-jack frequency.

10. The wireless communications industry should consider providing special instructions for 911 centers for handling wireless callers.

11. Further investigation is needed to provide a global check in status for persons missing or injured, making the WERT information available to other agencies beyond those directly interfacing with WERT.

12. Further investigation is needed to determine how best to provide a useful listing of WERT capabilities available to government emergency response teams. While local fire and police organizations may be equipped with the best technology available at the time of their last acquisition, WERT response teams will be equipped with the very best available in the industry at the time of a disaster. WERT should be considered as a possible resource to be deployed among "first responders".

13. A military lock down of a civilian center may change command.

14. The 911 Command Center guidance should be augmented to have operators ask callers if they can speak. Further investigation is needed to determine if keys should be pressed or if making tapping or other noises, or SMS is preferred as an alternate communication.

3.3 Recommendations

The following 4 recommendations are made to provide an improved Coordination Command Center for a wireless emergency response for this type of crisis.

Recommendation CCC-1
The WERT Coordination Command Center 44 Key Learnings should be reviewed by the larger wireless communications industry for inclusion in industry Best Practices.

Recommendation CCC-2
The NCS / NCC, along with the Federal Emergency Management Agency (FEMA) should conduct an annual test in which the WERT capability is tested. The test should consist of a simulated condition that adequately exercises WERT procedural and technical capabilities. The test should include a measurement for the effectiveness of the limitations of directing a Ground Zero team in order to better understand the technical capabilities available.

Recommendation CCC-3
Wireless Service Providers should review existing NRIC Network Reliability Best Practices, with a particular emphasis on those Best Practices related to Security, Power, Essential Services, Emergency Preparedness, and Disaster Recovery.

Recommendation CCC-4
The WERT should determine the most appropriate oversight of its operation. This oversight should ensure appropriate support and cooperation so that its Key Learnings and Recommendations can be properly addressed.

3.4 Coordination Command Center Sub Team Participants

The Coordination Command Center consisted of the following participants:

Karl F. Rauscher – Lucent Technologies, WERT Coordinator

P.J. Aduskevicz, AT&T
Andrew Collins, Lucent Technologies
Karen Davis, Lucent Technologies
Margaret DeCastro, Lucent Technologies
Bernard Farrell, NCS/NCC
Jessica Janovsky, Lucent Technologies
Lois Lazar, Lucent Technologies
Kritika Lomthong, Lucent Technologies
Maria Mantoudakis, Lucent Technologies
Kent Nilsson, Federal Communications Commission
Barbara Palanchi, Lucent Technologies
Chat Perry, NCS/NCC
Jerry Peterson, Lucent Technologies
Michele Robinson, Lucent Technologies
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4 NETWORK SURVIELLENCE AND ANALYSIS

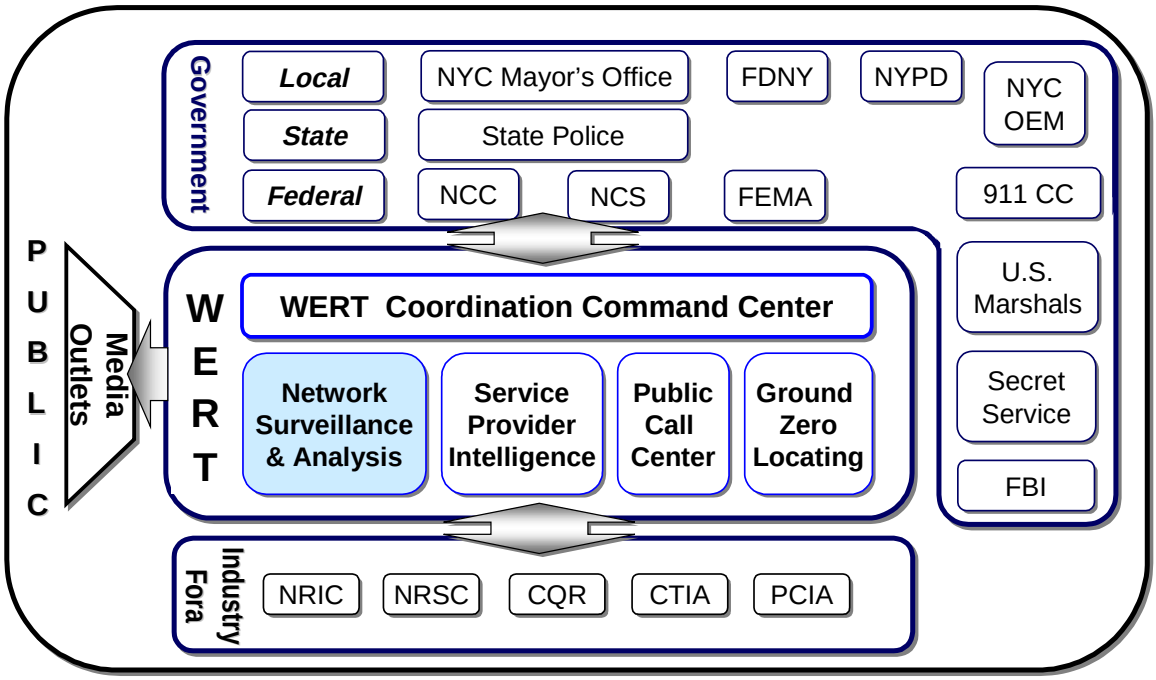

Figure 4. Network Surveillance & Analysis

The purpose of the Network Surveillance and Analysis Sub Team was to assist in the location of victims trapped in the disaster area by analyzing the calling and registration pattern from their personal wireless equipment. The intent was:

To determine if a mobile calling 911, or reported as placing a call from ground zero, was real or a false alarm. The intent was to prevent Search and Rescue teams from going into dangerous areas to look for hoax calls.

To determine if a list of wireless devices had been active or placing calls since the collapse of both towers. This helped in the tracing of missing persons.

To determine if there was any way to assist in the location of a mobile device if it was determined that it was located somewhere at ground zero.

To determine, in the event a victim did call from ground zero, what would be the best approach for conserving battery life, whilst ensuring the victim could still communicate with Search and Rescue personnel.

Service provider network monitoring teams were stationed throughout the United States, including key locations in the states of California, Connecticut, Florida, Illinois, Kansas, New Jersey, New York, Mississippi, Missouri, Texas, Virginia, and Washington.

The Network Surveillance and Analysis Sub Team was successful in providing this critical information in a quick timeframe.

4.1 Approach

Initially WERT relied on contact from the PSAP to initiate the search for a victim. The Mobile Identity Number (MIN) was provided by the PSAP to WERT. Telecordia used their database to identify the MIN's carrier. The carrier would then use their call records to look up the cell site of origin. If the cell site could have been seen by the mobile at ground zero, a further search was made though the records for earlier activity on that MIN. In most cases it was found that the MIN was placing calls after the collapse in areas well away from ground zero.

When we were unsure about the location of the mobile, a call was placed to it to see if we could talk with the owner. In all cases these turned out to be Search and Rescue personnel or members of the public who had accidentally placed a call to 911. (Pressing and holding the 9 key often initiates a call to 911).

This method quickly became more proactive. All 911 calls were monitored, and any originating from key cell sites were investigated immediately to see if they were possible victims.

On Sept 14 a call center was established to build a database of possible victims' wireless devices. These were provided from the public via the Public Call Center (Section 6). These numbers were forwarded to the wireless devices' carrier. The carrier then looked for any activity from this list of devices. If a device was found active an attempt was made to contact it and establish if the user was a victim.

After manually trying to interact with any paging device still responding to network interrogation (2-Way devices), all 1-Way and 2-Way pagers were placed in a cyclic test mode to provide an audible alarm to Search and Rescue teams. A single message was sent to all units once every 2 minutes.

4.2 Key Learnings

4.2.1 What Worked Well

The following seven items have been documented as potential best practices for a Network Surveillance and Analysis function for a wireless emergency response for this type of crisis.

1. Carriers quickly recognized the need to preserve battery life of mobiles at ground zero. Various steps were taken to do this. (see below). Guidance was provided to the PSAPs to pass to the victim. (See Appendix A)

2. Cooperation between carriers and vendors was exceptionally good.

3. Carriers quickly recognized that "false alarms" for 911 calls would place Search and Rescue teams at great risk, so they quickly worked out a protocol to identify them. This included searching call record databases, registration activity, intercepting and logging 911 calls, searching Short Message Service records.

4. Enhancing radio environment. All carriers had some disruption to their radio coverage of ground zero. Within hours, COWs (Cells on Wheels) were brought in to improve the number of channels available and to replace damaged cell sites. Some carriers were also able to enhance their radio reception by the use of pre-amp devices.

5. Pagers were actively "pinged". This established if they were still working, and if they were would produce an audible signal Search and Rescue may be able to detect. 2-way pagers were identified in case they were attempting to send messages.

6. Rescheduling personnel to provide 24x24 coverage on the WERT bridge and effort. All carriers were able to quickly identify and supply personnel to support WERT activities.

7. Carriers who had developed Fraud detection tools usually had all call detail records at their fingertips. They were quickly able to review a potential victim's calling patterns.

4.2.2 Areas for Improvement

The following 9 items have been documented as areas that can be improved in providing a Network Surveillance and Analysis function for a wireless emergency response for this type of crisis.

1. Legal requirements.
   Several carriers were concerned about releasing information about customer calling patterns. However, since time is of the essence in aiding victims, and all parties need to be clear about the information they can divulge to other members of the WERT. All potential members of WERT need to be briefed on their legal obligations on confidentiality, and when they can and cannot divulge customer information.

   Although the bridge was supposed to be carrier only, a member of the public did call in asking for information about a relative. All carriers need to set up a contact number the public can call for this purpose, so WERT can quickly direct them there.

2. Carrier participation.
   Not all wireless carriers and vendors were represented in the first couple of days. Even if there was a single bridge set up nationally for WERT, a carrier list is needed along with a contact name in order to get everyone on board as soon as possible.

   Fortunately, most, if not all, the MINs investigated were either local to New York, or belonged to a national carrier. The team did not observe any roamers from carriers outside NY. In a different scenario this could change and the team would need to contact an out of area carrier. The team needs to work out a method of alerting all carriers in this situation, so it could contact them immediately if a roamer appeared on our 911 list.

3. Location of COWs.
   The location of COWs was not always clear to the Network Surveillance and Analysis Sub Team; nor was their expected radio coverage, and whether or not they

were turned on. WERT needs better feedback on RF coverage from the respective carriers' disaster recovery team. The location of COWs, Pre-amps, paging transmitters and other surveillance equipment was frequently further away from ground zero than ideal. Heavy rescue equipment was obviously using area around ground zero, so any cables used to connect the equipment to the outside world was in danger of being severed. Line of sight microwave was not always available. All equipment used to improve the chances of detecting RF from a disaster site needs to be capable of being stand alone, or remotely connected by microwave or optical means.

4. 911 Calls from 3rd parties.
   There were several examples where a member of the public had received a call from a mobile. In most cases noises were heard, but nobody spoke. They then placed a call to 911 and sometimes were able, using caller ID, to identify the mobile. These were treated as if the 911 call had been placed directly by the mobile. A script for engaging 3rd parties should be considered. However there were cases where the MIN was not available. In this case a trace on calls placed to the member of the public was required. This process needs to be worked out and practiced, as it brings yet another carrier, the landline carrier, into the loop.

5. Secure wireline service provider 24-hour presence.
   There were several instances where we needed to confirm that a call placed to a landline came from a mobile number. This required assistance from the serving landline carrier.

6. Calls from unknown MIN.
   A call was received by an overflow 611 call center. No ANI was available. The customer care representative suspected a possible victim. The caller was able to press the keys in response to questions, but was unable to speak.

   We had three issues with this call:
   a) We did not have any way of determining which keys the customer was pressing. We needed a quick way of attaching a DTMF decoder to the call to see if the customer was actually trying to send a message to us. If we had one we could have asked them to key in the MIN, in order to record and playback with the DTMF Decoder.
   b) Secondly we did not have a quick way of tracing backwards from the call center to the previous switch to see if it had caught the ANI. It appears the old skills of tracing calls has atrophied.
   c) We tried to see if the call was coming from one of the ground zero switches by looking for a call to 611 that started within 5 minutes of the time it arrived at the call center. We discovered that associated mobile switches cannot do this if the call is still in progress. A procedure for tracing calls without MIN needs to be researched and documented.

