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Accessible Common Alerting Protocol Radio Data System Demonstration: Gulf Coast States

Final Report

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Homeland Security

Science and Technology

1 TABLE OF CONTENTS

Note: All Figures and Tables are included in the Appendices.

4

2 ACKNOWLEDGEMENTS

3 EXECUTIVE SUMMARY

The goal of this project was to create and demonstrate end-to-end text radio emergency alerting using Common Alerting Protocol (CAP) messages from the Federal Emergency Management Agency's (FEMA) Integrated Public Alert and Warning System (IPAWS) aggregator[1] for individuals living in the U.S. Gulf Coast who are deaf or hard of hearing. Tools created during the project were designed to be used by Public Radio Satellite System (PRSS)-connected FM radio stations and to have broad application for adoption by other commercial and non-commercial FM broadcasters using Radio Data Systems (RDS),[2] with the understanding that deaf and hard-of-hearing residents living in the vulnerable Gulf States region would benefit directly from receipt of emergency messages that are currently provided in an audio format to hearing individuals.

In utilizing elements of the public radio infrastructure in new ways, NPR demonstrated a system for delivering emergency messaging using CAP messages from the FEMA IPAWS aggregator, which may be expanded now that the underlying infrastructure has been developed.

NPR proposed using satellite delivery and broadcast technologies for secure and timely transmission of text alerts in an innovative way. This meant creating a delivery system for emergency information relying on radio technology that is accessible and available regardless of power outages, Internet disruptions or limitations with cellular service. More specifically, NPR Labs utilized the PRSS distribution path to 25 public radio stations in Alabama, Florida, Louisiana, Mississippi and Texas that are independently owned, managed and operated. The stations locally broadcast the alerts to deaf and hard-of-hearing field-test participants who received the alerts on specially designed radios. The disseminated emergency messages from FEMA's test platform using the Emergency Alert System (EAS) architecture demonstrated how attributes of the RDS, using CAP, can greatly expand the distribution of EAS alerts for the nation's 36 million citizens who have hearing loss.

To conduct this demonstration, significant hardware and software development was required, as well as system integration to provide a way to access, process and transmit text emergency messages. Tools created during the project were designed to be applied to PRSS-connected FM radio stations, which currently reach 95 percent of the U.S. population and have broad application for adoption by other commercial and non-commercial FM broadcasters. Vendors were identified and involved, to design and manufacture a specialized encoder for the stations and a specialized receiver for the end users. Additionally, software was developed that automated the relay of the alerts from origination through the system to the users, and which displayed the alerts to the field-test participants upon receipt.

Two rounds of consumer field tests were conducted during the summer of 2014. Messages were sent from the PRSS NOC to local public radio stations for broadcast to field-test participants. Consumers read text messages of up to 4,000 characters using an Android tablet paired with the custom FM-radio receiver. The FM receiver automatically tuned to the strongest signal of a participating station. During an alert, lights on the FM receiver notified the user that a message was being received and the text of the alert, on the Android screen, advised the reader of the emergency and actions to be taken. Field-test participants were surveyed daily for their impressions and experiences. Results from the first set of tests were used to improve and upgrade software for the second round of tests. The receiver was designed to be operated by battery and could be attached to a bed shaker to awaken the user.

The project employed best practices, and identified areas in technology development and design, engineering management, station installation, recruitment and management of field-test participants that could greatly improve future product development and testing methodologies. The NIPPER ONE prototype, the FM receiver developed for this project, won an

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[1] FEMA built IPAWS to ensure that under all conditions the President of the United States can alert and warn the American people. Federal, state, territorial, tribal and local authorities also have the opportunity to use IPAWS to send alerts and warnings within their jurisdictions. IPAWS improves alert and warning capabilities by allowing alerting authorities to deliver alerts simultaneously through multiple communications devices reaching as many people as possible to save lives and protect property (from http://www.fema.gov/alerting-authorities).

[2] While the U.S. version of RDS is called Radio Broadcast Data System (RBDS), we use RDS throughout because we are generally referring to the technology and the method of transmission. The terms may be used interchangeably.

International Consumer Electronics Show Innovations Design and Engineering Award for 2014. The project work was featured by the White House at its Innovation for Disaster Response and Recovery Day in July 2014. Recommendations and next steps include refining technological understanding and delivering non-English text alerts.

4 INTRODUCTION

The Wireless Emergency Alerts (WEA) service, authorized by the Warning, Alert and Response (WARN) Act of 2006, allows wireless service providers to send geographically targeted emergency alerts to their subscribers. Under Executive Order 13407, the Secretary of the DHS, in coordination with the Department of Commerce and the Federal Communications Commission (FCC), is responsible for implementing and administering a national public alert and warning system and ensuring that the President can alert and warn the American people in the case of an emergency. Within the DHS, FEMA is responsible for the implementation and administration of IPAWS. FEMA established the IPAWS program office to develop and manage technologies and processes capable of accepting and aggregating alerts from the President, the National Weather Service (NWS), and state and local emergency operations centers, as well as delivering validated, geographically targeted emergency alerts and warnings through the WEA. The DHS Science and Technology Directorate is tasked with researching and organizing the scientific, engineering and technological resources of the United States and leveraging these existing resources into tools to help protect the homeland.

NPR, with access to a satellite distribution path to more than 400 interconnected stations, completed a real-world end-to-end demonstration project. The project disseminated messages from FEMA's test platform, through the PRSS using the EAS architecture. The key goal was to provide an end-to-end demonstration of a RDS based emergency text alerting system, and to prove the viability of using CAP[1] messages from the FEMA IPAWS aggregator. The project was designed to utilize the PRSS, which can reach 95 percent of the U.S. population, and to educate staff and coordinate installation of the required hardware and software at 25 public radio stations in the Gulf Coast to transmit test messages to consumers.

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[1] The standards for the CAP are maintained and documented by the non-profit consortium Organization for the Advancement of Structured Information Standards (OASIS). OASIS has made several updates to the CAP since the standard was first published in 2004. The current standard is version is 1.2, available from OASIS at https://www.oasis-open.org/standards#capv1.2. This project implemented CAP version 1.2 in its INSO software.

5 METHODOLOGY

To conduct this demonstration of transmitting alerts via RDS, all hardware, software and system integration components needed to be designed and developed to provide a way to access, process and transmit text emergency messages to end users. More specifically, the project called for developing technical configurations for the project's software and hardware components, developing those components, producing technical test results, data and analyses, and conducting and producing evaluations by deaf and hard-of-hearing consumers. The project also identified vendors capable of building hardware and software used to ensure the end-to-end system would transmit text messages over radio broadcast signals using satellite transmission.

Twenty-five public radio stations were integral to the project. Because public radio stations are independently operated, their technical staffing varied during installation. In some cases stations had full-time employees in this role; in other cases they were part-time or contract workers, working at the station on an as-needed basis. Due to the wide variation in station personnel technical expertise, a project engineer was added to the project to work with individual stations and provide expertise and recommendations when needed to facilitate station set-up and streamline testing procedures. The project engineer also helped stations avoid unintended consequences such as operating the RDS signal at excessive levels that would interfere with other subcarrier or regular broadcasts. During initial engineering conversations with station personnel, it was discovered that there were many uses and configurations for RDS transmission—uses that had increased significantly beyond what was envisioned by developers of the technology. As a result of working with stations and vendors, additional features that made the system compatible with other common RDS functions were developed and easily installed in a wide variety of broadcast environments.

In order to test the system, two consumer field tests were conducted during the summer of 2014. During this period, 15 hourly emergency alerts were sent each day to field-study participants, using the CAP messages from FEMA's IPAWS aggregator.

Information from FEMA IPAWS was transmitted via RDS, concurrent with the normally scheduled broadcast of audio programming from the radio station. Messages were sent from the PRSS Network Operations Center in Washington, D.C., to local public radio stations who, in turn, broadcast the alerts to field participants. Deaf and hard-of-hearing consumers were able to read the text-based messages of up to 4,000 characters using an Android tablet paired with the custom-designed FM-radio receiver, called the NIPPER ONE, which was designed for the project. The FM receiver automatically tuned to the closest and strongest participating FM station, a public radio station carrying these special CAP messages on its RDS data stream. During an alert, lights on the FM receiver notified the user that a message was arriving. The text on the Android screen advised the reader of the nature of the emergency and any actions to be taken. The field-test participants were surveyed daily during the tests for their impressions and experiences. Results from the first set of tests were used to improve and upgrade software for the second round of tests. The receiver was designed to be operated by battery and could be attached to a bed shaker to awaken the user. A graphical representation of the end-to-end demonstration is shown in Figure 1 in Appendix B: Figures.

6 TECHNICAL CONFIGURATIONS AND TESTING

Emergency messages were delivered as text to end users, after moving through several stages of both new and preexisting infrastructure. The messages, sent by NPR, passed through the PRSS via satellite to participating member stations, where they were specially encoded so that the NIPPER ONE receivers would identify and process the signal delivered via FM transmission.

The PRSS, through its managing entity, the NPR Distribution Division, has continued to improve and enhance its ability to distribute audio programming and data to public radio stations since NPR became the first radio network to use satellite distribution in 1980. PRSS is in its second generation of digital equipment and infrastructure, providing a distribution method using a private internet protocol (IP)-based audio and data network that serves more than 1,600 public radio stations. Since the PRSS network uses satellite transmission, it can continue to operate despite various potential shortcomings of other channels, such as terrestrial Internet outages or bottlenecks.

All content within the system, whether live streaming audio, audio files, text documents or emergency alerting for this project, is assigned an IP address in the "dotted quad" format of "aaa.bbb.ccc.ddd." This made it possible to add a data channel for the demonstration project (e.g., edit a head-end configuration table and enter the satellite receiver identification information).

This section describes the hardware and software used in the project, including server, encoder and receiver hardware; the source of the alerting messages and the software used to generate test messages; and the development and implementation of software that gathers, processes and transmits alert messages via the PRSS. Figure 2 includes the schematic of the test messages' path.

6.1 HARDWARE, INGEST SOFTWARE (INSO) AND SOFTWARE TO MONITOR INSO (WATCHINSO)

Hardware

Two Dell PowerEdge R320 (225-2955) server-class, rack mount CPUs (central processing units) were the hardware foundation for generating and disseminating the messages. Their configuration and options are included in Table 1. They were the platform on which the INgest SOftware (INSO) and monitoring software, Watching Ingest Software (WATCHINSO) ran. The state of reliable and robust hardware is such that off-the-shelf components met or exceeded NPR's requirements, so no custom computing hardware was needed for these servers. The servers were installed in the NPR Tech Core, a restricted-access facility that contains corporate information technology, digital audio technology, telephony and PRSS equipment. Equipment in the Tech Core is powered by dual-phase uninterruptable power supplies (UPS) that have diesel generator backup. Mission-critical devices having two independent power supplies (and two AC power cords) can be plugged into two separate AC power sockets. They are fed from two different AC distribution systems supplying added protection from street power failure and brownouts.

The selected operating system (OS) for the two servers was Red Hat® Enterprise Linux® Server (v. 6 for 64-bit x86_64), chosen in consultation with NPR Distribution. It was selected because Linux is a well-tested OS, an open source platform, and is fast, secure and well supported. NPR Distribution maintains a support license with Red Hat for its corporate Linux servers, and these servers were covered under that support license. A standard set of Linux software tools and service was installed on the servers and secure access was set up through several layers of key and password logins. Operating system updates were made periodically and when vulnerabilities were identified. For example, the Open SSL components were updated in early April 2014 to eliminate potential threats from the Heartbleed bug.

Each server had three data network ports for specific purposes, each of which was configured with its own IP address. Each server was:

1. Connected through the NPR firewall for outgoing polls to FEMA/NWS. No incoming traffic was permitted to the servers from outside the NPR firewall;
2. Connected to the PRSS uplink data network—a secure, internal network serving only PRSS equipment for uplink and downlink; and

3. Connected to the NPR corporate network for the Integrated Dell Remote Access Controller (or iDRAC® described below).

The iDRAC allowed independent control and monitoring of the server even when the server itself was powered off. The iDRAC is Dell Corporations implementation of the Intelligent Platform Management Interface (IPMI), where a separate processor, memory, network connection and access to the server's system bus is built into the server. iDRAC is a computer that monitors and controls the server through a Web interface and hardware control, allowing the administrator to remotely power on or off the server, inspect its physical operation (fan, temperature) and provide a layer of security.

