WARNING, THE CRITICAL ELEMENT
TO MITIGATE THE EFFECTS OF A CBRN ATTACK

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MNS/CBRN System Integration

Abstract
Mass casualties are to be expected upon use of Chemical and biological weapons against military and civilian targets. To effectively mitigate the threat, an integrated detection—alerting system is required. MadahCom, Inc. has produced an effective integrated MNS-CBRN system that is able to provide the right message, to the right people, at the right time, and hence minimize the number of casualties before, during and after an attack. The system is also able to provide event notification up the command chain by integrating with Command and Control (C2) systems for improved situation awareness.

Introduction

The worldwide proliferation of chemical, biological, radiological and nuclear weapons capabilities, as heightened by recent events, has broadened the range of scenarios in which use of these threats is possible. Mass casualties is now the expected normal outcome from use of these weapons when used against military and civilian population concentrations.

Whereas the detection of the CBRN threats is necessary to in order to generate timely alerts, detection is insufficient, by itself, to save lives, mitigate casualties and minimize chaos. It is the actual warning of personnel in the effected areas, and the take-action instructions provided to them in a timely and coordinated manner that is equally critical a part in an overall effective mitigation response. Not unlike natural disasters, such as a tsunami, hurricane, or earthquake detection alone can not be effective without properly dissemination of this information.

Warning the public of an impending attack is obviously not a new tactic. Consider the midnight ride of Paul Revere as a historical example of using both an audible and visual alerting method. In April 1775, Revere hung two lanterns in the bell-tower of Christ Church in Boston, indicating from pre-planned signals that the British troops would row “by sea” rather than marching “by land.” He then alarmed the country-side by riding and stopping at each house.

Alerting has certainly come a long way since 1775. In today's world being prepared is even more critical than ever. And being able to quickly detect and identify such new threats as Anthrax, Sarin and Ricin, to name but a few, has become a necessity. As detection speed and accuracy increased, the need as well as the value of a more immediate alerting. Yet alerting technology has languished, often requiring a "person-in-the-loop" to create a response (often called the 'swivel-chair solution'). Manual activation of alerting scenarios often created difficulties of delayed activation, errors in following procedures, and, in general, chaotic over-reaction.

The ramifications of delayed alerting (or no alerting at all) are rather obvious. What is less obvious are the consequences of producing warnings that are not clear, or ones that are distributed too widely and cause an interruption to personnel that will not be affected by the threat and do not need to know. One can imagine being a soldier in a war zone, being awakened every hour, or so, by an alarm that may effect the general area, but that has no impact on his/her immediate location. After a few such unnecessary ["false"] alarms, one may be inclined not to respond to the next warning, which, clearly, can be a tragic mistake. False or indiscriminate alarms in buildings and areas not under immediate threat places more people in harm's way, and result in a poorly managed emergency scenario.

What is a Mass Notification System?

To reduce the risk of mass casualties there must be a timely means of notifying personnel in buildings and outdoor environments of threats and what should be done in response to those threats. Specific, well-directed, pre-recorded and live voice emergency messaging are the key ingredients of such notifications. Mass Notification Systems (MNS) are designed to inform and instruct personnel within protected areas, in real-time, what to do in cases of threats.

Available Technologies for Mass Notification

From historic emergency notification methods such as flags, bells and smoke signals to yesterday's methods of sirens (tones) and fire bells, alerting has evolved significantly. Due to current complex threats like a chemical attack, voice is important for specific instructions. When warning times are short or nonexistent, the message becomes even more critical. Today's MNS provides effective means of audible (speaker towers and indoor/outdoor speakers) and visual alerting (LED signs and strobes). An integrated MNS may contain some or all of the following components - base-wide control systems, individual building systems, outdoor systems, telephone notification systems and a network of alert sensors.

Fire protection systems are often considered a component of a MNS (but never a replacement).

Base-Wide Control System

Implementation of a base-wide mass notification system offers the advantages of centralized control, monitoring and message delivery. Base-wide control systems are a critical ingredient of an effective MNS; it leverages the 24/7 availability of professional emergency management resources in command posts and law-enforcement-dispatch centers to instantly notify personnel throughout the base of an imminent threat. As such, base-wide systems complements individual building systems that are primarily used for local emergency event management, but are not always staffed with properly trained personnel.