7. Contacting customers to identify 911 false alarms.
   In the early stages of WERT calls were placed to phones that were suspected of making a 911 call. These were usually done by anyone available from the home carrier. In the latter stages of WERT this was usually done by the same group in the home carrier. There are a list of questions and checks that need to be made to ensure that the caller establishes that this is really a false alarm. In many cases the

customer claimed that they had not called 911. Many models of cellular phone have a one touch dialing feature. Typically if at he 9 key is pressed and held for a few seconds it will automatically dial 911. This can easily happen if the phone is in a pocket or a belt clip.

Fortunately these models also have a dialed call log. In the future, if the customer claims not to have made the call, we ought to ask the customer to check the dialed call log. If the log does not record the 911 call, then further investigation may be needed to establish where the call came from. Two possible reasons are:

a) An "old" phone that still has the MIN in it. The ESN on the 911 call should be different to that in the HLR record.
b) A cloned phone. If authentication is turned on, the Authentication Center (AC) records may show this mobile registering and failing authentication If authentication is off, identifying this phone will be very difficult. Further research is needed.

We need to develop a flow chart of actions needed to determine if a 911 call is definitely a false alarm.

8. 15-20% of paging carriers were initially identified as the wrong carrier. Paging carriers should be aware of this and investigate each pager number reported, not just those that are initially identified as theirs.

9. Analyzing SMS text messaging
   The relatively new service of SMS presented problems to the carriers and public. There were several examples where people were sending text messages to persons feared trapped by the disaster and often believed they were receiving messages back. It was unclear to the carriers, in the initial hours, how to best analyze these.

4.2.3 Areas Requiring Further Investigation

The following nine items have been documented as areas that require further investigation in order to provide a Network Surveillance and Analysis function for a wireless emergency response for this type of crisis.

1. Each technology, Analog, TDMA, CDMA, IDEN, GSM and paging, has subtle differences that influence the way a search and rescue method would work. These need to be documented so that WERT team members don't start using the wrong method for a technology. Here are several examples

   a) Most Phones are dual mode, and in the absence of their primary technology, (e.g. CDMA, TDMA) the phone will work on an analog signal. If there is a roaming agreement for that phone it will be able to place a call. Any search for call records and registrations needs to include roaming partners as well.
   b) 911 call attempts, by their very nature are handled differently. Carriers will allow a 911 call from:
      i) A normal active mobile.
      ii) A mobile with a suspended account.
      iii) A cloned mobile.
      iv) A mobile with an invalid MIN/ESN combination.
      v) A mobile that has no roaming agreement with the carrier.

Each of the above calls requires additional checks to be performed by the serving carrier (not necessarily the home carrier) in order to establish if the call is a false alarm.

A matrix of who can and cannot place calls on the various technologies is needed to help with the false alarm search. For example a GSM phone cannot make an analog call, and a TDMA phone cannot place a call on a 1900 CDMA system.

Another example: at one stage a high power analog cell site was suggested to force phones to register. This may have had the side effect of shortening battery life.

2. E911 Phase 2 technology.
   Would this have helped in this situation? The consensus is that probably not for finding a victim. The loss of cell sites surrounding the area would complicate any RF based solution. Channeling and screening effects caused by the steel in the debris pile would also produce inaccurate locations. GPS satellite based technology requires a clear site of the satellites, so anyone buried would have to rely on their last known position.

   However it would have speeded up the screening of false alarms.

   In a different scenario, such as the Los Angeles Northridge earthquake, where the victims were spread over a much larger region, the E911 P2 technologies might have proven effective.

3. Use of text messaging to summon help.
   The relatively new service of Short Message Service (SMS) was found to be an effective mechanism for communicating on September 11th. SMS and two-way pagers send messages using very few resources on the radio spectrum. Customers may not have been able to place calls because of radio channel blocking, but were in general able to send SMS messages.

   However there is no established equivalent of 911 on SMS or paging. An attempt was made to look for keywords, such as “help”, “911”, “mayday”, “SOS”, etc., in the SMS paging stream, but none were found. One carrier reviewed all SMS messages from the ground zero switches and looked for requests for help on Sept 11th through Sept 14th. None were found. Members of the public also attempted to send messages to potential victims. The use of “return receipt” or “delivery receipt” markings may have given them a false indication that the mobile had received and read the message. Further work is required to clarify when these techniques are accurate.

4. Use of SMS or alerting to create an audible signal.
   The paging carriers were able to send pages to their units so that they beeped at approximately 2 minute intervals. The beeps could be used to help direct Search and Rescue teams closer to the victim.

   We should look at the equivalent on mobiles. There are two possibilities.

- Page the phone and instruct it to turn on alerting (ringing).
- Send an SMS message to the phone.

These techniques would use less battery power, and do not require the phone to access a voice channel. However there are a number of issues to be investigated and resolved.

a) If the phone's memory is full, it may reject the incoming message and not beep.
b) The cellular switch may not be capable of sending alert only.

5. Use of CALEA technology.
   All carriers have been mandated to install and operate "wiretap" technology. This was not used during the WTC attack. Further investigation is needed to determine if this technology would provide any aid in these circumstances to track and locate victims. For example, would it be possible to set up the CALEA equipment to track all calls placed to 911.

6. Analyzing pager signals
   Further investigation is needed on the use of decoders for pager devices. These units can decode the forward and reverse signaling information, and can filter by various parameters such as keywords or electronic serial numbers. These could be used to search for activity on victim's equipment. Decoders may be specific to particular paging carriers, further investigation is needed to understand the limitations of each type of decoder.

7. Details of equipment
   Further investigation is needed concerning WERT maintaining a complete list of wireless tracking devices to include pager-related equipment, and details (size, portability, contact information, battery life, frequency etc.).

8. Identifying details of search parameters.
   Further investigation is needed concerning the use of a common electronic template for screening, for example list of MINS, paging PINs, frequencies etc. The intention would be to develop automated scripts that could be downloaded to equipment at Ground Zero.

9. Identifying Search and Rescue equipment.
   A list of electronic devices being carried by Search and Rescue personnel can be maintained so that they can be quickly identified and eliminated in the search for victims. Caution is needed, as rescue personnel may also need rescuing. Carriers who supply or donate equipment would forward lists of devices to WERT for compilation into a single database.

10. Determining the last know activity on a mobile.
    All mobiles send a periodic signal to the base stations to indicate that they are still active on the network. The Switches record this information, but further work is needed to understand how to extract this information.

4.3 Recommendations

The following eight recommendations are made to provide an improved Network Surveillance and Analysis function for a wireless emergency response for this type of crisis.

Recommendation NSA-1
The WERT Network Surveillance and Analysis Sub Team's 26 Key Learnings should be reviewed by the larger wireless communications industry for inclusion in industry Best Practices.

Recommendation NSA-2
Establish WERT as a permanent entity, with contact names and reach numbers of all carriers.

Recommendation NSA-3
Industry associations should establish Best Practice procedures for mutual aid Search and Rescue efforts. This information should be documented and distributed to all carriers.

Recommendation NSA-4
The WERT should work with the industry to make information available that can be used to train Search and Rescue teams on the use of several communications technologies. For example, the cellular system could be overloaded or incapacitated, but data networks could have spare capacity.

Recommendation NSA-5
The wireless industry should consider processes for routing SMS and pages addressed to 911. With the increased usage of text messages, the time has come to determine how these messages should be routed to a PSAP in the event of an emergency. Clarification is needed for what happens to messages sent to 911.

Recommendation NSA-6
The WERT Network and Surveillance and Analysis Sub Team should periodically rehearse the execution of its function. This exercise should include coordination with the other WERT functions, and directing the Ground Zero Sub Team in their function.

Recommendation NSA-7
The WERT needs to consider how to prepare for disaster situations with significantly different characteristics. One of the successes of the Network Surveillance and Analysis effort in the World Trade Center scenario was identifying false alarms. However the WERT needs to review lessons learned and the WERT processes for a disaster with significantly different geographic characteristics. For example where the disaster region is over several square miles, and the wireless infrastructure of transmitters, receivers (cell sites) and switches is compromised. Examples include Los Angeles Northridge earthquake, or Florida's Hurricane Andrew. Identifying false alarms may require different techniques.

Recommendation NSA-8
National carriers should review the techniques and tools developed during this disaster to see if additional development is needed on vendors' equipment.[2]

4.4 Network Surveillance Sub Team Participants

The Network Surveillance and Analysis Sub Team consisted of the following organizations and associated employees.

Arch Wireless
Mark Witsaman
Jim Rodts

AT&T Wireless Services
AT&T Wireless Business Security Department - Florida

Mary Anderson	Laurie Wills	Tim Huckins
Aneliz Lorente	Lisa Likely	
Carlos Rojas	Liz Rojas	*New York region*
Curtis Cooper	Mary Wern	Gary Sutcliffe
Erik Douai	Natalie Brathwaite	Dan Brechbiel
Herman Gainous	Nestor Juarez	Tim Milford
Ian Schriver	Rami Eid	Scott Falick
John Kiggins	Rose Ricciardi	Glen Ten Kate
Josie Gibson	Sarah Mobley	John Murphy
Judy Franklyn	Shannon Atoonian	Carl Garcia
Keri Walters	Sharon Daly	Dan Gilmore
Larry Bryson	Teri Kaye	

AT&T Wireless Network End-user Operations, Seattle
Russ Waughman, Network Surveillance & Analysis Sub Team Lead Editor

Charles Gillaspy	Adam Gregorich	Joel Fonnesbeck
Jerry Stalick	Dan Curry	Marie Forster
Carl Garcia	Don Anderson	Steve Hinshaw
Donna Hlavacek	James Milligan	Kathy Kennedy
Bruce McNair	Jose Mercado	Wayne Shamlin
Eric Macellari	Arrenzo Corbett	Roger Stuckly
Michele Massart	Tara Stovall	Eric Gomillion
Doug Taplin	Albert Baas	Mike Clarkson

AT&T Wireless Data translations - Seattle

Lou Ascoli	Chris Nord	Carlos Correa
Mike Blackshaw	John Martyn	Nancy Stanbery

[2] For example, Lucent developed a tool for capturing network call event details and Emailing details for calls originating from the Ground Zero area.

CTIA
Rick Kemper

Lucent Technologies

Axel Hallo De Wolf	Edna Jones	Mike Smith
Karl Madsen	Don Galles	John McCarty
Steve Schuette	Mike Groener	
Rodolfo Tokarsky-Unda	Tony Hein	

Nextel

Rich Iozzo	Mike Dodson	Roger Tingley
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John Peppe	Mark McDonald	

Skytel

Bruce Deer	John Hunsberger	Richard Krigsman

Sprint PCS

Sprint PCS Network Management Center, Kansas City MO

Ron Shuster	Keith Sheldon	Tom Munoz
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Sprint PCS, National Technical Assistance Center (West), Irvine CA

Steve Oliva	Jonathan Woster	David Byrd

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Joe McGonigle	Paul Antola	Kim Brown
Tom Sweeny	Rich Lawton	Paul Fredericks
Tom Bradley	Jesus Robledo	Nicole Prince
Joel Antoine	Michael Aponte	Kerri Ignatius
Julio Velez	Rosseler Tuangco	Scott Ward
Faris Howat	Frank Padrayes	

VoiceStream

Michael McAdoo	Rich Lawton	Kevin Storms
Joe McGonigle	Tom Bradley	Faris Howat
Joel Antoine	Tom Sweeny	Scott Ward
Julio Velez	Jesus Robledo	
Paul Antola	John Ryan	

5 SERVICE PROVIDER INTELLIGENCE

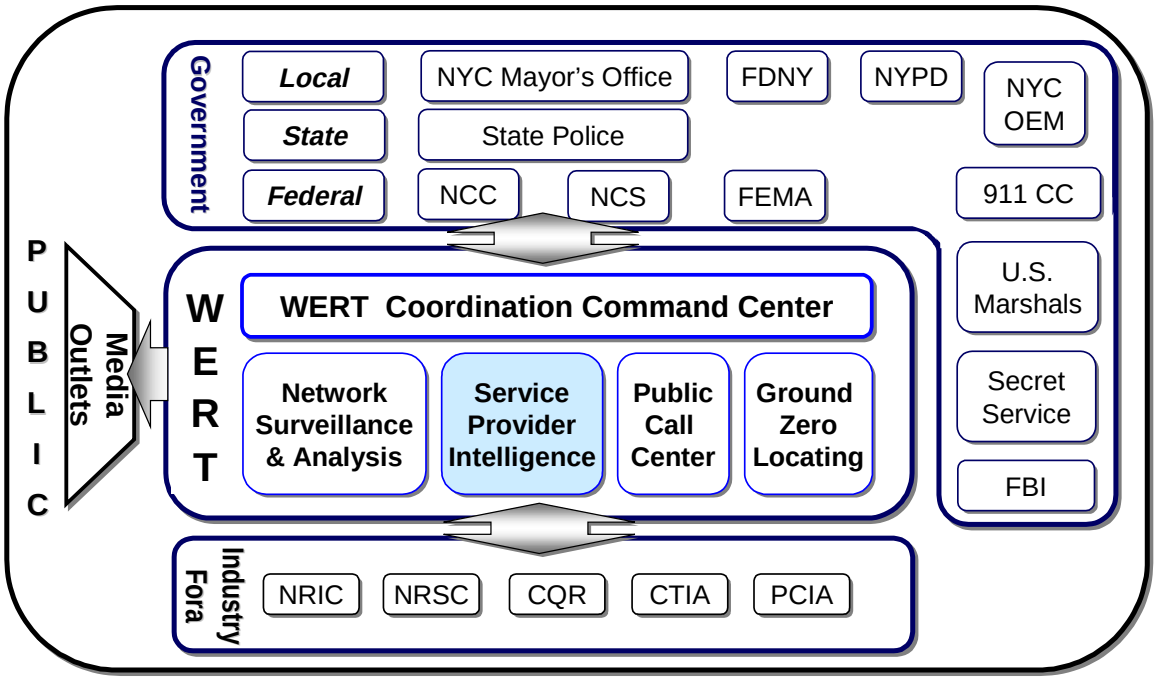

Figure 5. Service Provider Intelligence

The purpose of the WERT Service Provider Intelligence Sub Team was to provide rapid response database lookup information. This information included associating service provider names, switch addresses, and tandem homing arrangement information with cellular phone numbers of interest to WERT.