Source of Alert Messages

NPR is one of many public-sector companies that have executed a memorandum of agreement with FEMA for the purpose of gaining access to the Integrated Public Alert and Warning System-Open Platforms for Emergency Networks (IPAWS-OPEN) test environment, which provides the capability to safely disseminate and retrieve messages through the IPAWS-OPEN system. This test environment was well suited to allow NPR to submit sample alert messages and for the messages to be received by NPR after they had propagated through the IPAWS-OPEN test environment.

For this work, NPR was authorized to access CAP alerts that were aggregated by the IPAWS-OPEN system for the testing period. That authorization will remain intact for any future environment, where real alert messages are disseminated nationwide. During this demonstration project, NPR disseminated CAP-formatted test messages through the IPAWS-OPEN test environment. Field-test participants were made aware that they would receive *only test messages*, that the messages would be clearly labeled as TEST, and there would be no actual emergency messages transmitted to them.

System Architecture

As is seen in Figure 3, servers at NPR headquarters in Washington, D.C., gathered emergency alert messages from FEMA IPAWS, logged the contents of the messages, and transmitted the messages over the PRSS. The messages were receivable only by specifically enabled PRSS receivers at interconnected public radio stations.

At each participating station the messages were ingested by a firmware device, the CAP Manager (CAPMGR) that authenticated the message and determined whether it was relevant to the station's broadcast coverage area. If relevant, the CAPMGR formed the message into the modernized emergency alerting Open Data Application (ODA) and transmitted the message according to that ODA specification.

Central to any ODA is the RDS group type 3A, which acts as the Application Identification for Open Data. It is also known as the AID Group, or the 3A Beacon. An RDS data stream with address 3, and the "A" bit set (of version A or B) announces to a receiver of the transmission of a specific ODA (by *Application ID* number). Group 3A includes 16 message bits for use by the ODA and indicates the *Application Group Type* (if any) used for transmission of additional ODA data.

The alerting ODA was transmitted in *mode 1.1*, meaning a broadcaster needed to allocate an unused "type A" group — typically 9A — for transmission of emergency alerts. For broadcasts where emergency alerting was the only ODA running, the minimum recommended transmission rate was 24 3A Beacons per minute. For broadcasts where multiple ODAs were running, the minimum transmission rate remained 24 3A Beacons per minute with the alerting beacon present a minimum of once every five seconds within the 3A sequence.

The message bits of the 3A Beacon conveyed the global configuration of the alerting ODA to the receiver. A *System ID* identified a particular variant of the alerting ODA, where *System ID* = 1 indicated the variant with Geo Codes appropriate to the United States. A *Text Location Bit* (TLB), when set, indicated that alert-related text was transmitted within the ODA. When cleared, the TLB indicated that alert text was transmitted using RT or eRT (Enhanced RadioText). Seven unassigned message bits were available for definition by variants of the alerting ODA. The bulk of data transmitted by the alerting ODA occurred within the application group itself. The recommended transmission sequence could be broken into the four parts, as described in the following sub-sections: the receiver wake-up preamble, the rapid geo-code sequence, the text interleave sequence and the end-of-transmission marker.

I   Receiver Wake-Up Preamble

The wakeup preamble was a stream of useful data that triggered a sleeping receiver to wake up and gives the receiver a brief summary of the event. This preamble was transmitted for 10 seconds prior to the start of the rapid geo-code sequence. Data

included in the wakeup preamble allowed the receiver to make a geographical determination about whether the alert was meaningful to a particular user, and it also allowed time for battery-powered receivers to wake from a low-power state prior to transmission of the geo codes, known as defined Federal Information Processing Standards (FIPS) or Specific Area Message Encoding (SAME) codes.

The receiver wakeup-preamble sequence needed to contain addresses 0 and 2, known as Alert Control/ Digest and Alert Identity Event, respectively. The Alert Control / Digest contained the message type, message identifier and message digest for tracking purposes. *Alert Identity Event* contained CAP short codes, such as the event certainty, event severity and other event descriptors. It also contained the text-segment iterators and the total number of 64-character text segments to be expected.

The preamble might also contain address 1 *Alert Start / Duration* and address 3 *Alert Identity Odd.* The rapid geo-code sequence gave priority to the actual geo code addresses (4, 5 and 6), but might also contain address 0 and 2. Each geo code would be transmitted at least twice as part of this sequence.

II Rapid Geo-code and Text Interleave Sequences

The rapid geo-code sequence indicated the geographic area or areas targeted by the alert.

The text-interleave sequence transmitted the complete set of alert data with priority given to the text portion of the alert. The text-interleave sequence included the same data as the wake-up preamble and geo-code sequence along with any text associated with the alert. Priority was given to transmission of the text segments during this sequence.

When alert text was transmitted within the ODA, each text segment was then retransmitted at least twice before advancing to the next segment. Address 2 *Alert Identity Even* included a total count of the 64-character text segments associated with the alert, as well as a counter-identifying the text segment currently being transmitted. A maximum 4,032 characters could be transmitted in any message.

III End-of-Transmission (EOT) Marker

The End-of-Transmission (EOT) marker terminated the alert sequence. The minimum recommended transmission rate was two alerting application groups per second. The RDS group sequence was typically configured to replace the alerting application group with some other group type when the alerting ODA was idle. For example, the 9A groups became 2A or 0A groups. When transmission of the alert was complete, an EOT marker was sent, and the application group went silent.

Monitor INSO (WATCHINSO)

I Hardware

The Monitor INSO, or WATCHINSO, component ran on the same server as INSO, the Dell PowerEdge R320 (225-2955).

II Software

WATCHINSO was the application that ensured INSO was running. The implementation of WATCHINSO was a commercial software product called *Java Service Wrapper* version 3.5.25 by Tokyo-based Tanuki Software, Ltd. Java Service Wrapper is a container that made it possible for INSO to run in the background on the primary Linux server without user intervention. The Java Service Wrapper started INSO when the server booted up, restarted INSO when a network or other error caused INSO to crash, and wrote its activities to a log file.

For this project, the free, open-source Community Edition of Java Service Wrapper was installed on the primary server. The Community Edition's license agreement is based on General Public License version 2.

6.2   NPR LABS EMERGENCY ALERTING ODA

In 2013, NPR Labs developed an RDS emergency alerting ODA. This system is proposed as a modernization of the *Annex Q – Emergency Alert System Open Data Application* originally published in the National Radio Systems Committee (NRSC) U.S. Radio Broadcast Data System (RBDS) Standard (April 9, 1998) through and including revision *NRSC-4-A* (April 2005).[2]

Specific goals of this effort include:

- Adopting updated conventions for the transmission of an ODA. Specifically, the 3A Beacon shall be transmitted at a constant rate and use of its message bits limited to static configuration data. All dynamic data is transmitted within the application group. Group 9A is commonly used for emergency alerting, but this ODA may be transmitted using any available mode 1.1 application group. As RDS bandwidth is limited, no data is transmitted in the application group when the alerting system is idle;
- Providing a mechanism that makes delivery of essential, important event information (severity, certainty and the like) a high priority;
- Providing a mechanism for transmitting an event-related textual message of up to 4,032 characters within the alerting ODA itself. Such a message provides at-risk populations with a richer context and understanding of the event;
- Providing a mechanism such that non-generic data types, such as Circle, Polygon and the National Weather Service SAME Geo Codes, can be redefined for logical geographic regions, as needed. For example, the United States utilizes several types of Geo Codes for emergency alerts including National Institute of Standards and Technology-FIPS code for the identification of state and county. These state and county FIPS codes are not useful outside the United States; and
- Adopting new features of the IPAWS/CAP system while retaining the ability to transmit SAME data as specified in the original NRSC 1998 Annex Q – Emergency Alert System Open Data Application.

ODA Performance

NPR Labs and its development partners continued to test the system in early 2014 and evaluated ODA performance under different bandwidth constraints and with different alert message lengths. The metrics presented below were gathered during four alert transmission scenarios involving bandwidth shared between alerting and commonly used RDS services. The system block diagram for measuring the performance metrics may be seen in Figure 4. The four scenarios were:

- *High-bandwidth Alerting Service*, in which alerting was the only high-bandwidth ODA running, and it was given 50 percent bandwidth when an alert was actively being transmitted.
- *Alerting and Traffic Message Channel (TMC) combined*, in which two high-bandwidth ODAs each had 25 percent bandwidth.
- *Dynamic group order with Alerting and TMC*, in which two low-bandwidth ODAs stopped during alert transmission. In this example, TMC continued to run at 25 percent, but the low-bandwidth ODAs were stopped during alert transmission allowing about 35 percent bandwidth for the alerting ODA.
- *Low-bandwidth alerting Service with TMC*, in which two low-bandwidth ODAs continued during alerting transmission. This metric is illustrative only and not a recommended alerting mode because it delayed the arrival of the alert message text. It is shown as a "torture test."

It should be noted that the wake-up preamble continuously transmitted CAP short codes (start time and duration, event code, category, response, severity, certainty, etc.). These codes were for a receiver to display important event information while the text transmission was in progress. Also, each example alert targeted 10 unique geo-codes and all codes repeated during transmission. In these scenarios, the geo-codes were six-digit FIPS codes denoting portion (digit 1), state (digit 2 and

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[2]Annex Q was removed from NRSC-4 so as to bring the NRSC and European versions of the Standard into closer harmonization and because the NRSC was unable to identify a single instance of when Annex Q had been implemented either by a broadcaster or a receiver manufacturer.

3), and county (digits 4 through 6). Each text segment was transmitted three times before advancing to the next text segment.

The alerting content for these tests was created by capturing an actual CAP message from the IPAWS-OPEN aggregator's public portal. The message was saved to an XML file, keeping its CAP version 1.2 formatting intact.[3] To change the character count for each of the scenarios, the file's <description> field was edited to include the appropriate number of characters for a given metric. For example, the "512 char" metric originated from a CAP message that has 512 characters within the <description> field. The number of FIPS codes in the <area> field of the CAP message was increased to 10.

Each scenario used a CAP message file edited with the appropriate character count within <description>. The RDS Alerting Encoder or RAE ONE encoder ingested the message from a custom Java application that simulated the Transmission Control Protocol/Internet Protocol (TCP/IP) server connection found on an IDC SFX4104 Satellite Receiver. This model of satellite receiver is used throughout the PRSS, and the characteristics of its TCP/IP service are standard.

Once the message was ingested, the RAE ONE created an RDS signal that included the alerting data associated with that CAP message. The RAE ONE RDS signal output was captured and decoded using a 2WCom model A20 monitoring receiver, the output of the A20 monitoring receiver resulted in a plain text log file containing the raw RDS group data, one RDS group per line. The logging was started before the alert transmission began, and logging terminated after the alert transmission had finished. This log file represents the entire content of the RDS transmission, not just the 9A alerting group.

The log file was analyzed manually. Each log file was loaded into a text editor, where the start of each section of the transmission was identified manually. Counting the subsequent lines in the file determined the elapsed time at each of the identified points in the log, where each line of the log file represents one received RDS group, or a duration of 87.579 milliseconds.

The various transmission bandwidths were achieved by adjusting the group sequence of the RAE ONE encoder. The metrics spreadsheet includes the actual group sequence information used for each scenario. For those metrics intended to show shared-bandwidth performance with specified ODAs, group data was scheduled and transmitted continuously in those ODAs for the duration of the test. For instance, the Example #2 group sequence includes additional ODAs in group 8A, 11A and 13A. As the other ODA groups, transmitting data continuously represents a "worst case" transmit time for the NPR Labs alerting data transmitted in the 9A group.