Base-wide systems may be implemented as wired or wireless systems. Wireless systems increase the survivability of the entire MNS by increasing the communication reliability among the various system components. Wireless systems also offer significant cost advantages where wide-area coverage is desired.

Automated Responses to Events

Sophisticated mass notification systems, such as MadahCom's WAVES, offer programmed (scripted) responses to events. The activation of an alert sensor, be it a pushbutton at a gate, a wireless "panic" button or a CBRNE detector, may be programmed to trigger notifications without further intervention of a human operator, thereby decreasing response time and the likelihood of notification failures.

Remote Activation

An effective MNS must provide command and force protection personnel with the ability to remotely access the base-wide control system and activate critical mass notification functions. This can be done using the telephone (including cellular) or a computer, a networked computer as well as wired/or wireless activators.

Individual Building Systems

An individual building system consists of an Autonomous Control Unit (ACU) driving a network of notification appliances.

An ACU is used to control and monitor the notification appliance network as well as provide consoles for local operation. Using a console, personnel in the building can initiate delivery of pre-recorded voice messages and provide live voice messages and instructions. To avoid confusion caused by the simultaneous activation of a fire alarm, UFC mandates that the MNS temporarily deactivate audible fire alarm notification appliances while delivering voice messages. The ACU communicates with the base-wide system to provide status information and receive commands and messages.

The notification appliance network consists of audio speakers placed to provide intelligible instructions at locations in and around the building. Other devices such as strobes and LED displays may be provided to alert hearing-impaired personnel, as appropriate.

In a variety of cases, the use of speakers and other components of an existing public address system may be appropriate in buildings where the installation of a new speaker system is not cost-effective. If this implementation approach is taken, an individual building mass notification system may be interfaced with an existing public address system. Features are provided by the MNS to ensure that emergency messages have priority over non-emergency messages.