The Telcordia™ Routing Administration group was approached by WERT for support with this function due to their unique capabilities regarding the information needed. Telcordia readily offered to provide real time support during the crisis.

The Service Provider Intelligence operation was conducted at various Telcordia facilities in New Jersey with support from Telcordia employees in Iowa and Florida.

The Service Provider Intelligence Sub Team was successful in accomplishing its objective. Of particular note was the speed in which the information requested was provided. Key Learnings and Recommendations are documented in the following pages.

5.1 Approach

The Telcordia team remained on the WERT bridge continuously from September 13 through September 19 (and remained on-call thereafter) to do instant electronic lookup

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using the Telcordia™ LERG™ Routing Guide in response to requests over the bridge. In addition, a subset of the team responded throughout the crisis to the hourly reports collected by BellSouth on the 800 number, in order to provide the association between cell phone number and service provider name in written form (Microsoft Excel spreadsheet format). The Service Provider Intelligence Sub Team then distributed the annotated hourly reports and consolidated reports to the WERT service providers and others.

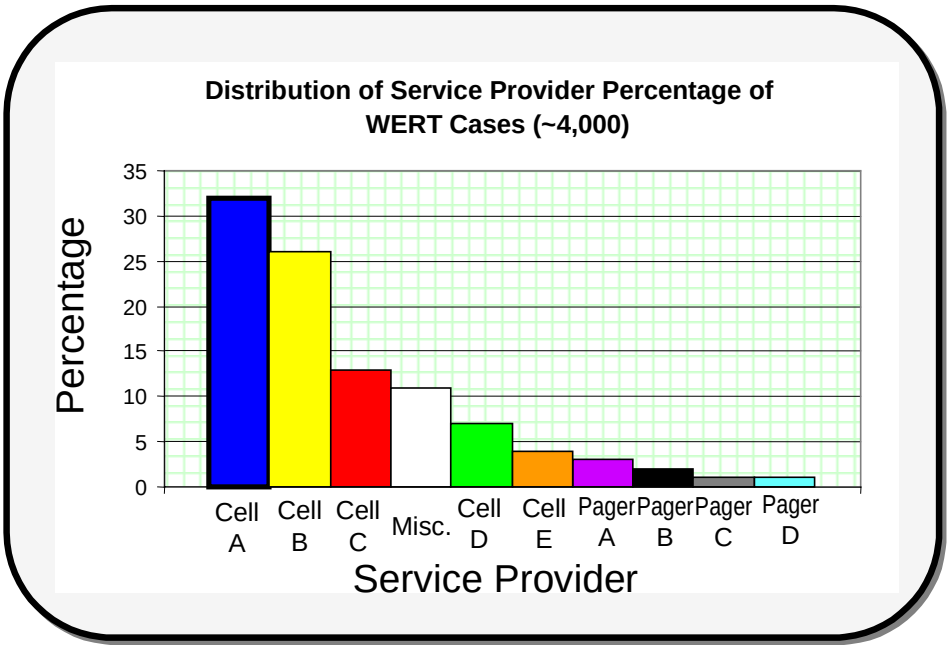

Figure 6. Service Provider Distribution for WERT Case List

Figure 6 shows the Service Provider distribution for the cases handled by WERT. On the high end, one Cellular Service Provider had 32% of the cases. And on the low end, two Pager Service Providers had 1% of the cases. The miscellaneous dispositions include cell numbers being provided that were 800 numbers, only the area code provided, invalid area code provided, and some cases of resellers.

5.2 Key Learnings

5.2.1 What Worked Well

The following 2 items have been documented as potential best practices for a Service Provider Intelligence function for a wireless emergency response for this type of crisis.

1. Although the Telcordia TRA group has no 24x7 capability in its normal operation, Telcordia employees volunteered eagerly to help out during the national emergency. As a direct result Telcordia had little trouble covering the emergency needs. During

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normal business hours Telcordia was able to perform it's WERT responsibilities through its TRA Customer Service Center.

2. Both the teleconference bridge and email worked well as inputs and outputs to the Service Provider Intelligence tasks.

5.2.2 Areas for Improvement

The following item has been documented as an area that can be improved in providing a Service Provider Intelligence function for a wireless emergency response for this type of crisis.

1. The emergency seemed to provide a good test of Telcordia TRA's disaster response capability. TRA fulfilled its role without serious difficulty. TRA was fortunate that none of the people or facilities depended on to respond were directly affected by the disaster (other than one participant who was stranded in Florida when planes were grounded). However, if the service provider intelligence function that was provided were to be considered in the future as a normal part of regional and national disaster response, then TRA would have to consider increased geographic redundancy in its capability.

5.2.3 Areas Requiring Further Investigation

The following five items have been documented as areas that require further investigation in order to provide a Service Provider Intelligence function for a wireless emergency response for this type of crisis.

1. Who will be maintaining an emergency response list and coordinating among other Telcordia organizations and outside agencies? If the industry maintains an emergency response call-out list, Telcordia would establish a point of contact to coordinate the Telcordia mobilization.

2. Potential emergency responses in other areas of the country would require rapid identification of affected wireless carriers operating in that area. That information is available in the Telcordia LERG Routing Guide and could be provided by Telcordia TRA if needed in the future.

3. It was not a problem to identify the wireless carriers associated with roamers (wireless customers from other areas) as long as a carrier in the North American Numbering Plan provided their service. In the case of these domestic roamers, the need to make quick emergency contact to distant cellular carriers should be researched. Perhaps the wireless industry's emergency contact list could be brought to bear. On the other hand, little information could be provided concerning cell phones whose home service was foreign. It is worth investigating how the companies of foreign roamers can be identified and contacted if need be.

4. Thousand block pooling for cellular companies (expected to begin November of 2002) is expected to complicate the service provider intelligence task only slightly. Accurate determination of the controlling wireless carrier will then require a lookup on NPA NXX X. This information will be available in the Telcordia LERG Routing Guide.

5. Wireless number portability (planned for November of 2002) will complicate and degrade the service provider intelligence task. The lookup in the Telcordia LERG Routing Guide will then identify the company that originally controlled the number. This will most often be the correct, currently controlling company, but as time goes on there will be an increasing number of cases where the number has been ported, either from another wireless carrier or from a wireline company. Further investigation is needed to resolve how to make these determinations of controlling carrier accurately.

5.3 Recommendations

The following two recommendations are made to provide an improved Service Provider Intelligence function for a wireless emergency response for this type of crisis.

Recommendation SPI-1
The WERT Service Provider Intelligence Sub Team's 8 Key Learnings should be reviewed by the larger wireless communications industry for inclusion in industry Best Practices.

Recommendation SPI-2
The wireless industry should investigate how to make accurate determinations of controlling wireless carriers in a wireless number portability environment (planned for November 2002).

5.4 Service Provider Intelligence Sub Team Participants

The Service Provider Intelligence Sub Team consisted of the following employees of Telcordia Technologies. Telcordia Routing Administration (TRA) provided the subject matter expertise.

Stuart J. Freidlin – Sub Team Leader
Robert W. Johnson - Sub Team Leader

Joyce Cabbell
Rubye Csehi
Donna R. Giordano
Richard P. Harrison
Karen D. Jefferson
Z. Marie Knight
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Lori Lopez
Thomas W. Mazzone
Martin H. Millman
Margaret T. Nathan
Adam C. Newman
Edgar R. Rodriguez
Joan M. Ross
Rodney E. Shaul
Peter A. Shelus
Mary Ann H. Southard
Anne Walker

6 PUBLIC CALL CENTER

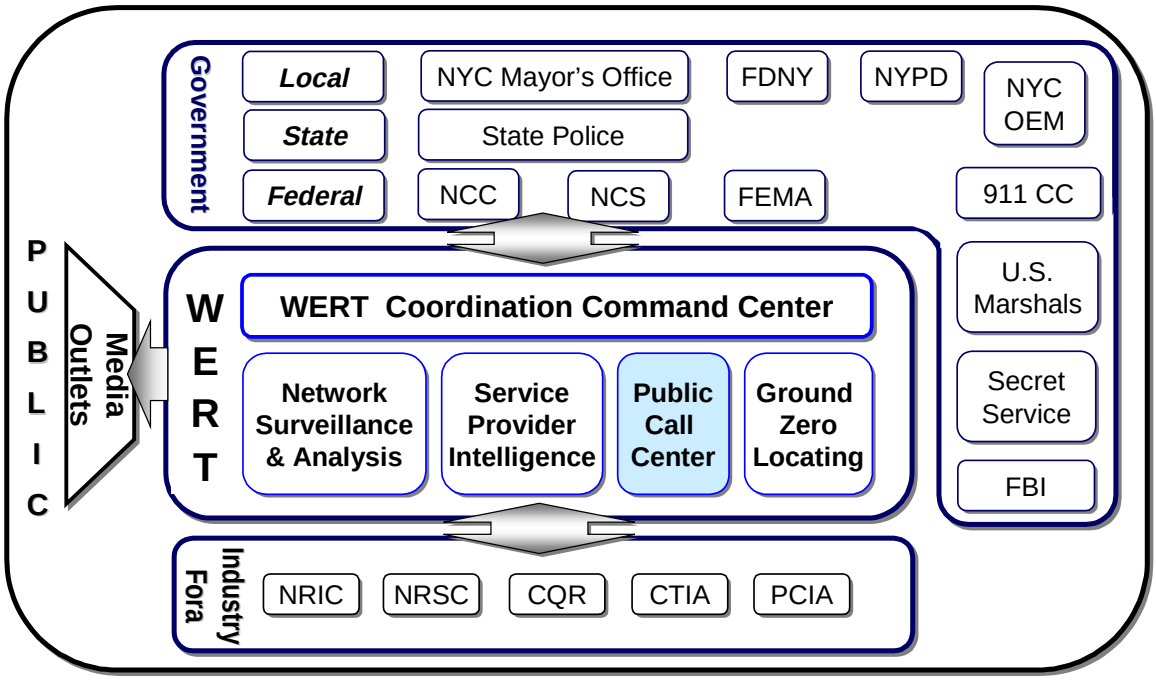

Figure 7. Public Call Center

The purpose of the WERT Public Call Center was to establish the ability to receive, process, and manage calls from the public through an advertised toll free number. Media outlets cooperated in promoting the number, encouraging the public to call to report cell phone or pager numbers of persons missing at the World Trade Center site.

Previous to the Call Center being established, the 911 Command Center and other government entities made reports of potentially trapped survivors to the Coordination Command Center or the emergency WERT bridge. Because of the high density of rescue workers using cell phones, having knowledge of potential cell phones and pagers for the missing would enable the Network Surveillance and Analysis and the Ground Zero Locating functions to differentiate "hot leads" more quickly and effectively.

As described in Section 3.1.4, WERT made a request to BellSouth to meet this need. BellSouth volunteered to provide a Call Center. The request was made on the morning of Friday, September 14. BellSouth quickly responded with a commitment, and had a Call Center operational by mid-afternoon on the same day. During that time the WERT developed a queuing announcement, an operator script, and media blitz to push the toll free telephone number to reach the Public Call Center. In parallel, BellSouth engineered a world class call center, prepared for a mass calling event, appealed for volunteers, trained volunteers, and coordinated with WERT leadership for a media blitz. The Public Call Center was located in Georgia.