6.3 THE MODERNIZED EMERGENCY ALERTING FM RADIO DATA SYSTEM (RDS) OPEN DATA APPLICATIONS (ODA)

Description of RDS Signals

RDS uses an encoder to create a signal which is combined with other components of the FM baseband, including the mono (L+R) and stereo multiplex (L-R) program audio-derived signals. The RDS signal, also called the RDS subcarrier, is a 1,187.5 bits per second (bps) data stream (with approximately 670 bps of usable data) encoded into a 4 kHz-wide suppressed-carrier AM subcarrier centered at 57 kHz.[4]

The structure of the standardized RDS data bits is well defined and recognized by most FM receiving devices. There are internationally defined data segments for broadcasting artist/title, station identification, time of day, radio program type and so on. The international RDS standard provides a way to send data customized for specific applications to purpose-built FM RDS receivers, such as those made for alerting messages, traffic data for GPS receivers, Apple® tagging and other data services that are not recognized by receivers that were not purposely built to recognize or use those data. This feature is called the Open Data Application (ODA) and each ODA is uniquely identified by an Application Identification (AID) number. In the United

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[3] The Common Alerting Protocol Version 1.2 OASIS Standard can be found at http://www.fema.gov/emergency-alert-system-participants.

[4] *NRSC-G300-A, Radio Data System (RDS) Usage Guideline, National Radio Systems Committee, April, 2014*, http://www.nrscstandards.org/sg/NRSC-G300-A.pdf (accessed 10 December 2014).

States, the NRSC accepts registration of new AID and ODA services. AID addresses are not seen by the general public; the addresses are numerical values used by specialized receivers built to look for particular values which trigger the receivers to read the associated data for the providing of ODA functionality.

With the approval of the NRSC, this project appropriated the use of AID E91 and built its custom ODA using that address. Our transmission equipment, built by Jump2Go, Inc., and accessible receivers were designed to use this new AID and ODA. To properly implement the accessible-alerting transmission with different station requirements, Jump2Go also examined the data rate at which the accessible-alerting data stream was compatible with other RDS services. A preliminary analysis by Jump2Go in mid-October 2013 showed the duration that a maximum-length alert message would take to transmit while also transmitting other non-alert related services. The ODA version 0.9.3 was selected for implementation on October 7, 2013.

This ODA was introduced to the NRSC RDS Working Group and to the European RDS Forum as a use-case for emergency alerting using RDS. A summarized version of the ODA is included in the April 2014 *NRSC-G300-A Radio Data System (RDS) Usage Guideline* publicly available from the NRSC website, www.NRSCstandards.org. It is reprinted in Appendix E:.

6.4 SATELLITE (SAT) RECEIVER

Hardware

NPR Distribution has had a long relationship with International Datacasting Corp. (IDC) of Ottawa, Canada, manufacturer of the current satellite receiver, model SFX-4104. The SFX-4104 is deployed at hundreds of public radio stations across the United States., and is the de facto standard satellite receiver in use by the PRSS. The receiver has multiple purposes in a public radio station, including to:

- Deliver live, time-sensitive audio streams for broadcast, created for national or regional audiences;
- Deliver national and regional audio programs as audio files for later broadcast by downloading and storing the audio programs on the satellite receiver's internal hard drive;
- Provide addressable signaling through relay contacts; and
- Provide convenient bi-directional TCP/IP and unidirectional Universal Datagram Protocol (UDP) of specific downlinked data to the station's local data network.

A suite of security and authorization mechanisms allowed only specified satellite receivers to access alerting messages for this project. Messages downlinked by an authorized receiver were available as a TCP/IP and as a UDP connection at one or both of the receiver's data network ports. TCP/IP connectivity was available by default and used in most installations. UDP connectivity needed to be enabled for use at stations having only one-way data communication from the studio to the transmitter.

For this project, 25 of the 26 participating public radio stations received a new SFX-4104 receiver for their participation. The value of each SFX-4104 is $4,160.32. KEDM in Monroe, Louisiana, requested to participate in the program after the original 25 stations were selected and offered to allocate one of its existing SFX-4104 receivers for the project.

Software

The SFX-4014 satellite receiver runs a Linux-based operating system and offers an authorized user a convenient Web control panel for configuration. The NPR Labs' IDC SFX-4104 Satellite Receiver Web interface in *Figure 12* shows how the multicast data routing, including UDP, was configured for the alerting project. The Web interface is configured to pass this project's messages by UDP on the first of two data-network interfaces ("eth0," the last line in the list).

UDP was essential for sending alerting messages to devices that are unable to acknowledge receipt of the receiver's data, as in the case of public stations that have a one-way data connection from the studio (where the satellite receiver is physically located) to the transmitter (where the CAPMAN and RDS encoder are physically located). Where the receiver and CAPMAN were connected by a conventional, bi-directional data network, TCP/IP was used.

NPR Distribution recommended disabling some unnecessary services on the new SFX-4104 given to stations because the station did not need the file-based download service on this receiver as it was already in place on one of the station's other SFX-4104 receivers. Also, disabling unneeded services reduced the data traffic on the station's network. If absolutely needed in the future, these services can be easily re-enabled on the SFX-4104 receiver.

6.5 COMMON ALERTING PROTOCOL MANAGER (CAPMAN)

Overview

The CAP Manager, or CAPMAN, was the interface between the PRSS satellite receiver and the RDS encoder. It was an appliance that monitored the satellite receiver's data port for incoming alert messages and synchronization messages from NPR. In addition, CAPMAN integrated the project's alerting services with each station's existing RDS services (artist/title information, traffic data for portable GPS devices, commercial alerting services) without interfering with or affecting those other existing services. The CAPMAN design and hardware evolved throughout the project, resulting in a complete RDS encoder and firmware-driven CAPMAN device, called the RDS Alerting Encoder or RAE ONE.

CAPMAN Development

The CAPMAN device was implemented by Jump2Go, Inc. of Seattle, Washington (www.jump2go.com). Jump2Go's Chief Executive Officer (CEO) Allen Hartle has history and experience with RDS generation, RDS transmission product manufacturing, unique data management techniques for RDS (including devising iTunes® tagging using RDS for Apple®), as well as installing Jump2Go's products at public and commercial FM radio stations nationwide while solving each station's RDS engineering challenges.

The early concept for CAPMAN was to use Jump2Go's existing JumpGate RDS management product, updated with new firmware to fulfill the CAPMAN requirements. During the development of the project's FM RDS ODA schema for transmission during the summer of 2013, Jump2Go sought a suitable RDS encoder to couple with its JumpGate device, and planned to consolidate them both into a single enclosure. The ODA and CAPMGR requirements were reviewed, and in September 2013, Jump2Go proposed custom manufacturing a device that integrated the CAPMAN functions with a built-in, full-featured RDS encoder and alphanumeric display.

Jump2Go continued its efforts to implement the alerting ODA in software and meetings began with Catena Radio Design of the Netherlands, the receiver designer, and NPR Labs, on implementation details. The ODA version 0.9.3 was selected for implementation in October 2013. Design of the new CAPMAN device, the RAE ONE, was well underway by this time. In February 2014, the initial RAE ONE firmware and more than two dozen RAE ONE updates were delivered. The RAE ONE was temporarily mounted at an NPR Labs office workbench to make configuration and testing easier with the goal of integrating it with the Lab's FM exciter and PRSS satellite receiver after Jump2Go delivered a functional firmware version.[5]

By the end of February, the RAE ONE firmware version made a data connection to a PRSS Satellite Receiver and could parse CAP version 1.2 messages (and match the geo-coded FIPS codes). The RAE ONE was able to ingest messages from the PRSS Satellite Receiver and correctly interpret and form them into an RDS transmission by early March 2014. Work continued to ensure the satellite receiver could complete the connection to the RAE ONE, including development of a periodic heartbeat to keep data flowing from satellite receiver to RAE ONE.

Firmware implementation work, primarily in correcting implementation and meaning of the TLB in the RDS specification between the Catena Radio Design and Jump2Go, brought the state of the RAE ONE to readiness. The RAE ONE moved from the workbench and was installed in NPR's radio frequency (RF) Lab. Its multiplex output was connected to the SCA1 input of NPR Lab's Nautel model NAE101/10 FM exciter. After configuring the RAE ONE's network settings, the device was plugged into the Lab's data network, and could be further configured and monitored from any location that had access to NPR's secure data network.

By mid-March, the Labs' Nautel FM exciter was configured to transmit with 250 milliwatts at a frequency of 91.3MHz, and the exciter's RF output was connected through an RF attenuator (reducing the radio frequency signal by half for safety to Labs staff) to a coaxial cable (coax) running from the RF Lab to an NPR office on the opposite side of the building. The goal was to

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[5] An FM exciter is part of an FM transmitter that combines the elements of a broadcast FM signal (analog audio, RDS subcarrier, HD digital radio carriers, Radio Reading Services, etc.), and modulates them at the correct broadcast FM frequency for output to the transmitter's high-power amplifier. At NPR Labs, only the FM exciter is used; it has the ability to output an FM signal power from 0.01 watt to 50 watts, sufficient to simulate an over-the-air broadcast FM station.

simulate a broadcast. In the office, the coax was terminated using an FM dipole antenna—the same kind of antenna to be distributed to deaf or hard-of-hearing field-test participants as part of their receiver set up. Once the accessible receiver and Android tablet were set up and operating, the receiver's green beacon indicator was illuminated, indicating the receiver was tuned to the 91.3 FM test station. As soon as INSO was activated, before the first test alert message was prepared to be sent end-to-end, the accessible receiver suddenly began flashing an alarm, and the connected Android tablet began displaying an alert message on its screen. The system worked as intended.

An event in March 2013 that indirectly affected station security prompted a review of the RAE ONE login security at participating stations. A national news story broke regarding a successful hacking of the RDS systems of public stations WVGR and WFUM, located in Michigan. Although those stations were not participating in the project, NPR required any RAE ONE installed on a public Internet connection to have its login credentials changed immediately after installation.

Seven of the public stations participating in the project use and maintain Global Security Systems' (GSS) ALERT FM™ brand RDS alerting structure. This project's alerting structure was required to work without interfering with the GSS alerts, so at GSS' request, the first RAE ONE was installed at a non-GSS affiliated station, KEDM in Monroe, Louisiana. During this installation, GSS engineering staff observed and analyzed actual RDS transmissions from the RAE ONE.

The installation at KEDM in Monroe took place in late March and the first over-the-air test transmissions started April 1, 2014. During April, the GSS Chief Engineer Paul Burt took data samples of the KEDM's RDS signal and on April 29, provided the project with the GSS RDS transmission schema, making it possible for Jump2Go to begin writing the firmware to interface with the GSS transmission equipment. Jump2Go had been independently developing GSS-compatible firmware for the RAE ONE, and this documentation gave Jump2Go important additional details.

Hardware Implementation

The RAE ONE produced by Jump2Go is shown in Figure 6 and Figure 7, with the technical drawing in Figure 5. The commercial standalone RDS encoder, Audemat® model FMB80 was initially specified by this project. However, by combining a comparable RDS encoder model, the Audemat Silver® RDS encoder, with the specially designed CAPMAN hardware into a standard rack cabinet with display, the project increased processing capability to serve the stations' alerting and RDS data management needs for the foreseeable future.

The device integrates the following four hardware elements into one unit:

1. The Audemat Silver RDS Encoder motherboard manufactured by Audemat of Bordeaux-Merignac, France. Using data from the NetBurner board, it formed an RDS signal suitable for sending to an FM transmitter. The general specifications for the board are listed in Table 10.
2. A micro-controller board designed and built in the United States by Jump2Go, Inc., specifically for this project provided the electronic interface between the NetBurner Ethernet Core Module, the Audemat RDS Encoder, the alphanumeric display and external serial-data connectors.
3. A MOD54415 Ethernet Core Module board manufactured by NetBurner, Inc. of San Diego, California, provided the following services: data network connectivity; management of the interface hardware board and controller of the Audemat RDS Encoder board; and ran an onboard Web server and telnet server for configuring and controlling the RAE ONE. It also ran the Jump2Go custom firmware that implemented CAPMAN functions: ingested CAP 1.2 compliant alert messages from the PRSS satellite receiver, determined if the location described in the CAP message is within the station's coverage, and formed the message into the project-defined RDS Open Data Application structure and transmitting the message through the FM station's transmitter. The MOD54415 specifications overview is shown in Table 11.
4. A 32-character alphanumeric-display board with three light-emitting diode (LED) indicators and a 'soft' knob for scrolling through and changing the RAE ONE configurations from the front panel, designed and built in the United States by Jump2Go, Inc. specifically for this project.