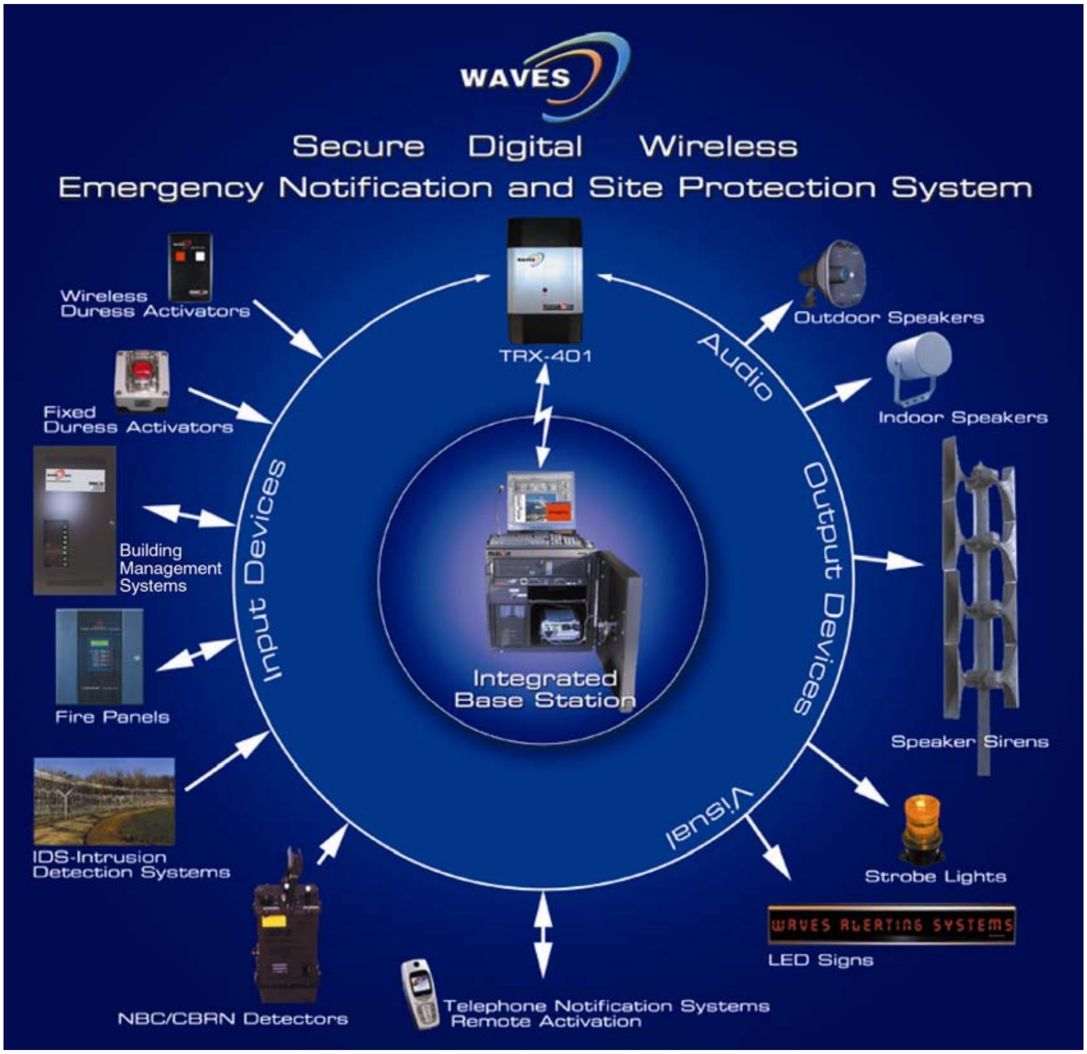
Giant Voice Outdoor Systems

The Giant Voice system is typically installed as a base-wide system to provide siren signals, pre-recorded and live voice messages. It is most useful in providing mass notification for personnel in outdoor areas, expeditionary structures, and temporary buildings. It is generally not suitable for mass notification to personnel in permanent structures because of the difficulty in achieving acceptable intelligibility of voice messages.

A base-wide mass notification system that incorporates both a Giant Voice sub-system and individual, indoor building systems provides the user better protection.

Telephone Notification Systems
Telephone alerting systems are independent systems that may be used to provide notification primarily to key personnel that are off-site. These systems should not be used for the purpose of reaching large number of people due to capacity limitations. It is also important to note that these systems generally rely on external infrastructure systems not in the control of the facility (such as land-line and cellular telephone systems).

MNS Advanced Technology
MadahCom, Inc., a recognized leader in providing Anti-Terrorism/Force Protection (AT/FP) for military bases worldwide, provides digital wireless emergency notification systems. MadahCom's WAVES (Wireless Audio Visual Emergency System) and its portable system, TACWAVES (Tactical WAVES), are stand-alone, integrated alerting and site protection systems. When combined with CBRN Sensors both systems provide a formidable component of the Force Protection needs for Bases, Expeditionary Units and Tent Cities. WAVES provides control of live and automated both indoor and outdoor, audio and visual warnings and instructions in emergency situations. By the use of strobes and LED (indoor & outdoor) signs, messages can be sent out when needed in areas that have audio problems (i.e. hangars, loud noise environments, etc).



Developed using secure wireless technology, a digital wireless MNS like MadahCom's WAVES is highly survivable and can successfully operate in severe electronic countermeasure environments. Secure digital Frequency Hopping Spread Spectrum (FHSS) technology and "a redundancy backbone" are incorporated in the system design, preventing jamming, and interference, eavesdropping, and spoofing as well as protecting the network in the event of a disaster. FHSS operation disperses the transmission over a large bandwidth, minimizes the possibility of any interference, and is virtually jam proof, even against the most sophisticated state-of-art jammers. This includes high power broadband jammers as well as jammers that attempt to detect the frequency hopping sequence using spectral analysis.

It can operate as a stand-alone system or be integrated with security systems such as intrusion detection, access control, fire alarms, as well as CBRNE detection systems. However, the only MNS that fully integrates with a CBRN detection system is WAVES. This integration is crucial for the following reasons:

1. Saving civilian and soldiers' lives
2. Minimizing casualties of personnel who check the detection equipment
3. Integrating plume propagation into the equation in order to give specific instructions to specific zones
4. Automatically instructing zone/areas where people only have seconds to respond
5. Alerting on a City/County-wide level