Within the first few hours, hundreds of calls were made to the Call Center. After 5 days, 5,039 calls were received. Figure 8, Public Call Center Activity, displays the hits recorded by BellSouth during the operation of the center. 20% of the calls were abandoned. As expected, media coverage of the Call Center number was directly correlated with sharp increases in the number of calls received.[3] In addition, the activity was higher during the day and evening, than during the night.

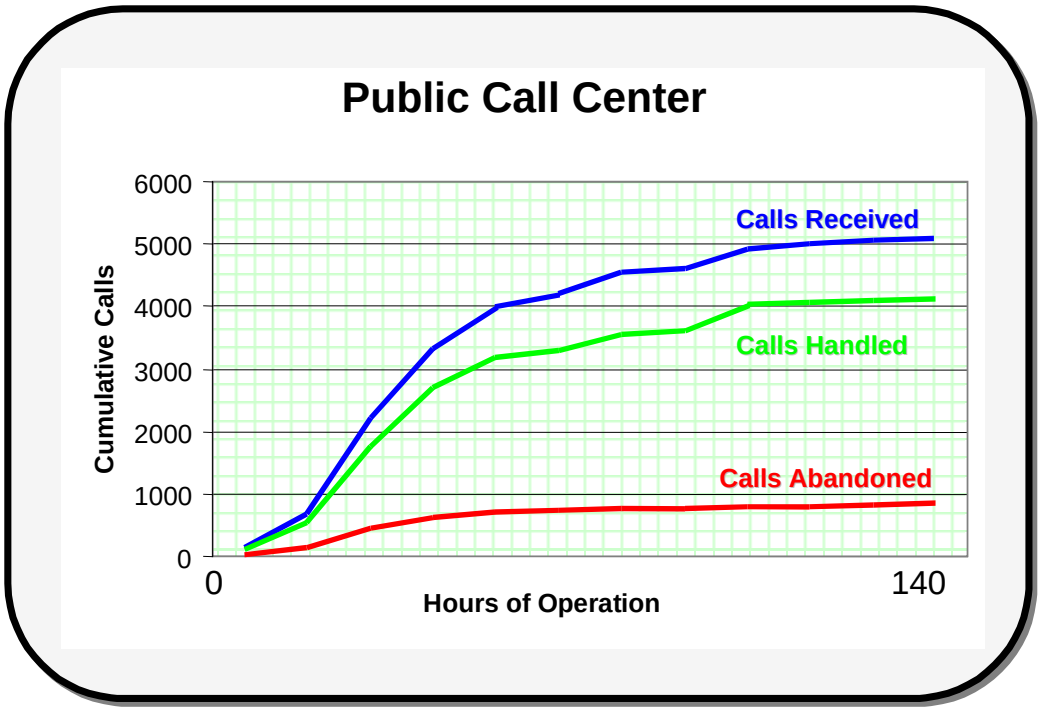

FIGURE 8. Public Call Center Activity

As the rate of calls being received was observed to decrease significantly, the Public Call Center was transitioned after 5 days (September 19, 11 pm ET). For the following week, callers to the toll free number were directed to an announcement that gave a confirmation that they had reached the "Wireless Emergency Response Team Call Center" and to a referral to the Department of Justice, Office of Victims of Crime, and then also provided contact numbers for the New York City Wireless Service Providers (i.e. AT&T Wireless, Verizon Wireless, Sprint PCS, Nextel, VoiceStream, Arch Wireless, Skytel, MetroCall).

The Public Call Center was successful in accomplishing its objective. Of particular note, was the speed in which the Call Center was operational, once the request from WERT was made. Key Learnings and Recommendations are documented in the following pages.

6.1 Approach

The approach taken to provide a Public Call Center was rapid staffing and training of a volunteer 24x7 work force at an existing secure major call center location.

[3] The interval of such spikes was associated with time interval granularity smaller than the 12-hour interval used in Figure 8.

6.1.1 Queuing Announcement

The Team developed the following announcement to be heard by callers before they reached a call center operator.

> *"You have reached the Wireless Emergency Response Team for the World Trade Center Site. This is not 911. If you are calling regarding an immediate emergency, hang up and call 911. Your call will be answered as soon as possible. Please be prepared to provide the cellular or pager number of the missing person. We are gathering information to assist search, rescue and recovery efforts."*

The announcement was designed so as not to communicate a commitment beyond collecting the information, and to not raise the hopes of the calling parties.

6.1.2 Call Center Questionnaire

The following script was developed for call center operators to use in handling calls. The script was developed by the team on the WERT conference bridge.

> *1. What is your name?*
> *2. What number are you calling from?*
> *3. What is the name of the missing person?*
> *4. Have you been contacted by this person since the building collapse?*
> *5. What day? What time? Please be as specific as possible.*
> *6. What number did this person call?*
> *1. _____*
> *2. _____*
> *3. _____*
> *7. What is this person's cell phone or pager number? Do you know their service provider? If a pager, do you know their PIN number?*
> *8. When was the last contact?*
> *9. Where was this person last known to be (what floor or area in the WTC)?*
> *10. What information did they provide during the phone call?*
> *11. What is their condition?*
> *12. Have you been able to contact them since this phone call?*
> *13. Is there any other information you can tell me, including the state of their batteries or if they will be turning the phone off?*
>
> *We appreciate the information and we will be reporting this to the appropriate Emergency Response Teams.*

The script was found to be effective for nearly all situations. Some reports came in the from faxes containing multiple numbers. In these situations, the numbers and available information was input manually.

6.1.3 Media Outlets

In order for the Public Call Center to be effective in gathering information, the availability of the 800 number and the awareness of the WERT effort needed to be broadcast to the public. BellSouth worked closely with the WERT Coordination Command Center to strategically get the message out. The initial primary outlet was FEMA (see Appendix

B). The message about the WERT Public Call Center was pushed through major media channels, including: ABC, AP, CBS, CNN, Fox, NBC, Reuters, and others. For examples, see
Appendix C.

The Coordination Command Center also worked with BellSouth to encourage "street level" promotion of the number. The Telephone Pioneers industry volunteer organization assisted in putting up posters in NYC area. In addition, members of the public had taken the initiative to produce leaflets with the toll free number and instructions on who should call. The leaflets were passed out on buses and trains.

6.2 Key Learnings

6.2.1 What Worked Well

The following thirteen items have been documented as potential best practices for establishing a Public Call Center for a wireless emergency response for this type of crisis.

1. Staffing the call center with company volunteers worked great. The volunteer response was huge. Having volunteers prevented labor issues, differentials, overtime hours, scheduling, etc. Going outside of the company for personnel was not an option.

2. Having the WERT expertise prepare the call center script ensured that the subsequent users of the collected information would be satisfied.

3. Starting with an available, existing call center facilitated speed. Having an existing 800 number allowed the center to be swung into immediate operation.

4. Security access worked well - ensured secure access was restricted to authorized BellSouth employees only. Also operated in a completely secure building.

5. Ability to overcome "secure information" restraints in this time of national emergency worked well. Inability to work through these issues would have severely hampered our abilities.

6. The speed that we were able to assemble and come together as a company and make this happen, with a quick commitment from the company to be involved. This type of effort requires the commitment of a large service provider to be able to respond and react in a national emergency.

7. Employee Assistance Program (EAP) response

8. Escalation desk at call center: The purpose and function of the escalation desk at the call center was to establish a single point for escalation of information directly into the ongoing consortium call that appeared to have criteria supporting the potential of a trapped survivor. When data received from the script suggested that contact may have been made with a victim since the collapse of the towers, that case was handled immediately and investigated through the consortium call.

9. The ability to staff the call center with large numbers of volunteers and organize their job responsibilities quickly and efficiently.

10. Call receipt organization - having enough staff with script to handle incoming calls efficiently with little or no hold times. Call durations varied notably depending on several factors including the callers desire to ask additional questions, the callers level of information being provided, and in some cases language barriers. Due to the varying nationality of many victims, there were times where we needed staff that could speak Spanish and other languages. Other times, the callers' native-tongue accent made communication difficult.

11. Data entry coordination: Data entry into worksheets was critical to ensure the call center could organize the data into an electronic format and be able to transmit the data files to the WERT Coordination Command Center and others.

12. Having a company executive available to assist the staff people with key internal contacts, direction, and information flow.

13. BellSouth's experience in handling hurricanes, commitment to help America in crisis, and traditional telephone company culture to volunteerism, enabled a rapid Call Center implementation.

6.2.2 Areas for Improvement

The following thirteen items have been documented as areas that can be improved in establishing a Public Call Center for a wireless emergency response for this type of crisis.

1. From a staffing and call-in aspect, a recommendation that two 800 numbers be established as active & idle and available at all times. Establish a coalition of entities available to do this call center function and establish coordination plans.

2. Need automated and/or web based, secure site for real time data entry.

3. Keep it as simple as possible to minimize training needs for employees/volunteers – consider having mechanized template for responses with Web access, but don't get too mechanized so its no longer simple.

4. Diagram the information flow very early in the process and distribute to all involved.

5. Publicize what "we" are doing after we receive the information.

6. Determine who, if anyone, is responsible for follow-up.

7. Establish an Overall Control Office (OCO) function.

8. Consider international limitations to accessing 800 numbers.

9. Train persons receiving calls on what is criteria for escalation to Call Center executive management for priority attention on the WERT bridge.

10. Add a page to the intake form for escalation tracking and status.

11. Questionnaire line 13 did not gather useful information; consider improvement

12. Ensure that ANI is used and logged on the data sheet to capture essential information on each call.

13. The script should be enhanced for callers reporting that a missing person called them, to include: "Do you have Caller ID and if so what number showed up?"

6.2.3 Areas Requiring Further Investigation

The following four items have been documented as areas that require further investigation in order to establish a Public Call Center for a wireless emergency response for this type of crisis.

1. Hold harmless clause for disaster recovery information access.

2. Having call center(s) predetermined and a game plan for relocation of employees who normally would report to that call center.

3. Have Consumer Services as the contact for this type of activity in the future.

4. Develop transition guidelines.

6.3 Recommendations

The following two recommendations are made to provide an improved Public Call Center for a wireless emergency response for this type of crisis.

Recommendation PCC-1
The WERT Public Call Center 30 Key Learnings should be reviewed by the larger communications industry for inclusion in industry Best Practices.

Recommendation PCC-2
Major communications companies should have a contingency plan to offer a public call center for a mutual aid national crisis.

6.4 Public Call Center Participants

The Public Call Center consisted of the following participants:

Bill Smith, BellSouth - Call Center Leader
Barbara Omer, BellSouth
Tony Garcia, BellSouth
Allan Kennedy, BellSouth
Cathy Swift, BellSouth
Terry McDevitt, BellSouth
David McCampbell, BellSouth
Peg Burnhardt, BellSouth
Durrett Evans, BellSouth
John Bratten, Lucent Technologies

6.5 Volunteer Operators for Public Call Center

To handle the large number of calls anticipated from the media announcement of the call center, BellSouth put out a call to its employees for volunteers. The response was strong and fast - as nearly 500 BellSouth employees volunteered to staff the 24-hour call center. Appendix D lists the names of these volunteers.