Software Implementation in RAE ONE

The CAPMAN functionality was implemented in C-language source code and compiled with Jump2Go's existing software libraries. The resulting binary code was loaded into the NetBurner MOD54415 processor board. Participating stations having contractual obligations to use their existing RDS encoders as part of an alerting service required an additional custom firmware modification of the RAE ONE code to work seamlessly with the existing hardware. Because there were a small

number of commercial RDS encoders available, modifying the firmware for one station meant the same firmware would work on a number of similarly equipped stations. Table 34 illustrates the evolution of the RAE ONE firmware and station customizations.

RAE ONE Configuration

To configure the CAPMAN services, a section within the RAE ONE's Web-based configuration screens were devoted to the station-configurable parameters. The first section within the Service Configuration tab, *Alerting Service,* contained the essential CAPMAN configuration parameters as listed in Table 8.

Of particular interest is the FIPS Codes configuration. The United States has 3,143 state, counties and county equivalents, and a unique code exists for each county in each state. The National Weather Service adds a zero to the beginning of a FIPS identifier to indicate a portion of a county (where zero indicates the entire county). Thus, the whole of Jasper County, Texas has a FIPS code of 048241, where 0 is the county portion and 0 indicates the whole county; 48 is the state FIPS code for Texas, and 241 is the county code for Jasper County. The NWS refers to these as "Specific Area Message Encoding" or SAME codes.

The RAE ONE was fully configurable by Web interface less used configurations that affect the integral Audemat Silver RDS encoder were set by logging into the RAE ONE using a password protected telnet session. Any standard telnet client would be used to log into the RAE ONE. A telnet session with the NPR Labs RAE ONE is shown in Figure 8. The level and phase settings are notable. The level changes the Audemat's 57 KHz output level in millivolts. When connected to an FM exciter, this value corresponded to the RDS injection level. Station engineers used a separate piece of test gear, the FM Modulation Monitor, to determine the RDS and overall modulation levels to keep both within FCC regulations, while maintaining adequate RDS levels to ensure proper coverage. The "phase" setting allowed the station engineer to match exactly the electrical phase of the Audemat output to be in synchronization with other components of the FM signal.

6.6 RDS ENCODER

Hardware

The RAE ONE was fully capable of functioning as a standalone CAPMAN device, where alerting messages were sent to the station's existing RDS encoder by data network or RS232 serial port.

Software

In those stations where the existing RDS Encoder was used, the RAE ONE firmware translated an incoming alert message from the PRSS Satellite receiver into an industry RDS standard protocol to ensure compatibility with existing RDS data sources, such as GSS Net's ALERT FM system and Florida's Alerting Network managed by ComLabs.

6.7 FM TRANSMITTER

The station's FM transmitter accepted the signal from the RAE ONE (or existing RDS Encoder) and mixed it into the composite signal, along with the main channel, and for some stations, stereo information and other digital or analogue subcarriers. The RAE ONE output level could be adjusted to achieve the proper injection level. The stronger the RDS subcarrier (higher injection), the farther the RDS signal would reach. Unfortunately, excessive RDS injection levels in some cases introduced interference, especially for stations using Subsidiary Communications Authority (SCA) subcarriers. Typically SCA's are used for specialized broadcasts such as Radio Reading Services, in which books and printed materials are read aloud for the benefit of blind or low-vision audiences. These low-fidelity SCA audio services can suffer from extra noise or even be made unintelligible in extreme cases of RDS subcarrier interference. In most public radio stations, the RDS injection levels were 6–8 percent. Engineers noted a need for scientific study in two areas as a result of work on this project, but both were outside the project scope. The first would look at terrain-based coverage mapping model for RDS transmissions at various injection levels. The second would quantify the RDS injection level at which interference to SCA Radio Reading Services is objectionable to listeners.

6.8   NIPPER ONE, THE ACCESSIBLE FM RDS RECEIVER

Vendor Selection

Research on existing alerting receivers and manufacturers began several months before this project's contract was executed. Meetings were scheduled with a number of manufacturers during the 2013 Consumer Electronics Show, where the Request for Proposal (RFP) was distributed. Several manufacturers and alerting companies had existing technology that could be modified to fit this project. Details of the selection process, including the ten companies considered, design specifications, and costs are included in Table 9.

In February 2013, NPR sent the RFP to Dietmar Kopitz, head of the European RDS Forum for dissemination to RDS Forum members. A single response was received from Catena Radio Design of the Netherlands, who began designing the specialized receivers within the project budget, something that no other manufacturer had offered. Meanwhile, Kensen Technologies expressed interest and asked additional questions about the proposed receiver, its operation and design. Kensen indicated the company could produce the receivers, but would need an industrial design from which to work. NPR Labs contacted the Industrial Design Society of America, which requested designs from its membership.

Radio Receiver Development

I   Receiver Design

In March 2013, Catena suggested that since all FM receiver functions were now contained on a single chip, and that the chip was manufactured in huge quantities (reducing the cost-per-chip to a few dollars or less), all that was needed was a microprocessor and memory to control and manage the FM receiver chip. Catena shipped an FM RDS transceiver—the TRX011—to NPR Labs for review. The TRX011 is an FM RDS receiver and low-power FM transmitter, capable of transmitting all RDS data for evaluating receiver designs and performance. Its software is driven from a Windows personal computer (PC)-based control program and it is able to control every aspect of an RDS transmission. This combination of attributes was ideal since an ODA was to be designed by Jump2Go and it needed a test transmitter to verify the ODA implementation and its performance on a to-be-created accessible receiver. Catena also suggested the new accessible receiver use the well-documented and popular Universal Serial Bus (USB) interface to connect to and be powered by an accessible display device.

Catena produced a prototype circuit board, and then began development of the receiver firmware. Because of budget constraints, it was determined that a crank generator was best left as an optional external device to power the receiver, rather than be integrated within the receiver enclosure. In April 2013, after further discussions about the LED indicators on the receiver, it was felt that two bright indicators, spaced apart, would be more effective than a single bright flashing indicator to grab the consumers' attention.

On April 23, 2013, Catena sent the first documentation of the receiver's application programmers interface (API) and the specifications for a digital picture frame to display the alert messages from the receiver. The API made a hardware product easily usable by allowing a second developer (of the display) to call built-in functions to request information from the receiver and to control it. The display developer did not need to know or care how the receiver accomplished the tasks—as long as it simply performed the required tasks. The receiver was designed without an ON/OFF switch since it consumed very little power.

However, Catena's China-based manufacturer could not make changes to their digital picture frame products to accommodate the accessible receiver. Their implementation of the USB port on a digital picture frame was designed for memory sticks only. The accessible receiver USB port was designed as a CRC interface. Instead, Catena sourced an inexpensive Android tablet from Eearl Group Limited, a China-based tablet manufacturer. This tablet was promising because an external tablet has more computing power and capabilities than a digital picture frame. The Android OS has accessible features that could increase the value of the receiver-tablet combination to a consumer; those consumers who could hear, but had lower vision would benefit from the tablet's built in audible text-to-speech feature.

By July 2013, discussions about the ODA design began between Catena, NPR Labs and Jump2Go. The discussion started with the 1998 U.S. RBDS Standard document, Annex Q, which was the basis for the alerting project. Knowing that Annex Q had been rescinded for lack of use in the 21st century gave the team enormous flexibility to modernize and redesign it without concern for breaking existing applications. Only the best traits of the ODA would be kept and modern technology would

dictate the rest of the transmissions. In mid-July 2013, the first receiver-board prototype and Android tablet sample were shipped to NPR Labs and Android application development began.

II Receiver-box Fabrication

In June, Catena began seeking manufacturers and suppliers to create the receiver enclosure, circuit-board and attractive retail box, and perform firmware loading and quality assurance.

By late July, Catena designers made a simple plastic box enclosure for the accessible receiver, and created labeled adhesive stickers that would be placed on the top of the enclosure. Since the receiver could be wall mounted or sit on a desktop or counter, two different adhesive stickers would be printed with the legends oriented in either direction. Working with Catena subcontractor Shenzhen Zhaohui Printing Co., Ltd., of Shenzhen City, China, label designs were developed.

Catena subcontractor Ningbo Yinzhou Keao Prototyping and Mould Factory of Ningbo City, Zhejiang, China, was designated as the receiver-box fabricator. It was decided that the receiver would need to be plainly visible because it was anticipated that some of the field-test participants, in addition to having hearing loss, might also have reduced vision. Therefore, the body color would be bright red and the receiver top would be a bright blue. An antenna selection was made; a "T" dipole antenna was selected, instead of a telescoping-rod antenna, because a wire antenna provided better reception. USB cables were specified; the cable from tablet to receiver was a custom-made USB cable called "On-The-Go," the pins of which are designed to tell the tablet that the receiver is a slave device and not a PC- or computing-device. The cable was designed to be short and have a 90-degree bend at the tablet connector to drape behind the tablet. Two other stock cables were included; one to connect the tablet to a personal computer, the other to connect the accessible receiver to a personal computer. It was expected these cables would not be required for the alert testing, but were included as a backup option for connectivity in the event issues arose with the Android tablet.

After initial testing, Catena made the first API revision request on Sept. 9, 2013. It included simplifying the receiver scanning and creating an algorithm for handling reception of more than one local station transmitting the beacon signal. Then, a primitive version of the alerting app for Android tablet was given to Catena for testing.

III Stand Development

To hold the receiver and Android tablet at a convenient, viewable position, a stand was required. NPR Labs' previous contact with the Industrial Design Society of America had brought a response from a small California design firm, Jeende Corp. NPR Labs had performed calculations to determine the angle and balance needed to hold the tablet and receiver, and still be lightweight. Jeende Corp. of San Francisco, California designed a prototype stand. After several iterations, the renderings were sent to a 3D-printing company in the United States and two stands were quickly fabricated.

IV Prototype Stand

The Ningbo Yinzhou Keao Prototyping and Mould Factory which had manufactured the receiver enclosure was contacted in late September and asked to produce 500 stands, based on the Jeende design. In late October 2013, a representative of the factory notified NPR Labs that the design could not be produced using injection molding and would need refinement. Jeende designers revised the stand design and a contract was signed in November for a rapid prototype and stand production.

V Hardware

Using a standard Silicon Labs FM RDS receiver chip and PIC18 microcontroller with internal non-volatile memory, the NIPPER ONE implements the RDS ODA developed in this project in a receiver. It was to match how the RAE ONE implements the RDS ODA for FM RDS transmission.

The receiver was a power-efficient device, consuming around 50mA in idle mode and 80mA when in alerting mode. The receiver had several connectors on its side:

- 2.5mm battery-powered jack;
- a USB-B jack;
- three 2.5mm jacks for a power supply;
- two bed shaker connections;

20

- a stereo 1/8-inch-jack for audio; and
- an F-Connector for antenna.

The built-in USB port allowed the receiver to be powered by almost any device that has a USB port, or even by several D-cell batteries.

The face of the receiver featured several indicators. Two buttons are the sole control over the receiver. The "Reset" button reboots the receiver. The "Snooze" button mutes the flashing lights and bed shaker for a predetermined time, while the unit continues to display the text of the alert.

Five LEDs of different colors indicate the status of the receiver:

- Power is on for the receiver;
- Searching for a local station;
- Tuned to an alerting radio station; and
- Two bright LEDs notify the user of an alert.