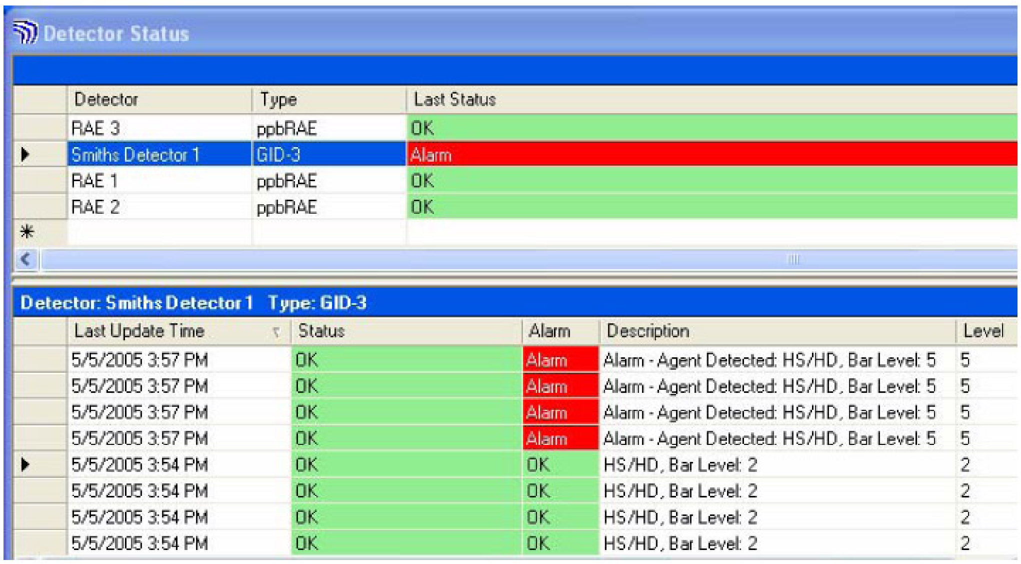
Integration of Mass Notification System (MNS) with CBRN Sensors

A well integrated MNS—CBRN detection system helps protect people in case of an attack. Before an attack, available information can be effectively disseminated via the MNS and directed by zone to the affected areas instructing personnel to take pre-attack mitigating actions. Once the threat is detected, specific warnings and take-action instructions are immediately distributed to the affected, or soon to be affected, zones providing personnel maximum time to take actions that minimize the brunt of the attack, minimizing casualties. After an attack, information can be disseminated that can help recovery efforts and restore operations.

When a chemical or biological agent is detected by the sensor(s), the sensor immediately sends the data to the WAVES MNS Field Transceiver, which, in turn, sends the data within several tens of milliseconds to the MNS central base station. At the central base station the incoming data is compared with a pre-set look-up database to determine the alarm levels. The WAVES MNS central base station display shows an alarm status, as well as information about the detected agent, and its relative concentration. Emergency alarms are triggered when concentration levels high enough to merit an alarm. In the example below, the screen shows detection of the chemical HS/HD and the time history of exceeding the pre-set emergency alarm level of 3. On its second screen (not shown) the WAVES MNS shows the alarm location with a blinking icon on its digital map display. A pop-up message next to the blinking icon shows the alarm level, the triggering agent plus additional details about the readings.

In addition, The WAVES MNS can respond based on pre-determined parametric scripts and automatically send pre-recorded voice and text messages to loudspeakers and LED/Strobe signage in the affected areas. For example, the message: "Alarm Yellow… Take Cover! …Don

Gas Masks & Chemical Defense Gear!" can be played in the immediately affected areas. The message is normally preceded by alarm tones and is repeated several times. The person in charge in the emergency operation center can manually override the message and send out a live or another pre-recorded message after examining the data. Other messages can also be automatically or manually sent to other areas (zones) advising personnel to either evacuate, take protective actions or do nothing, as the conditions warrant. The above described scenario is only one particular response type; the flexibility of the WAVES MNS allows for numerous pre-scripted response scenarios that can be further changed at any time thereafter by the system administrator.



Detector Status

Detector	Type	Last Status
RAE 3	ppbRAE	OK
Smiths Detector 1	GID-3	Alarm
RAE 1	ppbRAE	OK
RAE 2	ppbRAE	OK

Detector: Smiths Detector 1 Type: GID-3

Last Update Time	Status	Alarm	Description	Level
5/5/2005 3:57 PM	OK	Alarm	Alarm - Agent Detected: HS/HD, Bar Level: 5	5
5/5/2005 3:57 PM	OK	Alarm	Alarm - Agent Detected: HS/HD, Bar Level: 5	5
5/5/2005 3:57 PM	OK	Alarm	Alarm - Agent Detected: HS/HD, Bar Level: 5	5
5/5/2005 3:57 PM	OK	Alarm	Alarm - Agent Detected: HS/HD, Bar Level: 5	5
5/5/2005 3:54 PM	OK	OK	HS/HD, Bar Level: 2	2
5/5/2005 3:54 PM	OK	OK	HS/HD, Bar Level: 2	2
5/5/2005 3:54 PM	OK	OK	HS/HD, Bar Level: 2	2
5/5/2005 3:54 PM	OK	OK	HS/HD, Bar Level: 2	2