7 GROUND ZERO LOCATING

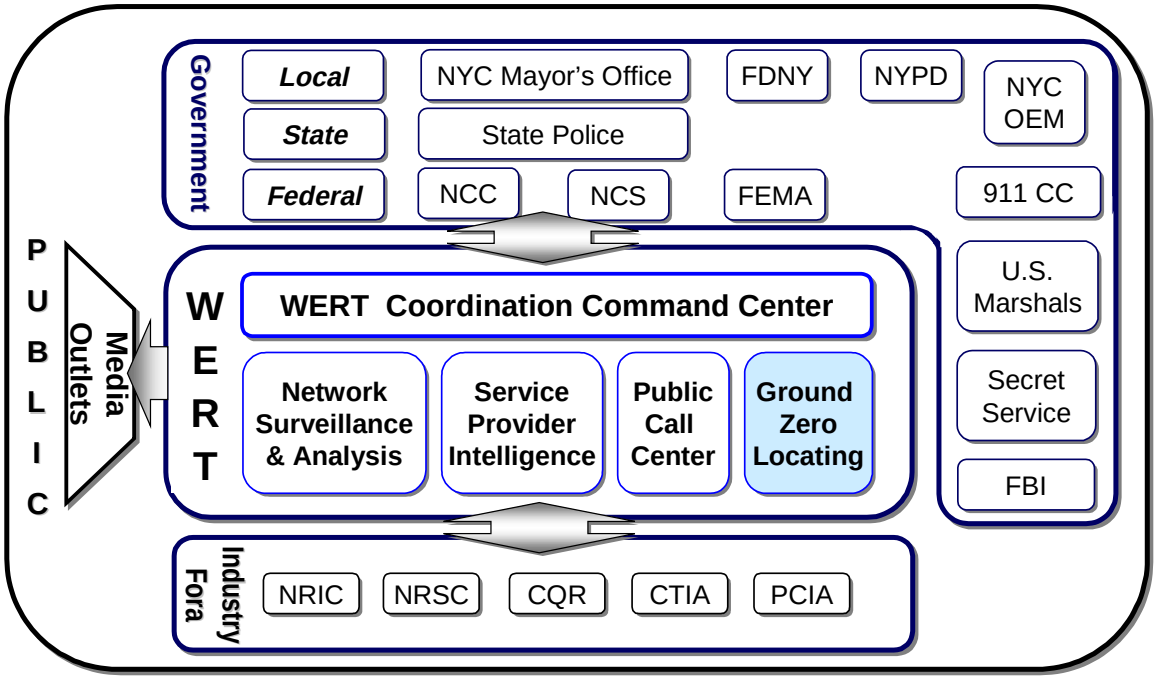

Figure 9. Ground Zero Locating

The purpose of the WERT Ground Zero Locating Sub Team was to assist in the location of victims trapped in the disaster area by detecting the radio emissions from their personal wireless equipment. The intent was not to simply locate mobile equipment, but rather to locate live people with the equipment.

In addition to being on-site at Ground Zero, at times, some volunteers maintained a state of alert while being stationed at various New York City staging areas at varying distances to the rubble site, as well as at staging areas in New Jersey.

Volunteers from several organizations assembled equipment and traveled to the WTC Ground Zero disaster site. Like others entering the WTC Ground Zero site, these volunteers put themselves at risk, as the site was dangerous. The Sub Team addressed numerous physical and logistic challenges and was successful in providing much needed coordination across the numerous on-site teams.

Key Learnings and Recommendations are documented in the following pages.

7.1 Approach

The collapse of several World Trade Center (WTC) buildings including towers one and two occurred on September 11, 2001 and potentially trapped thousands of victims in the debris. The goal of this activity was to assist in locating these victims by detecting the

radio emissions from their personal wireless equipment. The intent was not to simply locate mobile equipment, but rather survivors. This is an obvious but important distinction. In such a violent collapse there is the probability that a mobile phone was dislodged from the user or that the phone remains with the deceased person. The team had to provide credible evidence that live individuals were found and not simply their wireless equipment. Being recognized as wireless communications experts, the rescue operation would have shut everything down and immediately sent in search teams if we had claimed to find someone. This section provides an event record and the methodology used by the on-site teams to minimize false alarms and help locate individuals. Keep in mind that following through on a false alarm could place rescue personnel into a perilous situation.

There are two main advantages of an on-site team. First, they may be able to assemble the equipment and arrive on the scene before authorities have a chance to do their own detection sweep. This can provide extremely valuable data because of the relatively short battery life of the mobile equipment. As a result every minute is critical. However after the federal and local services arrive, the team's passive location effort has limited value. The second advantage is to connect trapped users directly to the network using repeaters or indirectly through a mobile-to-mobile basestation bridge. A network connection is critical in providing a credible indicator that a person is there and to possibly assist them.

The on-site wireless effort has two main components that can be done in parallel. The first is to sniff for, and communicate with, mobiles buried in the debris. The second is to provide technical assistance to the service providers. Although this last component is tangential to the location effort, it is nevertheless extremely important and cannot be overstated. Mobile phones are a central feature of any complex, coordinated rescue effort. It is extremely important to increase both the capacity and coverage of the effected area. Having said this, the rest of this paper will focus on location and detection.

Finally, it has to be emphasized that the on-site team does no harm. This is accomplished in several ways. First, we maintain our own team safety. We do not want to disrupt an ongoing rescue attempt by requiring our own rescue. In the midst of an emergency situation, an individual or team can easily be carried away by emotion and expose themselves or other team members to undo risk. In addition, the on-site team must constantly re-evaluate the value of their service. We do not want to get in the way of a credible rescue effort. This is also difficult because of course everyone wants to help and the team is already there. If the team provides only marginal benefit with other on-site teams (federal or state) they should remove themselves. They are then by definition "in the way".

7.1.1 Event summary

A number of teams worked together under a coordinated effort. The following descriptions summarize the events that were coordinated. Listed in chronological order:

- The first teams to arrive at the site were from AT&T Wireless, and a joint Verizon Wireless and TruePosition team. AT&T Wireless arrived during the early morning hours of the first night. AT&T Wireless monitored RF emissions from the periphery of the site. Later that morning, an attempt was made to triangulate

the signals by TruePosition and Verizon Wireless with CDMA and AMPS equipment. A separate Verizon Wireless team monitored RF emissions using directional antenna equipment.

- Lucent provided an initial site survey and additional emission power measurements. They arrived the day after the collapse.
- An additional Lucent/Motorola team simultaneously measured power and network connectivity. Both used lab equipment that had limited mobility and connected to a portable generator. Both teams were restricted to lowering antennas into the debris along the perimeter.
- Nextel had a team that brought a basestation crate and connected it to an antenna lowered three stories into the plaza section.
- Motorola had an additional team that measured network connectivity and was very mobile and battery powered.
- Wheat International offered to aid on-site Search and Rescue due to their military tactical communications platform capabilities. After two days they were released to return to VA. Shortly after returning to their headquarters, they returned to Ground Zero to provide on-site support with the OEM, FDNY, NYPD-TARU and the WERT Ground Zero Locating teams. Wheat also provided a high-powered AMPS link into the debris.
- AT&T Wireless and Cingular provided repeaters to extend coverage within the debris field. These repeaters were lowered into the debris.
- The final team was again a joint Lucent/ Motorola team that brought additional repeaters and a micro-basestation that was modified to operate autonomously and provide mobile-to-mobile communications.

Within the first 24 hours access to the site was extremely limited. There was the clear and present danger of further building collapses and none of the access roads were clear. Our first attempt relied heavily on the close proximity of our vehicles. This fact overly restricted the team. We were able to get the vehicles within 100 ft of the collapse but it was impossible to run any power lines out into the debris because of all the emergency equipment. In the future, measurements within the first few days must be highly mobile and autonomous. Probing the site remotely using directive antennas is also inaccurate because the debris strongly scatters the signal.

Coordination with the service providers is absolutely critical to sniff for mobiles. It should be recommended that service providers have, for all their markets, a list of channels readily available for these instances. This list shall be known to the service provider's central coordination body (NOCC, WNEO, etc.) and to the local RF engineers. Providers must supply a list of the unused channels within compromised network but which are still in the active frequency set of the buried mobiles. We cannot sniff occupied frequencies around the site. There is just too much local traffic and it is impossible to distinguish the surrounding traffic from the buried mobiles. Of course all basestations and repeaters should operate on all frequency channels. There is a possibility of forcing dual or Tri modes phones over to analog to make it easier for existing technologies to capture the RF, however there are power consumption concerns associated with this approach.

The general procedure of establishing contact with survivors and locating them provides an extremely high value. However, the details of the implementation are specific to the particular site. In this case the debris is fairly localized within four city blocks and has a

large metallic content. In this case remote access to buried survivors is difficult from around the debris periphery. Direct access to the debris was much more successful. In addition after two days it had rained. This substantially increases the absorption coefficient (by up to 20 dB) of the debris and makes remote penetration that much more difficult.

In the WTC situation antennas were brought directly onto the pile or placed in underground cavities. Because of scattering it is probably best to use an omni and rely on the received power to calculate an event horizon. In certain situations the high antenna gain of directive antennas can be used to help penetrate the debris. In general, depending on the debris compactness (or scattering properties) the directivity of the antennas and proximity to the scene may have to be considered from case to case.

In addition to received power measurements, the on-site equipment must have the capability of registering mobiles. Regardless of whether the registration equipment is a basestation or basestation emulator it must have sufficient transmit power to penetrate the debris and have a balanced link, preferably with an LNA at the antenna. It must be emphasized that the on-site equipment is relatively robust. However, care still needs to be given to the handling of the cable and equipment. Firefighters wanted to get down there and back out very quickly. In one situation, a cable was sent three stories down into the debris and received nothing. After it was pulled up and examined, an impairing kink was discovered 50 ft down. As a result nothing was ever broadcast from the antenna.

In the future, a portable basestation stripped down to the bare essentials for weight (remove heat-sink, etc.) in conjunction with a battery powered spectrum analyzer should provide enough mobility and capability to assist in rescue operation and provide remote network connectivity. Generator-powered equipment with antennas lowered into the debris can provide long-term monitoring for those users who turn their equipment on and off to conserve their battery. Eventually, repeaters can also be placed into the debris to provide remote network access. However, all these efforts must be coordinated. The available clean spectrum is very limited (possibly a single channel) and we don't want to be picking up our own signal.

7.1.2 Methods and procedures record

Traditionally, the location of an electro-magnetic source is found by using a narrow-beam width antenna in conjunction with the received power level. The directionality of these antennas can either be fixed (e.g. Yagi-Uda) or variable as in an antenna array and the received signal strength can be measured with a low-noise spectrum analyzer. At the WTC site this measurement was complicated by three factors. First, there was a tremendous amount of metal debris that scattered the signal. This is analogous to finding someone in a darkened room full of mirrors with a flashlight. As a result, directional antennas have limited value. The metallic content of the debris also severely complicates any coordinated triangulazation measurements. Second, there are a lot of people around the site using mobile equipment. With a power meter or spectrum analyzer, it is difficult to determine with certainty which signals are originating from the debris and which are from the rescue effort. Finally, there is a tremendous amount of rescue equipment at the site. The measurement equipment must be very close to the generator and the antenna. It is impossible to have long remote cables anywhere

around the periphery of the site due to both the amount of emergency equipment and the high-level of activity in the vicinity.

A day after the buildings collapsed we made our first on-site measurements with a spectrum analyzer. We scanned 850 MHz and 1900 MHz. Although we first focused on locating mobile phones at these two frequencies, we later also investigated the possibility of locating police and fire rescue equipment (470-482 MHz), mobile pagers, and automobile remote keyless fobs (315 MHz). We scanned the rescue spectrum from the surface of the debris field. Again, it was impossible to determine the origin of the signals because of the inaccuracy of DF. It should be noted that the battery life of police radios is approximately 24 hours. The pager and fob measurements were developed but never used. The pager measurements tried to locate the 8-bit acknowledgement on a 6400-baud reverse link. This message is very brief and must be coordinated with the downlink page. Because of this we dismissed the applicability of this technique.

After these initial measurements there were several obvious conclusions. First, the mobile service providers in that area must clear some spectrum for our measurements. The released channels must be in the buried mobile's active set so they would lock on, but otherwise would provide clear frequencies to monitor. Second, the primary contact with the mobile must be through a basestation or basestation emulator and not a spectrum analyzer. The link quality can be monitored with a spectrum analyzer, but as discussed previously, it is important to distinguish between buried mobiles and trapped people. To reduce the risk of false alarms to an acceptable level, the on-site team required that after a mobile registered and answered a page, that it would actually connect. This requires that the user acknowledge the ring by pressing the send button or opening the flip.

Standard spectrum analyzers, LNAs, antennas, and basestation test equipment were used in this effort. The equipment was modified to increase transmit power and receive sensitivity using standard equipment. Low loss cables pre-cut to length are preferred (e.g., up to 100 foot lengths). Minicell basestations software was modified to operate without a network infrastructure. One team's capability was similar to the test equipment and was restricted to registration, and paging. The second had limited mobility but could provide mobile-to-mobile connections. It would also be of great help to be able to program in telephone numbers known to be in the debris so we could call them. Finally AWS changed the registration periodicity to 2 minutes while sniffing was carried out. However, this assumed that the mobiles received the instructions.

The on-site team primarily utilized three methods in searching for buried mobiles belonging to possible survivors. These methods included:

1. Power measurements of emissions from wireless devices.

2. Use of basestation equipment (including simulators) to detect mobile registrations.

3. Use of repeaters to improve coverage in the debris.

Power Measurements of Emissions:
The main equipment used in this method includes spectrum analyzers & directional antennas to conduct power measurements. The benefit of this setup is that it can be

very mobile and lightweight. However, as noted above, the high metallic content of the debris coupled with the limitations in getting close to the impacted area (due to safety concerns) significantly reduced the effectiveness of this approach. Also note that manufacturers of wireless devices are required by the FCC to significantly limit the emissions from these devices.