The unit measures 152mm x 76 x 32 (6" x 3" x 1.25") and is visible in Figure 11: The Accessible Receiver Enclosure DesignFigure 11.

Software

The receiver firmware was original to this project and was written in Delphi (Pascal). It used licensed USB libraries to implement the USB-CDC protocol stack. Because Catena Radio Design underwrote the firmware development and retained the rights to the firmware, an API was developed that made it easy for a programmer to implement an application for a personal computer (PC), tablet, Apple computer (Mac), Smart TV, or other suitable programmable computing device to read data from and control the NIPPER ONE. The full API is shown in Appendix E:.

In addition, the receiver had a full set of operating parameters that were configured through the API.

Especially important was the notification API, part of the Notification API class. The NIPPER ONE was designed to push status, and when present, send alarm data to the connected device on the USB port. This eliminated the need for a connected device to continually poll the receiver requesting status updates.

The status notification was returned frequently and contained all the information a connected device needed to refresh a display, light up an external indicator, indicate the tuned frequency and similar functions.

6.9 ANDROID APPLICATION

Hardware

When the decision was made to separate the receiver from a display, thought went to suitable platforms and operating systems. Android was chosen because it is an open OS with an extensive developer base and functions on portable devices from mobile phones to tablets. With accessibility in mind, a search was made for a low-cost tablet of sufficient size and processing power with a USB port and longer-life battery. With the criteria that it could manage, process and display data coming from the receiver at the modest speed of USB serial data, an affordable tablet in 550-piece quantities was found, with the following features:

CPU	Allwinner A13
Operation system	Android 4.0.4
Memory	512MB RAM
Storage Device	4GB NAND Flash
LCD Size	7 inch
Camera	0.3MP front camera
Case	White
Battery	3000mah

Software

Android application development began on the Eclipse Integrated Development Environment using the Android Software Development Kit tools. The tools only covered hardware interfaces, and integrated an open-source, Java USB driver library to recognize the NIPPER ONE hardware signature was separate.

Participant / End-User Setup

Each participant was shipped a complete NIPPER ONE kit. The kit contained a NIPPER ONE receiver, 7-inch Android tablet, power supply, cables and antenna. Also included were step-by-step directions to set up the unit, as shown in Appendix G:.

In the first round of consumer testing, most of the field-test participants were asked to download and install updates to the Android tablet application. The update was necessary after reception issues were detected. Many field-test participants— Including those in strong-signal areas—either had trouble finding the beacon signal or keeping it tuned, once found. It was determined that this was largely an issue with the timer settings of the receiver. The settings had been set to scan very quickly and to analyze each signal for only 1.5 seconds once it found the strong stations' signals. The receiver would lose the lock and start scanning again on almost any decrease in reception, for instance, as the result of moving the antenna. A new application version was developed to correct this and allowed the signal beacon to be found more easily and held in almost any situation where reception would be sufficient for alerts and messages to work properly. Additionally, in the first round, data reception errors were discovered that resulted in the displaying of both clean and garbled versions of the same piece of text. Again, a software update was developed to display readable messages.

The second round of participants was sent receivers that had already been updated for the timing issue mentioned above, and additionally to correct forward error correction logic. A small number of field-test participants, who joined the first round of testing late, were moved to the second round, because they already had equipment. We also asked radio station personnel to make this update on the receivers that were sent to stations.

6.10 TECHNICAL TESTS

Extensive testing was done throughout the project to ensure the proper functioning of each component in the data flow. Some parts, such as data processing software and ISNO responsiveness, were tested directly at NPR Labs and found to meet the objectives for desired functionality. Satellite receivers, the CAPMGR/RDS encoder and consumer equipment were also field-tested by us and by participating stations. The overall result is that we were able to get all tested systems operating as expected, and that the equipment was reliable. Metrics from the INSO tests are in Table 12. Table 13 provides more details of tests carried out.

7 STATION SELECTION AND IMPLEMENTATION

7.1 STATION SELECTION AND ANALYSIS

More than 100 public radio (non-commercial) stations operate in the five Gulf States—Texas, Louisiana, Mississippi, Alabama and Florida. The selection of the 25 participating stations was based on four key factors: (1) representative distribution among station classes and across the five Gulf States, (2) reach among the hearing-loss population, (3) areas with incidence of severe weather, and (4) perceived technical readiness of the stations.

First, some weight was given to ensure distribution across station classes to test the efficiency and ease of implementation at stations with variable technical resources. This helped achieve distribution across the five states.

Our primary analysis ranked stations in the five states by population served. This ranking was based on the 2011 NPR Labs study for the Department of Commerce, which employed state-of-the-art terrain based propagation coverage projections, overlaid with the latest 2010 Census data and FCC service contours.[6] Where multiple stations served the same market, the one with larger coverage was selected, and the secondary station omitted in favor of service in an additional market. Also, some stations, such as WMPN in Jackson, Mississippi and WLRN in Miami, Florida have their signals repeated by associated stations. However, all those 'repeater' stations were not included in this project because of cost; additional equipment would have been required.

Second, since the demonstration project was designed with the goal of reaching those who are deaf or hard of hearing, communities with deaf and hearing-loss support organizations and schools were identified as locations with higher expected concentrations of affected consumers. Absent this factor, communities were expected to have distributions in line with countywide percentages. Evaluation of hearing-loss concentrations was based on the American Community Survey 2011 three-year estimates; percentages were by county, based on the county where the primary radio transmitter was located. No higher concentrations of deafness were found in places with a presence of HLAA or National Association neither of the Deaf (NAD) chapters, nor in Florida with higher percentages of the elderly. Accordingly, we relied on raw population coverage data from our 2011 Public Radio Coverage study.

It was also suggested that stations in communities with largely Latino audiences should receive a priority in the selection criteria. This was a good fit with overall project objectives, given the documented higher incidence of hearing-loss among Latino children,[7] and this higher concentration should occur in the adult population over time as well.

Third, patterns of severe weather were considered. "Dangerous weather/harm's way" factors were used in prioritizing stations with comparable population reach. Thus, we considered the incidence of tornadoes, hurricane paths, locations of refineries and nuclear plants in composing the list of station participants.

Finally, once the above factors were applied, technical readiness among final participants included surveying initially considered flagship stations for the existence of RDS capability and possible data-channel connectivity to repeater stations. These factors were critical to achieving maximum population reach within project budget.

Based on this approach and analysis, a list of stations was provided to DHS/FEMA. Antwane Johnson, Director, IPAWS, concurred with the approach and the proposed stations.

7.2 STATION PROFILES

Twenty-five stations from five Gulf Coast states were selected for the project. A 26th station—in Monroe, Louisiana—was added when it was determined that it could be included based on equipment available, proximity to the target testing area,

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[6] The NPR Study is available at secure.nprlabs.org/maps as an interactive online application.

[7] See http://www.hear-it.org/U-S-child-hearing-loss-more-prevalent-in-Hispanics.

and its management's enthusiasm, technical capability and commitment to the project. The stations and their main locations are listed here, with profiles of each included in Appendix F:

- Alabama (4 Stations): WBHM, Birmingham, AL; WJAB, Huntsville, AL;WHIL, Mobile, AL; WLRH, Huntsville, AL
- Florida (9 Stations): WGCU, Fort Myers, FL; WQCS, Fort Pierce, FL; WUFT, Gainesville, FL; WJCT, Jacksonville, FL; WLRN, Miami, FL; WMFE, Orlando, FL; WFSU, Tallahassee, FL; WUSF, Tampa, FL; WPBI, West Palm Beach, FL
- Louisiana (5 Stations): WRKF, Baton Rouge, LA; KRVS, Lafayette, LA; KEDM, Monroe, LA; WWNO, New Orleans, LA; KDAQ, Shreveport, LA
- Mississippi (1 Station): WMPN, Jackson, MS
- Texas (7 Stations): KUT, Austin, TX; KVLU, Beaumont, TX; KETR, Commerce, TX; KEDT, Corpus Christi, TX; KERA, Dallas, TX; KMBH, Harlingen, TX;[8] KUHF Houston, TX

7.3 STATION IMPLEMENTATION

Overview

The implementation of RDS encoding for the project required an engineering effort focusing individual attention on each station and situation. This is because the stations, independently owned and managed, are unique in their technical facilities' setups and staffing. Until this implementation stage at the public radio stations, all equipment design, testing and readiness occurred either at NPR Labs and/or with its vendors. Stations had been sent general information, but their actual configurations or requirements for installation of the project equipment had not been discussed.

To participate, each of the original stations participating received an IDC SFX4104 satellite receiver and a RAE ONE RDS encoder/CAP manager. In addition, each station received a NIPPER ONE receiver kit, which included the Android tablet. Having the kit would enable each station to see and experience the alerts the field-test participants were receiving.

Every station participating in the project had its own staff or contract engineers. In some cases, because contract engineers are not permanently at the station, scheduling arrangements lengthened the installation process. Also, stations that are part of a university system often required the help of university campus IT staff and a few needed to contact their local commercial IT contractors. Since many public institutions have necessarily strict network security and tight firewall parameters, this meant that access to the needed ports and services for the project equipment had to be arranged. Seemingly simple installations on the same campus networks required considerable IT work. A NPR engineer visited several sites to discuss implementation and issues. The face-to-face interaction was helpful on several levels, including seeing the facilities and developing more refined insight into station needs. Station engineers were also encouraged to talk to each other and share their experiences and techniques.

Installation Procedures

The initial engineering effort began by reaching out to each engineer affiliated with each public radio station. Typically, the initial discussions were about how signals and IP data are fed to their transmitters, current RDS usage and methodology, and the resources and scheduling necessary for the station's part of the work. In some cases, where a station was affiliated with a university, this was followed by also speaking with the station's or university's IT staff or sending detailed information about IP networking requirements and ports.

For the first few stations and for more complex installations, NPR scheduled a conference call with Jump2Go, the NPR engineer and the station engineer. NPR Labs personnel were brought into each installation briefly at the end for sending test

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[8] During the station implementation phase, one station, KMBH in Harlingen, Texas, asked to withdraw from the project. In this case, the station – a dual public radio and television licensee—alerted NPR that it was in the midst of major management change. The general manager had been replaced, the TV station was being sold and converted to commercial operations, and the sole station engineer was moving to the new TV entity; it was unclear who would handle the engineering and technical needs of the radio station. The interim general manager for radio said the small station did not have the personnel capacity or the technical expertise to commit to the project during the time frame of the pilot. As a result, equipment was then sent to public radio station WKCP in Miami.

messages. An engineer from GSS joined in person or by phone for the first few installations, where this demonstration project and GSS would co-exist—namely, at stations WRKF, WWNO and KRVS. The station engineer would install and connect the power and IP connections to the satellite receiver, RAE ONE encoder and NIPPER ONE receiver in advance of the setup call.

Once the satellite receiver and encoder were installed at the station, setup took about two hours and the station became operational, meaning that test messages could be transmitted from the NPR Network Operations Center, via the PRSS to the station. Station personnel could then verify that the NIPPER ONE receiver was powered and could receive a signal.

If after installation the station equipment was not operational, troubleshooting would begin. The methodical procedure involved checking whether:

- The PRSS SFX4104 satellite receiver was outputting data on its local network. This is done by putting a computer on the same switch or hub as the SFX4014 and using the common freeware "Putty" or similar software to confirm the receipt of "heartbeat" messages that are sent every 40 seconds on the satellite. If not, check receiver programming and authorization to receive these data.
- The heartbeat messages were being received by using Putty again on the network at the transmitter site. If the messages were not received, then check the IP between sites. Network security and firewall rules might need to be fixed to allow data, or routing translations may need to be added.
- The RAE ONE could be reached, on the transmitter site network were the satellite data was working. If not, its IP Setup software was used to check and set the IP.
- The "service address" and port in the RAE ONE were set correctly, and then using Putty or similar software in telnet protocol to the RAE ONE to confirm our heartbeat data are reaching and going through it.
- The heartbeats were reaching the RAE ONE, checking FIPS codes, to be sure the correct ones are programmed into the RAE ONE and that a FIPS code for that RAE ONE was included in the test alert being sent. Looking at the "alert" light on the front panel of the RAE ONE or the status screen when logged into the RAE ONE showed when an alert was being sent.
- The RDS signal was not being transmitted over the air, in which case a check was made to determine if the correct device was set to the RDS encoder ("internal modulator" for the RAE ONE directly, FMB80, or 2WCom), and make sure it was properly connected. If so, we would check RDS injection levels.
- Since RDS injection defaults to a low level on the RAE ONE, it needed to be adjusted. It could be set using a modulation monitor, if the monitor supported this measurement. Otherwise, we would set the RDS subcarrier output voltage according to the manufacturer's guidelines for the stations FM exciter (the part of an FM transmitter that originates the signal).