Smith Detector Event Gas Type and Concentrations

Integration of Plume Propagation Models

By adding a plume propagation model, and by adding a GIS location-aware capability (GeoSmart™) to the wireless transceivers, the MNS can be programmed to automatically send different messages to different zones based on the plume propagation model's predictions. This feature can significantly improve the effectiveness of the overall CBRN attack response by minimizing chaos and consequently casualties. Depending on the plume propagation prediction, personnel in specific areas may be instructed to stay in a building and take protective actions or evacuate to a safer area if time allows.

In the industrial example below, the security command center at plant XYZ sends out four specific voice/visual instructions to the different zones. The voice messages are preceded by alarm tones, and the visual text messages are preceded by flashing strobe signals in order to get immediate attention:

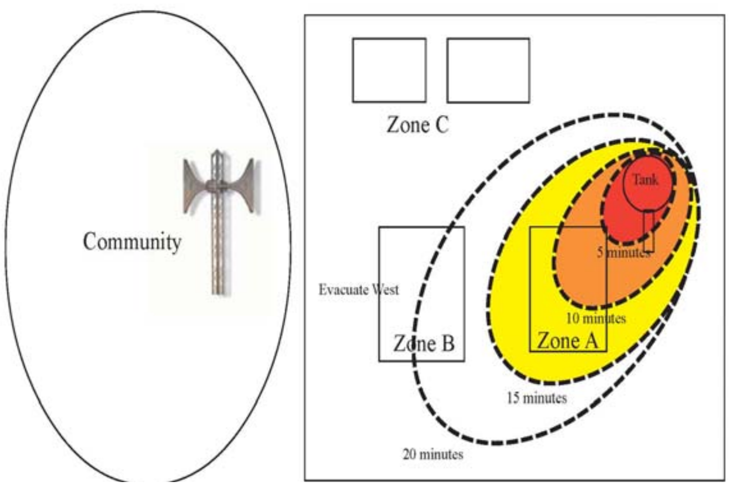
Zone A Message:
"This is Security. There has been a Chlorine tank explosion in the plant. You are in the danger zone. Do not leave the building. Immediately take the following actions: Close and seal all windows and doors by placing wet clothes around them. Turn off the air conditioning system and

any stand-alone air conditioning units. Repeat – Do not leave the building! Await further instructions from Security.”

Zone B Message:
“This is Security. There has been a Chlorine tank explosion in the plant. Immediately evacuate the building by exiting only through the West doors and head to the assembly area in Parking Garage C. Repeat – Immediately evacuate the building through the West doors to Parking lot C.”

Zone C Message:
“This is Security. There has been a Chlorine tank explosion in the plant. You are not in the danger zone. Please remain in the building until further notice. Take the following precautions: turn off the air conditioning system and close all windows and doors. Do not leave the building until further notice. Await further instructions from Security.”

Message to the Community: (over high powered speaker-sirens)
“Your attention please: there has been a Chlorine release at Plant XYZ. You are not in the immediate danger Zone. However, please remain indoors until further notice. Please remain calm and await further information from authorities.”



The GeoSmart™ capability allows the WAVES MNS to determine which of its units are within an area determined by a geographical criterion (such as determined by a plume propagation model) and automatically assemble announcement zones on an ad-hoc basis. This feature is called AutoZoneAlert™ and is an especially powerful feature when warning times are very short and the detected threat is bound to affect areas that do not conform to pre-zoned layouts. Hence, information received either directly from detectors or indirectly via a host Command and Control (C2) system can be parlayed into relevant emergency alerting announcement within seconds of threat detection. Whether a CBRN attack, a HAZMAT spill, perimeter breach or incoming munitions, the WAVES MNS can effectively issue alerting messages that are specific to the threat, specific to the area affected, and in real-time.