Use of Basestation Equipment to Detect Mobiles:
This method included two types of setup. The main distinction between the two setups is that one required an AC power source and therefore was not very portable while the second was battery powered. The main equipment used in this method includes:

- Basestation equipment such as a modified basestation (stripped-down to be portable) or a HP8924C (CDMA basestation simulator) or IFR1900CSA-5 (TDMA basestation simulator).

- External power amplifiers to amplify the transmit signal & low noise amplifiers to improve the uplink sensitivity. This is required in order to penetrate several feet of concrete and present a stronger signal to a buried mobile relative to the commercial system.

- Directional or Omni antenna (depending on area being monitored).

- Low loss cables (cut to length is preferred).

- Generator for AC power (not required for portable basestation setup).

The basestation equipment was configured to operate on a cleared channel (channel not being used in the impacted area but approved by the respective carrier for transmit) and a valid system ID. Obtaining a cleared channel from the carrier is important in that it minimizes interference with the local commercial network and therefore also minimizes false alarms. However, this channel must be verified to be in the scan list for the mobile (PRL in the case of CDMA).

Registration messages are then transmitted from the basestation equipment into the debris. Registration messages were sent periodically over a minimum of 4-5 minutes in the event the mobile is in a “power save” mode. The transmit power should be set to the maximum capability of the setup. In the case of CDMA, the initial power level was set to a nominal level (~-70dBm at the output of the basestation simulator) and increased to the maximum level in 10dB increments (due to open loop power control considerations).

The intent of this procedure is that mobiles that are buried under several feet of concrete will not be able to maintain a link with the commercial system. As a result, these mobiles would scan for a stronger signal and eventually lock onto the signal from our setup. Once locked on to the mobile, the basestation equipment can either originate a call to the mobile or send a text message in the hopes that there is a survivor at the other end who is able to respond and establish a communication link.

Although this method proved to be fairly effective there are several limitations that should be noted. First, due to the high metallic content of the debris, it is very important that the engineering teams closely coordinate their efforts with the local search and

rescue officials to focus on specific areas of concern. Second, although one of the setups was portable, it still required engineering expertise, which limited the portability benefits due to safety concerns.

Use of Repeaters to Improve Coverage in the Debris:
This method is fairly straightforward and involves extending the coverage of the commercial system into "high probability" areas of the debris using repeaters and omni antennas. The intent of this procedure is to improve the radio link to mobiles that are buried. The benefit of this setup is that it allows autonomous and remote monitoring of registration activities. The drawback is that it's the least portable of all the methods discussed.

7.2 Key Learnings

7.2.1 What Worked Well

The following four items have been documented as potential best practices for a Ground Zero Locating function for a wireless emergency response for this type of crisis.

1. Establish weak mobiles onto our network.

2. Autonomous, portable equipment (without generators) for remote monitoring.

3. Valid secondary channels with service providers were crucial [secured, although not immediately available].

4. While at Ground Zero it was not uncommon for NYPD or FDNY personnel to approach the on-site WERT members and request specific searches for MINs belonging to those known to be missing in the debris field. These requests were fielded and handed off to the Team on the WERT bridge.

7.2.2 Areas for Improvement

The following seventeen items have been documented as areas that can be improved in providing a Ground Zero Locating function for a wireless emergency response for this type of crisis.

1. The ability to distinguish between mobiles inside the debris and outside the debris.

2. True mobile test equipment with mobile-to-mobile communication.

3. Immediately available secondary channels for emergency use.

4. Continuous direct communication link to the Coordination Command Center. Possible 2-way intermediate link.

5. Establish coordination between the on-site groups.

6. Local 2-way communications between the on-site teams.

7. Magnetic company ID for automobile identification and emergency response equipment.

8. Phone number script automation.

9. Early access for site survey to determine access, spectrum, etc.

10. Assortment of antennas, cable, etc.

11. 24x7 on-site coverage with relief crews.

12. 24 hour control center for the on-site teams that works logistical issues (i.e., access to site) and is continuously updated on team activities and progress. This control center should be an extension of the WERT Coordination Command Center with a separate access number. Continuous direct communication link to the Coordination Command Center. Possible 2-way intermediate link.

13. Phone number script automation. Preferably a mechanism for electronic transfer of phone numbers from the site to the Coordination Command Center. This would minimize possibility of human error.

14. Basestation emulator should have enough capabilities to change some mobile-dependent translations. For example registration periodicity or number of rings. Vendors can change these on networks but those commands must reach the mobiles to take effect.

15. WERT coordination of logistics was excellent from NJ to NYC through multiple checkpoints; access to actual rubble required additional coordination with authorities at rubble. Preparation could improve coordination at this disaster site.

16. Improved capabilities for a single Ground Zero Lead located at the site to know what teams are deployed in what areas and using what equipment each team is using. This should help prevent duplication of effort and severe risk of injury to team members.

17. The industry should adopt as a standard practice the use of certain emergency channels on the local PRL (Preferred Roaming List) for rescue efforts.

7.2.3 Areas Requiring Further Investigation

The following five items have been documented as areas that require further investigation in order to provide a Ground Zero Locator function for a wireless emergency response for this type of crisis.

1. Consideration should be given for including an emergency beacon or emergency mode into mobiles through the standards process.

2. The use of automobile key fobs for location of lost, trapped survivors should be investigated.

3. Further investigation is needed to determine what, if any, enhancements should be made to existing equipment to improve its capability, reliability, availability and usability. This may lead to the development of kits.

4. Expertise should be developed to operate any enhanced equipment that may be developed.

5. Further investigation is needed to consider the trade-offs of a set of network parameters to extend the battery life of handsets and to accelerate registrations.

7.3 Recommendations

The following seven recommendations are made to provide an improved Ground Zero Locating function for a wireless emergency response for this type of crisis.

Recommendation GZL-1
The WERT Ground Zero Locating Sub Team's 26 Key Learnings should be reviewed by the larger wireless communications industry and emergency response entities for inclusion in Best Practices.

Recommendation GZL-2
In future wireless emergency responses, the Ground Zero Locating Sub Team, in coordination with the Coordination Command Center, should use the following 7 Step On-Site Deployment Strategy:

On-Site Deployment Strategy:

a. Identify local emergency contacts at the disaster site with which to coordinate efforts.
b. Brief local officials on RF detection capabilities, strategy and plan.
c. Obtain approval from local officials and agree upon deployment plan.
d. If service exists, deploy repeaters with antennas deployed into the wreckage to extend the existing wireless service as far as possible to minimize the path loss in both the uplink and downlink direction between the wireless communication device and the network.
e. Get service provider permission to radiate on at least one clear channel in their spectrum for emergency purposes regardless of whether there is coverage up or not. (It is necessary for service providers to free up at least one emergency channel that is on the local PRL for rescue efforts.)
f. Deploy highly portable, stand-alone technology-specific microcells at the disaster site that are capable of mobile-to-mobile calls. Deploy antennas as far into the wreckage as possible to maximize RF coverage. (Note: these miniature basestations will be independent of the existing network with the exception that they will use the channels that have been cleared by the service providers.)
g. For technologies where portable basestations with mobile-to-mobile calls are not available, deploy sniffing equipment with the appropriate band-specific filters and LNAs for uplink gain to detect any RF signal activity coming from the wreckage.

Recommendation GZL-3
The wireless communications industry should consider how mobile phones and pagers could be placed in an emergency mode that would facilitate location of survivors. Operation in this mode should maximize chances of locating survivors while minimizing power consumption.

Recommendation GZL-4
FEMA should recognize the WERT as a legitimate and valuable capability to be fully utilized, when appropriate.

Recommendation GZL-5
State and Local governments should recognize and utilize WERT for smaller emergencies, when appropriate.

Recommendation GZL-6
The WERT should establish a comprehensive list of appropriate authorities and procedures for interaction with federal, state and local government agencies.

Recommendation GZL-7
The WERT should work with the NCS/NCC and FEMA to conduct periodic, formal test and trials in areas targeted for demolition to further explore RF detection of mobiles placed within these structures before demolition.

7.4 Ground Zero Locating Sub Team Participants

The Ground Zero Sub Team consisted of the following participants:

Gee Rittenhouse, Lucent Technologies – Designated WERT On-Site Representative

AT&T Wireless

Scott Reid	Todd Hollritt	Mike LaJoie
Joe Anderson	Rob Kopp	Wayne Maxwell

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Marty Klos	Robert Wilson

EDO Corporation, Electronic Systems Group
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Lucent Technologies

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George Elmore	Rich O'Sullivan	

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Rob Pento	Muzaffar Khurram	Tom Daniel
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Brad Silva	Mike Schiksnis	Kevin Brennan
Anthony Dennis	Don Cordell	
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Nextel

NYPD Technical Assistance Response Unit (TARU)

Sgt John Ross

TruePosition

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Jeff Andrews	Scott Holladay	James Reynolds
Ted Boinske	Roger Hoover	Clyde Smith
Paul Czarnecki	John Jarvis	Kerri Strike
Larry Dodds	Joe Larson	Bill Townsend
Jim Gall	Rash Mia	

U.S. Marshals Service, Electronic Surveillance Unit

Ron Libby, WERT contact	Jeff Cox	John Cuff
Bill Hufnagel	Scott Samuels	Kirk King
Bill Sorukas	Brian Murphy	

United States Secret Service

Conrelius Tate	A.J. Venit	Keith Kelly

Verizon Wireless

Team I	*Team II*	*Regional Team*
John (JR) Ryan	Brian Higgins	Paul Antola
Keith Ryan	Bill Shortall	Joe Ehret
Rich Griffin	Dale Regan	Joe Karatka
Jeff Budney	Jim Elter	Nick Horvath
	Bob Iwaszko	

Wheat International

Hank Altemus	Dennis Smith	Woody Wheat
Larry Palmer	Mike Troutman	

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Arch Wireless
David C. Duclos, Vice President - Technical Operations

AT&T
PJ Aduskevicz, Network VP of Infrastructure and Media Capacity
Chair - Network Reliability Steering Committee

AT&T Wireless Senior Management
Don Verkest – VP National Network Operations
Toby Seay – VP Filed operations
Roseanna Demaria VP Business Security.
Greg Slemons – Executive VP Wireless Network Services

BellSouth Corporation
Bill Smith, President, Interconnection Services & Chief Technology Officer

Cingular Wireless, *Cingular Interactive Emergency Support Team*
George Pappas, Chief Operating Officer
Karyn E. Hann, VP Customer Support
Lee Rudolph, VP of Engineering
Howard Fingerhut, Chief Architect
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Juan Rodriquez, Strategic Account Coordinator
Josh Montone, North East Regional VP
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Mark Csernica, Manager Network Planning
Bill Homer, Manager Logistics
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CTIA
Thomas Wheeler, President & CEO
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Eaton Corporation
Mike Taranowski, Proposed Key Fob Location Approach
Matt Planning, Proposed Key Fob Location Approach

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Federal Communications Commission
Ken Nichols, Chief - Laboratory Division, FCC Office of Engineering and Technology

Kent Nilsson, NRIC V Designated Federal Officer

IEEE Technical Committee on Communications Quality & Reliability (CQR)
Raymond J. Bonelli, Board of Advisors

Nortel Networks
Kelly Krick, Director, Wireless Technical Support Operations
CQR Board of Advisors

NRIC V Leadership / Level 3 Communications
James Q. Crowe, NRIC Chairman, Level 3 CEO
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Lucent Technologies
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Albert Bogaard, Vice President, Process & Platforms Center of Excellence
Jim Brewington, President, Mobility Solutions
Talmage Bursh, Technical Support Services Vice President
Mary Chan, Vice President, Mobility R&D
Victor DaSilva, Vice President – Technical Support Services
Nick De Tura, Program Management Vice President, North America
Homa Firouztash, President, LWS Americas Operations
John Heindel, President, Lucent Worldwide Services
Donna Hlavacek, CTA Technical Manager
Jeff Jaffe, President, Bell Laboratories Research and Advanced Technologies
Peter V. Lessek, President E-Services
Howie McDonell, Network, TDMA Vice President
Dale Newton, TDMA Technical Manager
Jerry Prestinario, Vice President, AMPS/PCS/UMTS Core Support
Juan Segura, Director TDMA
Rick Shaw, Program Director
Vilma Stoss, Program Management Vice President, AT&T Wireless
Pam Tomczyk, Director, Wireless Technical Support Center
Bill Zucker, Vice President Wireless Development

SkyTel
Bruce Deer, Senior Vice President

Telcordia Technologies
David E. Burns, Corporate Vice President & Group President – Professional Services
Dennis L. Jennings, Group Vice President & Managing Director – Systems Engineering
Richard P. Harrison, Senior Director – Information Infrastructure: Standards, Requirements, Numbering and Forums
Thomas W. Mazzone II, Director – Telcordia Routing Administration

TruePosition, Inc.
Kent Sander, President and COO
Clyde Smith, Senior Vice President, Operations

U.S. Department of Energy
John Veatch, Program Manager, Office of Emergency Operations,
Headquarters Emergency Response Officer
John R. Tanke, Special Technologies Program, U.S. Department of Defense Liason
Dorland Edgar, Argonne National Laboratory

U.S. Marshals Service, Electronic Surveillance Unit
Robert J Finan III, Assistant Director for Investigations

Verizon Wireless
Bruce Ciotta, Director of Technology Development, HQ
Larry Rybar, Executive Director - Technology Development & Implementation, HQ
David Heverling, Vice President Network, Northeast Region
Michael Haberman, Executive Director, Network New York Metro
Gian DaGama, Director System Performance, New York Metro
Faris Howat, Manager System Performance, New York Metro

Wheat International Communications Corp.
Forrest C. (Woody) Wheat – CEO
L. Dennis Smith

. . . And numerous others who are too many to list.