Once confirmed that the equipment was operational, tests were made between NPR and the station to ensure the signal was reaching the NIPPER ONE receiver. Sample alert messages were sent for each new installation, so that a full end-to-end test could be conducted, which would be received in the same way as it would be by an end user. In some cases, logs from special diagnostic software [TRX011 RDS] used with the receiver were reviewed as well, to allow for a detailed analysis of the RDS data.

The first issue, moving data from the satellite receiver to the RDS encoder, was done in a variety of ways. In the very simplest installations, the two devices were physically located at the same site. This happens where a station has its broadcast tower at the studio, such as WQCS in Fort Pierce, Florida. This arrangement is rare, except in small markets. Others, such as WPBI in West Palm Beach, Florida or WHIL in Mobile, Alabama, are satellite-fed stations, and have a satellite dish at their transmitter facilities which are not co-located with the studios. Some stations have private, dedicated IP connections between the studio and transmitter sites. These may be campus networks or extra equipment on their studio-transmitter-link (STL) microwave equipment. KUHF in Houston, Texas and WJCT in Jacksonville, Florida are among the stations that have such arrangements. Though less desirable, due to issues of reliability, public Internet connections have been used at some stations. KERA in Dallas, Texas and KRVS in Lafayette, Louisiana required this approach.

A second issue was that many stations already have RDS and use it for data services that needed to remain and co-exist with this project. Some of these RDS uses are internal to the station, such as display of programming data or song titles. In other cases, stations may have commitments to other emergency alerting projects and companies, such as GSS/Alert-FM, or the stations may lease data capacity to traffic services such as NavTeq. To create these required compatibilities, the NPR Labs team worked with Jump2Go. As a result of these efforts, NPR now has the ability to use the RAE ONE to generate messages that can be added to the data stream of an Audemat FMB80 RDS encoder. This is the most popular encoder on the market, and is used by many RDS data providers, including GSS and NavTeq. The RAE ONE also now works with the JumpGate device.

This allows it to get messages generated by a variety of automation and playback systems. Jump2Go also added compatibility for 2WCom and at least partial compatibility for "The Radio Experience," a RDS product that sends programming information as RDS Radio Text.

Details of Installations at Stations

Station installations varied widely in the specifics and customization that was required. The starting point for evaluation of each station was an understanding of if and how they used RDS prior to this project. Of the 25 stations, five stations had no RDS capability. Seven stations started with RDS data that contained only a station ID or static display slogan. Fourteen stations had other RDS uses.

Each station had unique IT requirements and challenges, but they fell into five major categories.

- At six stations, satellite receivers were located at their respective transmitter sites. Such co-location allows for easy installation, and is the optimal arrangement for reliability and functionality in an emergency because it does not rely on utility wiring that could be damaged or on the Internet, which could be overloaded or hacked.
- At ten stations, the station engineer was able to use an existing private network LAN transmitted on the STL. This capability is an option, but it is not available on all STLs. This is almost as good as co-location, since it avoids having to use the Internet. If telephone or Internet services are interrupted in an actual emergency, these will also continue to operate.
- At seven stations, networking and routing rules were managed by the station engineer or people who work closely with the stations. Each station needed to add routes or ports in their networks, but personnel had the ability to do it easily, either due to having direct control and knowledge or access to the people having it. These stations' operations were on either virtual private networks (VPNs) or on campus networks, which may share some resources with the Internet or telecom carrier facilities.
- At two stations, the public Internet connection was the only option at the transmitter site. At both of these, the station engineer was able to have the necessary routing set up in the studio and open the correct port in order to reach the RAE ONE at the transmitter site.
- Finally, at one station, the microwave STL was the only means of sending data to the transmitter site. While this type of setup was originally not supported, NPR conducted additional research on the receivers and worked with Jump2Go. It should be noted that while 19 of the stations did not have major IT issues delaying their installations, every station's IT situation required planning. Again, this level of effort was not anticipated at the outset of the project. Even in those stations where IT-savvy engineers controlled their whole systems, IP addresses had to be found and assigned, and in some cases, routing had to be established.

After the first round of participant testing, additional adjustments needed to be made at each station in cooperation with their engineers. At all of the stations, a checkbox within the RAE ONE encoder graphical user interface needed to be selected to authorize management of the emergency messages. Checking this box changed the way messages were sent, so they were fully compliant with standards. This review was also helpful in that it provided a good time to update older firmware versions in order be sure that all had message buffering. This allowed for proper handling of multiple simultaneously sent emergency alerts.

7.4 STATION RESPONSES AND FEEDBACK

At the end of the testing period, station personnel were surveyed to characterize their experiences of implementation procedures and practices. Additionally, they were questioned about how this technology might best be used to serve their communities. A survey of station personnel was conducted by phone at the conclusion of the field testing. Those who responded included station managers, engineers and operations managers. In most cases, one contact person provided all of the data, but occasionally two people from one radio station answered different questions, based on their expertise and involvement with the project. The questions included and responses are included in *Table 28*.

With regard to what we should do differently in future installations, the most common request was to provide a manual for the RAE ONE. Adding the ability to control the RAE ONE from the front panel was mentioned. There were several comments about having the RAE ONE arrive with the correct firmware already loaded, and to have a version which did not require updates. Those who made this request also acknowledged that frequent changes are expected at this stage—what one person called "the pain of a pilot project."

When station personnel were asked what could be done differently in the future to assist the consumer, concerns were mostly about the ease of receiving the signal. The two most common suggestions were to provide a manual-tuning option and better antennas. Most station personnel appreciated the usefulness of scanning as a default, but one suggested a manual-tune default and a published station list. Two engineers pointed out that at a minimum, we should supply information about how and where to purchase and use a better antenna. Several had tried inexpensive "rabbit ear" antennas with results superior to the included dipole, and one used an amplified indoor antenna that substantially improved reception. It was also suggested that more detailed instructions on antenna set-up be provided. There were also some comments that it is more difficult for those unfamiliar with the Android operating system. Better documentation, an "auto-open" app, or an all-in-one box, not needing a tablet, were suggested.

Most stations were enthusiastic about their participation in a permanent real-alert project of this type and said it was an important public service for their communities.

8 DEAF AND HARD-OF-HEARING PARTICIPANT EVALUATIONS

During June, July and August, two consumer field tests were conducted to determine (a) whether the end-to-end system was delivering alerts as intended, and (b) consumer reaction to user interface features included in the initial prototype. The first field test occurred between June 19 and July 9. The second field test occurred between July 24 and Aug. 13. During each field test, participants read real-world weather alerts and were encouraged to complete Web surveys concerning the look-and-feel of the alerting display.

Consumers in range of the 25 radio stations participated. Recruitment took place over a series of months, with the overall goal of reaching deaf and hard-of-hearing male and female adults of all ages (over the age of 18). Recruitment was done by way of postings on list-serves and outreach to national and local organizations serving deaf and hard-of-hearing individuals.

8.1 PARTICIPANT RECRUITMENT

There were two recruitment phases. The first campaign, started in early 2014, recruited several hundred individuals. Letters to national agencies, universities and local organizations were distributed covering all five states.

Due to manufacturing delays, consumers recruited during the first campaign were not sent hardware until April, which inadvertently reduced the number of individuals willing to participate (i.e., some lost interest over time, some attrition occurred, etc.). The second campaign was conducted during the summer in 2014 when it was decided that more participants were needed to increase the test sample size. National agencies, including TDI, HLAA, NAD and local chapters were again contacted and received updated announcements for distribution to local agencies and potential participants. This campaign yielded an additional 65 potential participants.

Recruitment Procedures

Recruitment announcements directed participants to express their interest by emailing NPR and including their home address. When they wrote in, they were contacted by staff via email, explaining in detail the purpose of the study, what would be required of them, and what the benefits were for participating (i.e., keeping the accessible receiver with 7-inch color Android tablet). They were told that their address would be checked to make sure they qualify geographically.

After addresses were verified, all participants were re-contacted. Those participants who were thought to be in the appropriate broadcast areas were asked to complete a demographic sheet and consent form, including gender, age, a self-description of their hearing loss (deaf or hard of hearing), at what point hearing loss occurred, whether English or American Sign Language (ASL) was their first language, their work status (e.g., employed, unemployed, retired, etc.), their educational background (e.g., did not graduate from high school, graduated high school, graduated college, etc.), their general schedule—times they are at home and not at home due to work, leisure and other commitments, how they wanted NPR to communicate with them (phone, TTY, email, text messaging), what one-hour block of time they would commit to reading the emergency alert, whether they lived alone, lived with someone, family members, etc., and whether they had a bed shaker or a strobe light that they could make available during the test period to plug into a test receiver.

8.2 SETTING UP RECEIVERS AND TABLETS

Radios were shipped to participants with instructions on how to hook the receiver to the tablet, how to position the antenna and how to connect the device to a bed shaker or strobe, as appropriate. After several days, participants were contacted to see whether their "green beacon" light was activated. If participants had difficulties setting up the radio or activating the green beacon, NPR staff worked with them over email or phone to help sort problems out. Problems included: equipment failure (receiver or tablet not working properly out of box); antenna positioning difficulties; not receiving green beacon (multiple hardware failures); receiving green beacon, but not receiving full messages (incorrect settings on tablet); and receiving garbled messages or messages in triplicate. Participants who were able to successfully receive messages were asked to go to a website and complete a survey about their initial impressions.

8.3 FIELD TEST

Participants were asked to read an emergency alert each day for 14 days and complete a Web survey after they read the message one time. Alerts were broadcast at the top of the hour, starting at 7am EST and ending at 9pm EST. Alerts changed every day, thus a total of 14 alerts were broadcast in addition to the first test message. Participants were requested to read at least 4 of the 7 messages each week.

The content of the messages included information from weather bulletins and how the weather affected the local area. Alerts included hurricanes, wildfires, water swells, high winds, tornados, blizzards and earthquakes. Messages were shown either in "UPPER CASE" or "Mixed Case" text. Half of the messages were shorter (μ = 207 words, ranging between 168 and 231 words) and half were longer (μ = 304 words, ranging between 281 and 321 words). Messages in the first round of testing were sent to participants in "block form," and in the second round of testing participants received messages with "line breaks." Line breaks were inserted into messages when information changed from describing the weather event to describing public actions to be taken or other statements, such as "this is a test from N-P-R." Examples of both may be seen in Appendix H.

Messages were available for 15 minutes, after which time they were cancelled. Alternatively, after a participant read the message, he/she could delete it manually.

Although there were 14 unique messages, each alerting session ran for 21 days, to ensure that people away on a planned vacation or having trouble initially setting up equipment could read as many alerts as possible. Participants were directed to answer only 14 surveys. However, occasionally participants completed duplicate surveys (i.e., during week three they filled out a survey they had already completed during week one). In all of these cases, the first survey they filled out was kept and the duplicate survey was discarded. Table 14 shows alerts used during weeks 1 and 2, whether they were Mixed Case or UPPER CASE, and short or long.