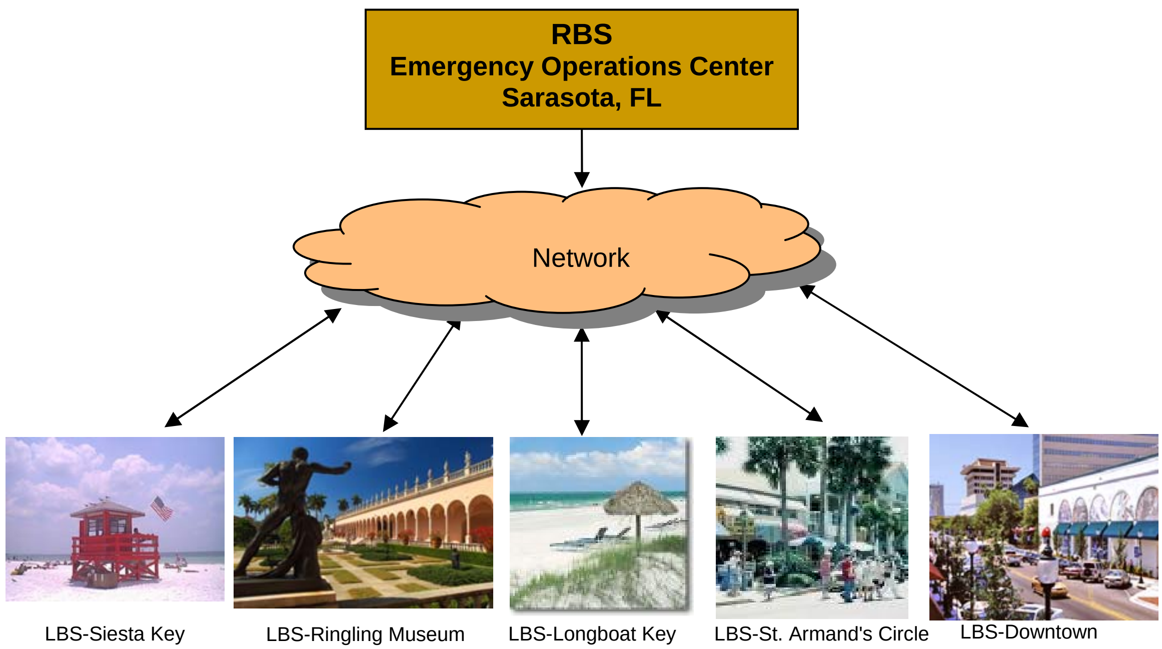
Wide-Area Alerting

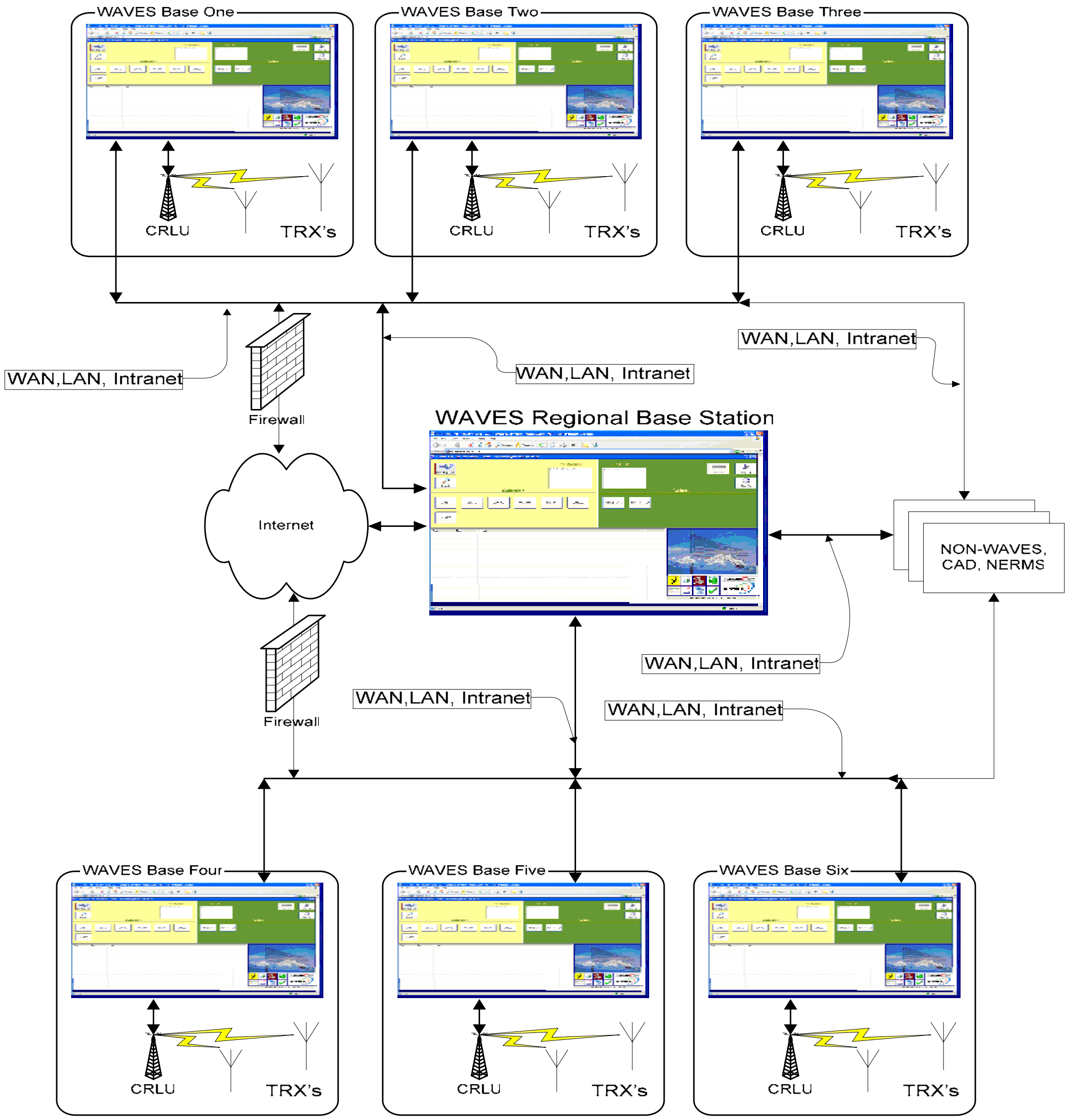
Often, CBRN threats may encompass entire communities. The WAVES MNS is capable of assembling multiple local, geographically separated MNS sites into a broader regionally controlled system. The MNS Local Base Stations (LBS) are connected via LAN, WAN, Intranet or Internet to create a wide area coordinated alerting and monitoring network, expandable to essentially any scale.