9 GLOSSARY

AMPS/NAMPS - Analog and Narrow Band Analogue cellular systems

ANI - Automatic Number Identification, particularly useful in 911 situations when a call may be dropped.

CALEA - Commission on Accreditation for Law Enforcement Agencies

CDMA - Code Division Multiple Access, also IS95, A frequency modulation which independently codes data in multiple channels for transmission over a single wideband communication link. It may be used as an access method that permits carriers from different stations to use the same transmission equipment by using a wider bandwidth that the individual carriers otherwise require. Upon reception, each carrier is distinguished from the others by means of a specific modulation code. This enables reception of signals that were originally overlapping in frequency and time.

COW - Cellular on Wheels, these are self-contained cellular operating infrastructure stations typically placed in semi-trailers.

DF – Directional Finding

DTMF - Dual Tone Multi-Frequency, telephone touch tone sounds/frequency

ESN - Electronic Serial Number, A 32-bit binary number. The ESN is assigned by the manufacturer and can never be changed

Fob - Short strap, ribbon, or chain used to attach electronic communicator for convenience

GPS - Global Positioning Systems, used primarily for pinpointing a location off satellite information this technology is more useful for grand scales than narrow locations.

GSM - Global Standard for Mobile Communications. GSM uses narrowband TDMA, This is the primary system used in Europe and Asia.

HLR - Home Location Register, cellular home network of a handset.

IDEN - Integrated Digital Enhanced Network. digital technology that enables users to take full advantage of the benefits of the wireless world by integrating four communications services into one network specfically features of dispatch radio, full-duplex telephone interconnect, short message service and data transmission.

LNA - Low Noise Amplifier, lab test equipment

MIN - Mobile Identification Number, A ten-digit number that is similar to a landline phone number in that it has a three-digit area code and a seven-digit phone number. The MIN is assigned by the cellular service provider and can be changed, such as when changing service providers.

NOC - Network Operating Center

PRL - Preferred Roaming List

PSAP - Public Safety Answering Point

PINS - Pager Identification Number

POW - Pagers on Wheels

SMS - Short Message Service is the transmission of short text messages to and from a mobile phone, fax machine and/or IP address. Messages must be no longer than 160 alpha-numeric characters and contain no images or graphics.

TDMA (Time Division Multiple Access), also IS136, digital technology divides a channel into different "slots". Each slot can carry one voice or data transmission. This capacity increase is accomplished using a state-of-the-art technology called TDMA. TDMA utilizes GPS satellites to reference a synchronized time, and then divides the channel into time slots. As a result, channel capacity is increased because one channel has now been converted to multiple voice or data transmission vehicles.

TDOA - Time Difference Of Arrival

10 REFERENCES

White, Don. (1998). The 1998 EMC Encyclopedia. Gainsville, Virginia: EMF-EMI Control, Inc.

Network Reliability and Interoperability Best Practices, www.nric.org

ATIS Network Reliability Steering Committee (NRSC), www.atis.org

APPENDIX A. GUIDANCE for 911 COMMAND CENTER

This Appendix contains guidance that was developed by the WERT for the 911 Command Center. The WERT believed that special guidance was needed for handling calls from Cell phones of trapped survivors because of the special circumstances (e.g., the normal practice of keeping callers on line could waste battery power, the challenging debris field made signal transmission very difficult, etc.)

URGENT - TOP PRIORITY

ATTENTION: Platoon Commander
NYC 911 Command Center

Here are guidelines that the Wireless Emergency Response Team (WERT) has developed for the NYC 911 Command Center Operators.

KARL F. RAUSCHER
WERT Coordinator
Director - Network Reliability, Lucent Technologies

_____
We will continue to meet on AT&T bridge no. 877 XXX-XXXX, access code XXXXXX

_____
Suggestions for the PSAPs when talking to the Trapped Survivors:

1. Since existing conversation indicates established signal, advise survivor to keep handset in same position, during and after end of 911 call.
2. Record survivor name, phone number, and service provider (e.g., AT&T, Verizon, Sprint, Nextel, etc.). This may speed the search for the victim.
3. Advise them to keep the phone on, but minimize the talk time. We can call back. Most phones are usually efficient at conserving power. If the victim keeps turning off the phone this might drain more power.
4. Advise the victim NOT to manipulate the phone (for example, pressing buttons) in any way that makes the face light up. The lights in the phone use a lot of power. If handset is on vibration mode, and the operator determines that the survivor is alert enough, turn off vibration mode, if possible.
5. Customers will be sent a text message to call 911 at the time when trace equipment is in place. If it is not necessary to talk to the customer, but 911 operators need to send a message to them, we can use Short Message Service for some of the phones. 911 Center should contact WERT at bridge 877 962-2638, 124927

6. Conduct additional routine 911 questioning (get condition of survivor)

7. Minimize length of call

8. Encourage survivors that we are working very hard to locate them.

*Notify the Wireless Emergency Response Team (WERT) IMMEDIATELY, when calling please provide all recorded information and please provide the 911 call record.

Additional 911 Command Center Input from U.S. Secret Service

(1) What floor or location do you recall being on before the collapse?
(2) Are you able to hear any noises?
(3) Are you able to see any sunlight?
(4) Are you able to see others? Are they conscious?
(5) What is your physical condition?
(6) Help is on the way.

APPENDIX B. WERT MEDIA STATEMENTS for FEMA

WERT No. 1
ANNOUNCEMENT PREPARED FOR FEMA
SEPTEMBER 14, 2001
12:40 PM ET

A Wireless Emergency Response Team (WERT) has been established as a mutual aid priority of the major communications service providers and suppliers of wireless handset and equipment. This is a world class team of experts that is deploying every possible means of state-of-the-art technologies to support the search and rescue mission. This includes advanced network monitoring techniques and cutting edge radio frequency sniffers.

WERT is in the process of establishing a call center with the support of BellSouth. The number for the call center will be announced within a few hours. The call center will be used to record information from members of the public who (1) have received contact via an electronic device (cell phone, 2 way pager, etc.) by a potential trapped survivor at Ground Zero, or (2) are aware of any electronic devise associated with a missing person at WTC.

The delay in establishing the call center number is due to necessary precautions being taken to ensure that network degradation does not occur due to mass calling.

The team is led by Karl Rauscher, Director - Network Reliability, Lucent Technologies. The team consists of cellular and pager experts from AT&T, Lucent, Verizon, Sprint, Nextel, Voicestream, Motorola, Telcordia Technologies, Ericsson, Nortel, CTIA, PCIA, SkyTel and others. The team has been established under the authority of the NSC / NCC and is cooperating with U.S. Marshals Electronic Surveillance Unit, Secret Service, NYPD, NYC 911 Command Center, FEMA and other federal, state and city authorities. The team has been working 24X7 since Tuesday.

More information can be obtained by contacting LUCENT Technologies,(610) 966-3252.

_____
Prepared by Karl Rauscher 610 966-3252

WERT No. 2
ANNOUNCEMENT PREPARED FOR FEMA
SEPTEMBER 14, 2001
9:00 PM ET

1 877 348-8579

A Wireless Emergency Response Team (WERT) has been established as a mutual aid priority of the major communications service providers and suppliers of wireless handsets and equipment. This is a world class team of experts that is deploying every possible means of state-of-the-art technologies to support the search and rescue and recovery mission. This includes advanced network monitoring techniques and cutting edge radio frequency sniffers.

The WERT has established a call center with the support of BellSouth. The number for the call center is **1 877-348-8579.** The call center will be used to record information from members of the public who (1) have received contact via an electronic device (cell phone, 2 way pager, etc.) by a potential trapped survivor at Ground Zero, or (2) are aware of any electronic devices associated with a missing person at WTC. The public to call this number with such information immediately.

The WERT team is led by Karl Rauscher, Director - Network Reliability, Lucent Technologies.The team consists of cellular and pager experts from AT&T, Lucent, Verizon, Sprint, Nextel, Voicestream, Motorola, Telcordia Technologies, Ericsson, Nortel, CTIA, PCIA, SkyTel and others. The team has been established under the authority of the NCS / NCC and is cooperating with U.S. Marshals Electronic Surveillance Unit, Secret Service, NYPD, NYC 911 Command Center, FEMA and other federal, state and city authorities. The team has been working 24X7 since Tuesday.

The public is urged to respect this solemn effort, and to not provide misinformation to these channels. The data will be passed on to law enforcement authorities.

All media outlets are also asked to provide related information that they have been receiving to the 1 877 348-8579 call center.

_____
Prepared by Karl Rauscher, Coordinator - WERT

WERT No. 3
ANNOUNCEMENT PREPARED FOR FEMA
SEPTEMBER 15, 2001
10:00 AM ET

1 877 348-8579 for Reporting Cell Phones of Missing WTC Subscribers

Hundreds of calls have been received within the first few hours of the announcement of a call center established yesterday for the purpose of identifying survivors that may be using cell phones to send distress messages from WTC Ground Zero. The Wireless Emergency Response Team (WERT) has established a call center with the support of BellSouth. The number for the 24 hour-staffed call center is **1 877-348-8579.** The call center will be used to record information from members of the public who (1) have received contact via an electronic device (cell phone, 2 way pager, etc.) by a potential trapped survivor at Ground Zero, or (2) are aware of any electronic devices associated with a missing person at WTC. The public to call this number with such information immediately.

WERT has been established to coordinate rapid mutual aid from the major communications service providers and suppliers of wireless handsets and equipment. This is a world class team of experts that is deploying every possible means of state-of-the-art technologies to support the search and rescue and recovery mission. This includes advanced network monitoring techniques and cutting edge radio frequency sniffers.

The WERT team is led by Karl Rauscher, Director - Network Reliability, Lucent Technologies.The team consists of cellular and pager experts from AT&T, Lucent, Verizon, Sprint, Nextel, Voicestream, Motorola, Telcordia Technologies, Ericsson, Nortel, CTIA, PCIA, SkyTel and others. The team has been established under the authority of the NCS / NCC and is cooperating with U.S. Marshals Electronic Surveillance Unit, Secret Service, NYPD, NYC 911 Command Center, FEMA and other federal, state and city authorities. The team has been working 24X7 since Tuesday.

The public is urged to respect this solemn effort, and to not provide misinformation to these channels. The data will be passed on to law enforcement authorities.

All media outlets are also asked to provide related information that they have been receiving to the **1 877 348-8579** call center.

_____

Prepared by Karl Rauscher, Coordinator - WERT
610 966-3252

WERT No. 4
ANNOUNCEMENT PREPARED FOR FEMA
SEPTEMBER 17, 2001
11:45 PM ET

FEMA Encourages +1 877 348-8579 for Reporting Cell Phones of Missing WTC People

Well over 3 thousand calls have been received at the 877 348-8579 call center number set up for the purpose of identifying survivors that may be using cell phones to send distress messages from WTC Ground Zero. FEMA encourages the public to use this number. Information is being received about those who (1) have received contact via an electronic device (cell phone, 2 way pager, etc.) by a potential trapped survivor at Ground Zero, or (2) are aware of any electronic devices associated with a missing person at WTC. The public is urged to call this number with such information immediately.