After viewing each alert once, participants were asked to go to the website and complete a questionnaire that included the questions shown in Table 15. For each alert, participants were also asked two questions about the content of the message in order to see if presentation scheme had any effect on their recall of alert details. These questions focused on the description of the weather alert itself or some immediate action participants were being asked to take because of the weather situation. For example, in one alert, people were asked if Hurricane Linda was the 6th, 1st, 3rd or 10th hurricane of the season (i.e., a description of weather alert). In another alert, they were asked where the alert recommended they evacuate to—a safe basement, nearby Sears store, United Methodist Church or no evacuation (i.e., an immediate action people would have to take). Experimenters tracked participants to ensure that they were going to the website to complete questionnaires on a regular basis. At the end of the test period, participants were notified that they had completed the test and were asked to complete a final questionnaire about their experience with the receiver and the alerting procedures; questions are in Table 17.

Participant Pool

More than 260 participants were recruited, hailing from 25 radio broadcast coverage areas in Florida, Mississippi, Alabama, Louisiana, Georgia and Texas. Participants ranged in age from 18 to older than 65, were both female and male, and were self-reported as either deaf or hard of hearing. Of the initial participants, more than 660 responses were collected, with 98 discarded for duplicate and or incomplete information; the resulting 564 responses were analyzed. Inferential statistics were used to analyze the data, and descriptive statistics were used where appropriate to describe the sample population. Analysis of variance (ANOVA) was conducted for all preliminary analyses. Repeated measures ANOVAs were conducted on all main test results with block or line break as a between-subject measure, and short or long and upper case or mixed case as within-subject measures.

Coding Data

There were two types of questions in all questionnaires—multiple choice and open-ended. For multiple choice opinion questions, data was numerically converted using Likert or interval scales. For example, in the question "How easy was it to read the text?" participants were given five choices as follows: (a) very easy; (b) easy; (c) neither easy nor hard; (d) hard; and (e) very hard. Responses were converted numerically such that each categorical response received a number in sequential order. Thus, very easy was converted to "1," easy was converted to "2," and so forth. Likert scales assume that the distance between each numerical value is equal, and allow parametric statistical tests such as analysis of variance to be conducted. For

memory questions, correct responses were assigned the value of "1" and incorrect responses were assigned the value of "0." Percentage correct for each alert was calculated by adding values and divided by two, in that there were two questions per alert.

Open-ended questions, used only during the post-test, were analyzed descriptively, with the most salient or commonly cited comments being listed.

Results

I   DAY 0 ALERTING – PRE-ALERT QUESTIONNAIRE

To practice reading alerts and inputting responses, a pre-alert questionnaire was created in which participants were asked a series of questions about their experience with the set-up of the equipment. These questions and responses are in *Table 16*. Participants who were unable to complete this cycle were contacted to see whether they could get their equipment connected to complete the test. The responses of those participants who were able to connect are included in Table 16.

II   DAY 1 to DAY 14 ALERTS

Analysis of Gender, Hearing Status and Age

A 2 (Deaf; hard of hearing) x 2 (Gender) x 3 (Age: Under 50, 50-65, 65+) ANOVA was conducted to see if there were differences in the way participants responded to questions asked over the 14-day trial period. Table 18, Table 21 and Table 22 show differences where they occurred for (a) how quickly the alerts were read (reading speed); (b) how easy the text was to read (ease of reading); (c) how tired eyes felt after reading (eye fatigue); (d) how easy it was to understand the text (ease of comprehension); (e) how clear and useful the information was (clarity); and (f) whether they remembered specific information from the alert (connoted as their memory score). Column 1 lists the question asked. Column 2 of the tables lists the scales used to code participants' answers. Column 4 indicates whether these average scores were statistically different from each other. Column 5 summarizes the finding.

Analyses of Message Length, Message Type (Block, Line Insert) and Font Type

Table 21,Table 22 and Table 23 again show differences where they occurred for how quickly the alerts were read (reading speed); how easy the text was to read (ease of reading); how tired eyes felt after reading (eye fatigue); how easy it was to understand the text (ease of comprehension); how clear and useful the information was (clarity); and whether they remembered specific information from the alert (memory score). A 2 (Block, Line Insert) x 2 (Short Message, Long Message) x 2 (Font type: UPPER CASE, Mixed Case) Repeated Measures ANOVA was conducted with Block/Line Insert as a between-subject measure and Message, Font Type as a within-subject measure. Tukey–Kramer post-hoc tests (at p<.05) were conducted when differences were found.

Short messages vs. Long messages

Table 21 highlights differences between participants' processing of shorter and longer messages. Not surprisingly, participants reported they took a longer time to read longer messages than shorter messages. No other differences were noted, including reading ease, eye fatigue, comprehension, clarity of message, and importantly, memory for important details. Thus, the length of the message need not be considered a factor for processing, and under some circumstances, longer, more detailed messages may be desirable. However, in times of extreme emergency, it may be valuable to keep messages as brief as possible for speed of reading alone.

Block Text vs. Line Break Text

Table 22 shows differences between block text and text that included line breaks. Notice that participants reported reading more quickly, reading with greater ease and feeling less eye fatigue when line breaks were inserted into the text. Interestingly, participants' memory for details was also better when they read text with line breaks. It is recommended, therefore, that all messages coming through the alerting system appear with line breaks.

UPPER CASE vs. Mixed Case

Finally, Table 23 shows participants' responses when they saw upper-case text vs. mixed-case text. There were no statistical differences in any of the measures, suggesting that alerts presented in upper case or mixed case does not impact people's ability to process that information successfully. However, it should be noted that in both open-ended questions and email correspondence, participants stated that UPPER CASE text was more difficult to read and harkened back to earlier captioning days.

Post-Test

A post-test questionnaire was sent to all participants who initially signed up for testing and who were actively involved in trying to complete surveys. Eighty-five participants answered the post-test survey, in which 48 answered that they were able to successfully receive alerts and answer surveys, and 37 answered that they were unsuccessful. Table 24 lists comments from participants who were not successful in receiving alerts and Table 25 shows comments from participants who were successful.

Open-ended Comments

Participants commented on a range of issues, from testing procedures to equipment shortcomings. Table 27 is a compilation of many of these comments, with specific examples highlighting the feelings many participants had. The most frequent issues participants cited are grouped into eight categories, listed in Table 26.

9 LESSONS LEARNED

Lessons learned comprised several areas: project planning, design and technology, engineering management and station installation, project and financial management, communications and marketing, field-test participants and participant management, and consumer testing, and are described below.

9.1 PROJECT PLANNING AND MANAGEMENT

The scope of the project was overly ambitious given the resources available, the time allotted and size of the team. The work covered a large geographic area and required significant development of hardware and software. While technical staff development was adequate, additional staff was needed for project management, engineering and marketing communications management. More time was needed for participant recruitment and development.

9.2 DESIGN AND TECHNOLOGY

Using vendors knowledgeable about software and hardware development, radio and audio technologies, including RDS, was critical. Networking with national and international broadcasting organizations helped significantly with identifying several potential design organizations, and ultimately finding Catena Radio Design.

A desirable attribute of a firmware-controlled receiver is that once the receiver hardware is designed and built, future firmware may be written that repurposes it for other tasks, including:

- Gathering every area station's "now playing" information and sending it to a computing device for publication;
- Acting as a diagnostic tool for examining a station's RDS data components and reporting faults;
- Connecting to a smart TV and pushing its alert data to a big screen;
- Processing and displaying others' ODA data (by arrangement with the ODA owner); and
- Interfacing with other accessible devices, such as a refreshable electronic Braille display for deaf and blind consumers.

Upgrading the firmware in the RAE ONE during the development process made it possible to evolve for improved integration with existing station RDS encoders and automation systems.

9.3 ENGINEERING MANAGEMENT AND STATION INSTALLATION

Engineering management assistance was not included in the original project plan or budget. Having knowledgeable radio and IT assistance, especially to provide coordination with local stations, was critical to the testing and implementation phases. The PRSS provided that assistance, both at NPR and at some stations. This helped station personnel understand the nuances and for NPR to configure the equipment for compatibility with station operations.

Because the stations are all independently owned and operated, their technical setups, operations and personnel vary widely. Timetables needed to be adjusted for permissions, education and communications as a result.

The team was able to identify some similar needs and recurring issues during installation at stations. As the project continued, lessons from initial installations helped save time with later ones.

Encouraging station engineers to share their experiences with their colleagues also helped installations and operations.

9.4 FIELD-TEST PARTICIPANTS AND PARTICIPANT MANAGEMENT

Working with deaf and hard-of-hearing organizations helped recruiting efforts and provided legitimacy for the project because those groups are valued and trusted by their members.

Field-test participants needed more assistance than originally thought; including providing attention, education and time for them to get used to equipment that was not "commercial grade." They were unprepared for technical glitches or set-up challenges since many had never participated in beta trial and had limited understanding of the technology. Additionally, many of them were outside strong signal areas, which thwarted their attempts to connect to the signals.

Based on experiences of the first round of consumer testing, the project team quickly resolved to conduct two rounds of testing with two groups of field-test participants—using lessons learned from the first round to make improvements in round two.

More time should have been set aside for participant recruitment. Participant attrition during the field tests was more significant than expected.

Using project team members who are fluent in ASL assisted with speaking with representatives of trade groups for the deaf and hard of hearing. It underscored our commitment and attempts to ensure they understood the project.

The ratio of participant sign up to participants who could receive the alerting beacon was lower than expected, primarily from a lack of accurate techniques to predict RDS coverage at a participant's address. Although selected field-test participants were living in areas thought to have sufficient RDS coverage, in many cases reception was not adequate given the present equipment and antenna configuration.

9.5 CONSUMER TESTING

Having staff available at all hours to respond immediately to consumers was critical to assist the participants with set up, while reassuring them and educating them about testing.

Employing lessons learned from round one in round two of testing assisted interactions with field-test participants during the second round. Upgrades to software and the user interface were adjusted and recruitment and communications were improved.

For consumer testing, it was preferable to bypass IAWS-OPEN and uplink messages directly to the stations because it provided a more stable data point by ensuring only NPR messages were received by the participants. It also reduced participant confusion.

10 RECOMMENDATIONS AND NEXT STEPS

This demonstration project successfully tested the efficacy of delivering text-based emergency alerts that were broadcast to individuals who are deaf and hard of hearing in a designated region. The availability of resources (i.e., time, personnel, funding) will determine which technical improvement recommendations and methods of broadening the impact are considered for future work. For example, developing a prediction model for RDS coverage (including terrain and transmission injection level variables) to more accurately predict alert receiving capabilities based on location; employing enhanced error correction for accurate and precise reception by the consumer; improving consumer hardware; developing equipment and methodologies for stations already using some form of RDS technology, to easily add emergency alerting to their preexisting infrastructure at a lower cost. This project made English language text alerts available; follow-on work could focus on investigating and developing methods to create emergency alerts for non-English speakers. Similar technology could be utilized to deliver alerts in other languages, such as Spanish, Vietnamese and Chinese.

11APPENDICES

Appendix A: Glossary

Term	Definition
Bandwidth	A section of the electromagnetic spectrum between two frequencies. Each satellite system carrier has, in addition to a center frequency, a specified range of frequencies that determine the carrier's ability to carry complex or detailed signals. The bigger the channel bandwidth, the better quality audio it can carry. Narrow band channels (about 50 kHz side) can only carry voice-grade audio (3, 4, 5 or 7.5 kHz of dynamic range). Wide band channels (about 200 kHz) can carry high quality audio (15 or 20 kHz of dynamic range). An entire satellite transponder (40 MHz wide) can carry one color television signal.
Beacon	Part of the RDS data stream that tells receiving devices when certain ODAs are present. Specifically, when we refer to the beacon in this document it is referring to the signal which indicates that a station has our CAP/EAS data on it for this project.
Bit Rate	The transmission speed of a data signal. Different than baud rate, which is the frequency of the audio encoding signal used when data is transmitted over long distances by modem. The public radio modulators and demodulators can use any of several available bit rates, using more bandwidth and yielding better quality audio or more channels as the bit rate increases.
Common Alerting Protocol (CAP)	The standard format of alert messages, which may be generated by the National Weather Service, FEMA or local authorities via IPAWS.
Cap Manager (CAPMAN)	The interface between the PRSS satellite receiver and the RDS encoder. It is the functionality in the RAE ONE that monitors the satellite receiver's data port for incoming alert messages.
Carrier	A very specifically defined frequency, RF bandwidth and power description of a segment of a satellite transponder.
Catena	Catena Radio Design Company is the manufacturer and designer of the end-user receiver, the NIPPER ONE. The receiver is used as a primary component of a kit which includes an Android tablet as the display device.
C-Band	In satellite communications, generally any system, satellite or earth station that uses frequencies between 5925 and 6425 MHZ for uplink and those between 3700 and 4200 MHZ for downlink. The PRSS is a C-band communications system. See also KU-Band.
Channel	A part of a satellite transponder, capable of carrying a single audio, video or data signal. A transponder may be used as a single channel, or divided into as many as hundreds of channels.
Commercial-Off-The-Shelf (COTS)	A standard, widely available product that is suitable for the intended use without modification. Typically used to refer to computer software, in contrast to "custom" software, which was developed for a specific customer's needs instead of the general market.
Content Metadata	Text related to the content of a program. It contains items such as rundowns, text cues, rights, etc.