The WAVES MNS Regional Base Station (RBS) would normally be placed in regional command center in a military setting, or in the emergency operations center in a city, county or state. The entire regional system can be controlled from any remote location via a zero footprint GUI such as Internet Explorer running on a laptop computer or PDA. Standard roles and privileges security measures are used to authorize access to the system. The individual LBSs continue to operate independently with local inputs; however, based on pre-defined privileges, they accept and execute RBS commands; they also provide status reporting to the associated RBS server.

External interfaces are also provided for non-WAVES applications. Both the LBS and the RBS can accept XML messages via Socket, file transfer, or serial communication ports to execute WAVES scripts. This enables integration with external C2 systems and Computer-Aided Dispatch (CAD) Systems.

In the example below, an RBS is shown to connect multiple local LBS placed in different parts of Sarasota County, Florida. The regional structure is also shown schematically in the diagram following.





CONCLUSIONS

An effective real-time alerting and warning action, in response to a CBRN attack, can be generated by an "intelligent" parametric Mass Notification System (MNS) tightly integrated with CBRN sensors. A detection, decision, and alerting model must be employed to successfully produce the desired result. The decision element (what's detected, who to alert and when) can be done locally by the MNS, a regional MNS, or externally by a Command and Control (C2) system connected with the MNS system through an IP network.

An effective response can be characterized as one getting **the right message, to the right people, at the right time**. The use of a secure (jam-proof, spoof-proof) communication environment is strongly recommended to assure high reliability of communications links critical in assuring system response and prevention of hostile counter-effect actions. An effective response can significantly improve readiness, reduce casualties and decrease chaos.

The *right message* is one that is event–specific (i.e., informs people of the specific danger detected, and instructs them what to do (and what not to do), using clear voice and when appropriate visual means such as LED signs.)

To the *right people*, implies being able to automatically direct the correct alerting messages to the affected areas (zones). Targeted zones can be pre-determined based on a-priori scripts, or assembled ad-hoc based on a momentary assessment and propagation direction of the threat and location-aware field alerting units. It is often equally important to prevent alerting in unaffected areas or to advise unaffected areas not to respond.

Acting at the *right time* implies being able respond instantly upon detection when needed, or when most appropriate under some criterion (e.g., staged zone alerting that can minimize chaos).