The team is sending out short text messages to cell phones that are registered on the network. The messages advise potential survivors to conserve battery power, respond with a simple response, and know that we are "looking for you". A beep every 2 minutes is being sent to pagers.

The team currently has several open cases. These include situations where reports from 911 or family were confirmed with network call events information such as cell tower site location, time stamps, and billing data.

WERT continues to identify call details that leave open the possibility that there may be survivors with cell phones. In addition, sophisticated monitoring of cellular network activity has been able to determine that numerous reports could not possibly be from the Ground Zero site, and have thus helped avoiding putting rescue workers at risk.

WERT has been established to coordinate rapid mutual aid from the major communications service providers and suppliers of wireless handsets and equipment.

The WERT team is led by Karl Rauscher, Director - Network Reliability, Lucent Technologies. The team consists of cellular and pager experts from AT&T, Lucent, Verizon, Sprint, Nextel, Voicestream, Motorola, Telcordia Technologies, Ericsson, Nortel, CTIA, PCIA, SkyTel and others. The team has been established under the authority of the NCS / NCC and is cooperating with U.S. Marshals Electronic Surveillance Unit, Secret Service, NYPD, NYC 911 Command Center, FEMA and other federal, state and city authorities. The team has been working 24X7 since Tuesday.

The data will be passed on to law enforcement authorities.

All media outlets are also asked to provide related information that they have been receiving to the 1 877 348-8579 call center.

_____

Prepared by Karl Rauscher, Coordinator - WERT
610 966-3252

APPENDIX C. EXAMPLES OF MEDIA COVERAGE

Workers, Rescuers Seek Phone Signals
Associated Press, Genaro C. Armas: September 14, 2001 6:07 PM

Mobile Phone Companies to Help in Search for Missing
Reuters, Jeremy Pelofsky, September 14, 2001 8:11 PM ET

WTC Search Sniffs Out Wireless Signals
Reuters, September 15, 8:16 pm ET, WASHINGTON

Searching for Wireless Signals -
Communications Team Collecting Cell, Pager Numbers
MSNBC STAFF AND WIRE REPORTS, September 16, 2001

WERT Interview
Irish National Radio (RIE), Pat Kenny Show, September 19, 2001

CNN Headline News
September 18, 2001,

Location Vendors Attempt To Find Survivors Phil Carson
Wireless Week, September 24, 2001

APPENDIX D. VOLUNTEER OPERATORS for PUBLIC CALL CENTER

The following Bell South employees volunteered as operators for the WERT Call Center:

Mini Acosta
Adair Karin
Kathy Adams
Denny Addis
William A. Aguila
John T. Albritton
Kenny Allen
Kimberly Allen
Sonya Allen
Ann Anderson
Dave Anderson
Robert Andres
Robert Andrews
Armento Mary
Debbie Arogeti
Lisa Ash
Carol Ashby
David Avera
Kathy Baird
Deborah Baker
Lynn Barclay
Patricia A. Barnes
Tara Barnett
Ryan Barras
Jeanette W. Beard
Carol Beckham
Erik Benner
R. B. Bennett
Peg Bernhardt
Claudia S. Berry
Shannon Beske
Dennis Betz
Beverly Bibikan-Koenig
Leslie Bishop
Sandra Bishop
Richard Bissell
Barbara Bivens
Kathy Blake
Jose Blanco
David Blumenthal
Gail Bobbitt
Mary Boehm
Ernie Bond
Ernesto Bonilla
Danny Bonivtch
John Bradberry
Kristin Brahm
Jim Brinkley
Lisa Bronson
Earvenia Brooks
Jackie Brooks
Jeff Brothers
Carlton Brown
Chris Brown
Richard Brown
Susan Brown
Wanda Brown
Loren Brumbaugh
Nancy Bruns
Scott Bryan
Debra Bryant
Jill Buffa
Rolando Buigas
Linda Burke
Ali Burkholder
Carol Burrell
Jeannette Butler
Judy Byrd
Margaret Calger
Calves Heberto
Grace Camp
Wayne Camp
Alison Campbell
Betty J. Carmon
Kevin Carnes
Trish Cartwright
John Caruso
Julie J. Castro
Diane Chadwick
Carrie Chapman
Anne Chastain
Harvey Chatham
Gordon Chatterton
Jane Chiang
Jim Childs
Trent Clack
Terry Clements
Jimmi Coffey
David Colvard
Janice Compton
Judy Connor
Stacey Conyers
Millie Cook
Susan Cooper
Lorraine Corcoran
Archie Course
Cindy Cox
Anne Crawford
S. D. Crittendon
Melissa Crook
Christianne Curran
David Cygan
Joy Dance
Sharon R. Daniels
Beverly M. Davis
Rita Davis
Shelley Decker
Denson Blake
Frank Depalo
Rod DeYonker
Dickie Dane
Rick Diehl
Rachel Domba
Pete Donnelly
Nancy Dooley
Angela Downs
Genevra Dubose
Kim Dunbar
Glenda Duncan
Joan Dyer
Tony Easley
Jeff Edwards
Martha Edwards
Peggy Emrey
Jorge Esteban
Bob Evans
Durrett Evans
Holly Ewert
Patrick Fahey
David L. Farrow
Jan Flint
Lea Floyd
Kevin Foley
Terry Fontaine
Cindy Ford
Laura Ford
Lisa Foshee
Gail B. Fountain
Miriam Fountain
Harriett Francis
Phyllis Frey
Dave Fulton
James Gaffey
Kim Galbreath
Daniel R. Garcia
Linda P Garcia
Tony Garcia
Karen Garmon
Holly Gault
Joanne Gauzens
Paul Gauzens
Jody Gayhart
Jackie Geyer
Tom Gibbs
Robert Gillian
Thomas C. Gillon
Neil Gilmartin
Charles Ginn
Delores Glaraton
Sharon Gotfredson
Beverly Graham
Lindsay Graham
Kevin S Graulich
Kathryn Green
Patricia A. Green
Sandra Green
Grier Robbie
John Griffin III
Lianne Griffin
John Griffith
Karen Habra
Cindy Hamrin
Julia Hand
Christina Hargon
Rex Harper
Rashida Harris
Theresa Harris
J. Robin Harrison
Gary Hasty
Milt Hasty
Cindy Hawkins
Ken Hawkins
Kathleen Hawthorne
Sherish Hedden
Susan Henderson
Jim Hendry
Phil Hilliard
Donna Hodges
Patricia Hodges
Edna Hofstetter
Carla Holbrook
Maleika Holder
Scott Holt
Antonio Hosey
Cindy Hosey
Leney W. Houston
David W. Hubbs
Robbie Hudec
Brantt Hudson

Machelle Hudson
Suzanne Hulsey
Fred Iffland
Asha Imani
Louis I. Ingwersen
Michael J. Irvin
John Irwin
Clarissa Jackson
Yvonne Jackson
Phil Jacobs
Stacy Jamison
Maxine Jarman
Kelly Jenkins
Johnson Cynthia
Deborah Johnson
Tim Johnson
Brian Jones
Deborah Jordan
Billie Josey
Larry Kahn
John Karry
William Keith
Elizabeth Kelley
Jennifer Kendall
Alan Kennedy
Thomas Kenny
Saleem Khan
Steve Kimbro
Candace King
Mabel Kingsberry
Theodore Kingsley
Rick Klucznik
Aisha Knight
Joe Knoerle
Gina L. Knox
Dyna Kohler
Rao Komma
Scott Kubie
Robert Kulp
Patricia Kushner
Valerie Kutikov
Karen S. Labord
Burbel Lacour
Michael Lang
Michelle Lavin
Celia Lee
Courtney Lee
Kim Lee
Pamela Lee
John Lemmon
Linda K. Lemmon
Linda Lemmon
Melinda Lemon
Mel Levine
Colleen Lewis
Jodi Lewis
Karen Lewis
Kim Lierley
Jared Likes
Anastassia Listopad
Amy Little
Sharon S. Little
Sandra Lomas
Linda Long
Carolyn Lovett
Jean Lowe
Joseph Lowery
Bob Lumpkin
Catherine Lynch
Fai Mack
Laurel MacKenzie
Cheryl Magoon
Sue Mahan
Catherine
Mahoney
Katie Malcom
Soneta Malit
Tom Mangum
Pete Martin
Belinda Massafra
Matheson Steve
David McCampbell
Linda Mccann
Mccarty Delores
Pat Mcclure
Mccurdy Terri
Terry McDevitt
Edris Mcgalliard
Patsy Mcgirl
Linda McLeroy
Chet McQuaide
Mejia Michael
Norma Melendez
Betsy Melvin
Tamara Meng
Kelly Messina
Alethia Middleton
Carolyn Miller
Mindy Miller
Donna Minix
Ann Mittelstead
Albert Moore
Glyndell Moore
Greg Moore
Kauyaai Moore
Lorene Harris
Nancy N. Moore
Nancy S. Moore
Tom Moquin
Kathy Morgan
Kathy Morgan
Carlos Morillo
William R. Morrison
Doyle Mote
Angelic Moxley
Terry Murphy
Vanessa Murphy
Jeanette Napp
Laura Narducci
Brenda Neal
Shirley Nelson
Ann Nettles
Sandra Neuse
Sue Noetzel
Thomas A. Obra
Julie O'Kelley
Florena Oliver
Carol O'Neal
David Overdorf
Francine Pafumy
Maryann Palmisano
Dave Parker
Susan Parker
Jeania Parrish
Tom Parsons
Eric Paschal
Shailesh Patkar
Bonnie Patrick
Karen Perryman
Vijay Perumbeti
Renee Peterson
Nancy Pettyjohn
Kevin Philips
Denis Pichanick
Pamela Pierotti
Rhonda Pitts
Virginia Planchon
Debbie
Plemmons
Kyle Pointer
Kriss Poll
Regina Porcello
Lynn T Portee
Sherry Porter
Dave Powell
Edna Powell
Cindy Preston
Anne Provost
Janet Pytelewski
Suzy Quenzer
Tom Guinn
Rick Radke
Marci Raible
Kris Rainey
Tom Rajek
Kimberli Ransom
Julianne C. Rask
Steve Rasmussen
April Ray
Rayburn Brenda
J. R. Rebecky
Bonnie Reeves
Nafis Rehman
Andrew
Reichman
Andy Reichman
Linda Richards
Betty Ridgeway
Pearlie Riley
Aletha Roberson
Jacinth Robotham
Susan Rodgers
Celina Rodriguez
Sheri Rose
Elliot Rosenberg
Lyn Rosser
Cathy K. Rutherford
Regero Sampson
Lynda Scardina
Maria Schnabel
Diane Schott
Tisha Scoby
Brian Scott
Debbie Scott
Susan Scott
Lee Scrabis
Bob Seidel
Wikki Sellers
Jeff Shadrick
Lisa Shaver
Judy C. Shaw
Amy Sherwood
Dior V. Castlin
Dick Sibbernsen
Sheila Sidney
Alan Silverstein
Felicia Simmons
Hallie Sinor
Debra Skopczynski
Mark Smilie
Bill Smith
Edith Smith
Mark Smith
Al Snow
Debra Sorrow
David Sosnin
Kristine Spraga
Clem Stancell
John Stefanik
Theresa Stelmachers
Barbara Stephens
Jeanne Stephens
Ranae Stewart
Millie M. Stoddard

Carmen Stokes
Laura Stokes
Debbie Stoye
Diane Strickland
Jill Strickland
Alicia Suarez
Mike Suarez
Debra Sullivan
Michelle Summers
Jill Sutton
Sutton William
Cathy Swift
Lynn Taylor
Peggy Taylor
Marcia Terry
Robbin Teti
David Thierry

Audrey B. Thomas
Brenda J. Thomas
Julie Thomas
Lee Thomas
Vanessa Thomas
Erin Thompson
Stanley C. Thompson
Michelle Thorntonfrink
Pam A. Tipton
Patrick Tipton
Tjioe Susan
Rita Todd
Kristine Toole
Vivian Trabue
Walter Trimble
Steven Tunnell
Julie Turner

Dorothy Vallery
Mirta Vangorden
Linda Wade
Shelley Walls
Sharon Wasserman
Mike Watson
Eric Watts
Sandy Webb
Roenell G West
Eric White
Cris Wilcox
Mark Willard
Craig Williard
Brian Wilson
Melody Withrow
Tammy Witsch
Marquelle Wohlford

Marc Wong
Cheryl Woodie
Richard Wright
Vicki Wright
Brenda Wrixon
Ken Wrixon
Bob Vingling
Jerry O. Young
Vickie Young
Kara Zahler
Kara Zahler
Hector Zayas
David Zhang
Weda Zoller