ContentDepot®	Public radio's national program distribution system operated by the Public Radio Satellite System (PRSS). The ContentDepot uses a combination of Internet and satellite technologies to offer automated content delivery services to stations. Both live and pre-recorded programs are distributed via the ContentDepot, as well as accompanying marketing and promotional materials and modules.
Department of Homeland Security (DHS) and its Science and Technology Directorate (S&T)	The research and development group within DHS, having an operational focus for the purpose of enhancing the nation's security through innovative technology.
Downlink	A satellite earth terminal capable of receiving signals from the satellite. Every interconnected station in the PRSS has a downlink.
Emergency Action Notification (EAN)	Messages of national emergency requested by the president and sent by FEMA to the PEPs for dissemination to all broadcasters. Unlike typical CAP messages, it is mandatory for stations to interrupt programming to carry EANs.
Emergency Alert System (EAS)	National public warning system, required of broadcasters to provide the president communications capability in a national emergency, and may also be used by state and local authorities.
Encoder	A device that encodes audio into digits for transmission.
Federal Emergency Management Agency (FEMA)	Agency of DHS, coordinates resources in response to disasters.
Federal Information Processing Standards (FIPS)	Federal-government identified numerical designations that standardize specific geographic areas of the United States.
FEEDSAT	The software module which sends the alert data out via the PRSS satellite data stream.
Heartbeat	A small data burst sent at regular intervals to inform the receiving equipment that the signal is present.
Ingest Software (INSO)	The software that polls IPAWS-OPEN and sends it to the integral FEEDSAT software module, which sends the alert data out via the PRSS satellite data stream.
Internet Protocol (IP)	Network layer protocol in the TCP/IP communications protocol suite. IP contains a network address and allows messages to be routed to a different network or subnet. It is a specific type of framing protocol that allows digital information to be packaged and transported in a way that allows easy routing of information from one computing device to another. IP "packets" can be transported over physical wires (for example, using the "Ethernet" protocol), over optical cables (for example, using the "Gigabit Ethernet" protocol), over wireless communications devices (for example, over the 802.11b protocol) or even encapsulated into other protocols (for example, encapsulated into a Digital Video Broadcast or DVB stream). Other protocols, such as TCP (Terminal Control Protocol), RTSP (Real-Time Streaming Protocol) and HTTP (Hyper-Text Transport Protocol) can be encapsulated into IP streams.
Integrated Public Alert And Warning System (IPAWS)	The system by which local authorities, the National Weather Service and FEMA originate CAP alert messages.
IPAWS-OPEN Platform	This is a test environment that simulates IPAWS and IPAW-OPEN. It is operated by FEMA and intended for research and test transmissions of CAP messages.

IPAWS-OPEN	A term is an abbreviation for "Integrated Public Alert and Warning System Open Platform for Emergency Networks." It is an IP-based network that transmits CAP messages from IPAWS.
IPAWS-OPEN Test Environment	A system built on the model of IPAWS-OPEN for testing and development.
Jump2Go	The company that designed and manufactured the RAE ONE, and worked closely on the development of the ODA.
KU-Band	Any satellite or earth station that uses frequencies between 14,000 and 14,500 MHZ for uplink and those between 11,700 and 12,200 MHZ for downlink. The PRSS operates primarily on C-Band, but may use KU-band facilities as part of the transmission path.
Megabits Per Second (Mbps)	The speed of a telecommunications, networking or local area networking transmission facility (i.e., something that moves information); means million bits per second. Mbps, referred to in the context of computing, means million bytes per second, which is the same as one million bytes per second. The number of bits depends on how many bits there are in a byte, which is typically eight.
Megabyte	One million bytes; a multiple of the unit byte for digital information storage or transmission.
Megahertz (MHz)	One million Hertz or one million cycles per second. Used to measure band and bandwidth. Also used by the computer industry to mean millions of clock cycles per second, a measure usually applied to the computer's main microprocessor.
Metadata	The information, or data, that accompanies a piece of digitized content, such as a video or audio clip, graphic or script, often used to identify, sort or search the data. Examples of metadata include description, subject heading, file format, author/producer, rights holder, etc.
Monitor INSO (WATCHINSO)	See WATCHINSO.
MONSAT	The software that monitors the performance of FEEDSAT to assure continuous operation.
Multipath	A type of signal interference that comes from reflections of the signal. It is most familiar as the "ghosting" that used to be seen on analogue TV, or as the static on a strong local stereo FM station when an antenna is in the wrong position for it.
NAB	The National Association of Broadcasters (www.nab.org).
National Radio Systems Committee (NRSC)	Organization jointly sponsored by the National Association of Broadcasters (NAB) and the Consumer Electronics Association (CEA) "to study and make recommendations for technical standards that relate to radio broadcasting and the reception of radio broadcast signals. The NRSC is a vehicle by which broadcasters and receiver manufacturers can work together towards solutions to common problems in radio broadcast systems" (www.nrscstandards.org).
Network Operations Center (NOC)	The central control and operations point for NPR Distribution's file transfer and streaming functions and PRSS. Located at NPR's headquarters building in Washington, D.C., the NOC is staffed 24 x 7 and is responsible for supervising all satellite carriers on the PRSS, quality control on the distribution of ContentDepot delivered content, monitoring all shared use services, program scheduling and managing the PRSS Help Desk.

NIPPER ONE	Radio receiver designed to lock onto a frequency transmitting specific emergency alerting RDS information. The receiver notifies consumers that an alert has been issued and outputs the alert as text to a tablet or PC.
National Public Radio (NPR)	A multimedia organization that produces content for distribution to public radio stations throughout the United States and internationally. NPR reaches 27 million listeners each week, and nearly 23 million people monthly on digital platforms. In collaboration with more than 900 independent public radio stations nationwide, NPR strives to provide the public with a deeper understanding and appreciation of events, ideas and cultures. (www.npr.org)
NPR Labs	NPR Labs provides broadcast technology research, consulting and testing capabilities for members of the public radio community, including NPR member stations, NPR, other networks, and producers of public radio content and shows. NPR Labs also markets its consulting services to commercial customers.
Open Data Application (ODA)	ODAs are defined in the RDS and RBDS standards to accommodate various applications and features that have been or may be developed use RDS-equipped broadcasts.
Primary Entry Point (PEP)	Broadcasters in the Emergency Alert System who receive EANs directly from FEMA.
Program Associated Data (PAD)	Program Associated Data (PAD) or Program Service Data (PSD). Information related to broadcasting content that consists of a number of different fields or streams which are displayed on many HD Radio and satellite radio receivers in order to describe the program being transmitted. This is intended to be seen by the listener as the program is heard.
Public Radio Satellite System (PRSS)	The distribution network through which thousands of hours of news, music and specialized audience programming are delivered every year to public radio stations throughout the United States. Managed by NPR Distribution, the PRSS is a unique, cooperative enterprise. Each Participating Station is a stakeholder in the collective assets of, and services provided by, the satellite system. Interconnected stations own their own downlink and uplink equipment. The satellite transponder capacity, as well as the national operating system equipment located in Washington, D.C., are owned by the Public Radio Satellite Interconnection System Charitable Trust. The PRSS includes more than 400 downlinks, and more than 200 program producers and distributors. Many additional stations also receive programming sent over the satellite through local connections with downlink stations or through the ContentDepot portal. Located at NPR headquarters in Washington, D.C., the Network Operations Center (NOC) is our state-of-the-art system control and routing center for audio and data transmissions, as well as the master uplink for PRSS programming.
Public Radio Station	Non-commercial radio stations meeting the requirements of the Public Broadcasting Act of 1967 (47 U.S.C. § 396) to be eligible for CPB funding. Most public radio stations interconnect with the Public Radio Satellite System and many are members of NPR.
Radio Broadcast Data System (RBDS)	See Radio Data System (RDS).
Radio Frequency (RF)	Any frequency that can be fed to a local antenna and radiated to a remote antenna to allow for communication over a distance. Generally, any frequency over about 30 kilohertz (30,000 vibrations per second).

Radio Frequency Interference (RFI)	The reception of unwanted signals that may render the use of a satellite downlink terminal, or of any radio receiver, useless. This is avoided through frequency coordination.
RAE ONE	The device, sent to each of the participating stations in this project, which processes the CAP messages (a CAP Manager) and also acts as the RDS encoder at some stations.
Radio Data System (RDS)	Radio Data System (RDS), used internationally, is a communications protocol standard for embedding small amounts of digital information in conventional FM radio broadcasts. RDS operates on the 57 KHz subcarrier and is designed to be compatible with the use of other subcarriers and HD Radio®.
RDS Encoder or RDS Generator	Two interchangeable terms referring to the piece of hardware that adds the RDS data to an FM broadcast signal.
SAT RCVR	See SFX4104.
Satellite	Any object in orbit around the earth. In broadcasting, the term refers specifically to "geostationary communications satellites" that, unlike some military and weather satellites, remain parked in a fixed position relative to a spot on the ground.
Satellite-Interconnected	Description of public radio stations which subscribe to the services of PRSS and receive live programming or files via satellite dish antennas and receivers designed and set to pick up the PRSS signal, which is found in C-Band on the communications satellite Galaxy 16, located at an orbital position of 99 degrees W over the equator.
Science and Technology Directorate	See Department of Homeland Security (DHS) and its Science and Technology Directorate.
SFX4104	The model SFX4104 satellite receiver made by International Datacasting Corp. (IDC). It is the data receiver used in this project, and is the standard receiver for data and audio at all of the roughly 400 Satellite-Interconnected Public Stations.
Signal-To-Noise Ratio (SNR or S/N)	This is a comparison of the strength of the desired signal to the strength of any interference including other signals and Multipath.
Studio-Transmitter-Link (STL)	Term often referring to a microwave link that brings programming audio from a station's studio facility to its transmitter site. However, some engineers use it to describe any means of accomplishing such a connection, including leased phone company circuits, a campus LAN, satellite link or even Internet streaming equipment.
Subcarrier	A method of transmitting more than one channel of audio, video or data on the same radio frequency carrier. Commonly used in television broadcasting and satellite video transmission.
Transmission	The process of sending content (to include programs and metadata) over satellite or the Internet to be distributed to stations.
Transponder	A portion of a satellite's total signal carrying capacity. Most broadcast communications satellites are divided into 24 transponders of equal bandwidth. A transponder can transmit one color video signal with audio sub-carriers or may be used for digital or analog audio distribution of between 20 and 100 channels, depending on transmission format.

UDP	An abbreviation for "User Datagram Protocol," but it is known only as UDP. Unlike IP (Internet Protocol), it is a method of data transmission where the sending device does not rely on acknowledgement back from the receiving end. Thus, it can be used for one-way or two-way data connections, whereas IP must be bi-directional.
Uplink	A satellite earth terminal capable of transmitting signals to the satellite, as well as receiving from it.
WATCHINSO (Monitor INSO)	The software that monitors the performance of the INSO software to assure continuous operation.

Appendix B: Figures

Figure 1: Overview of the End-to-end Demonstration
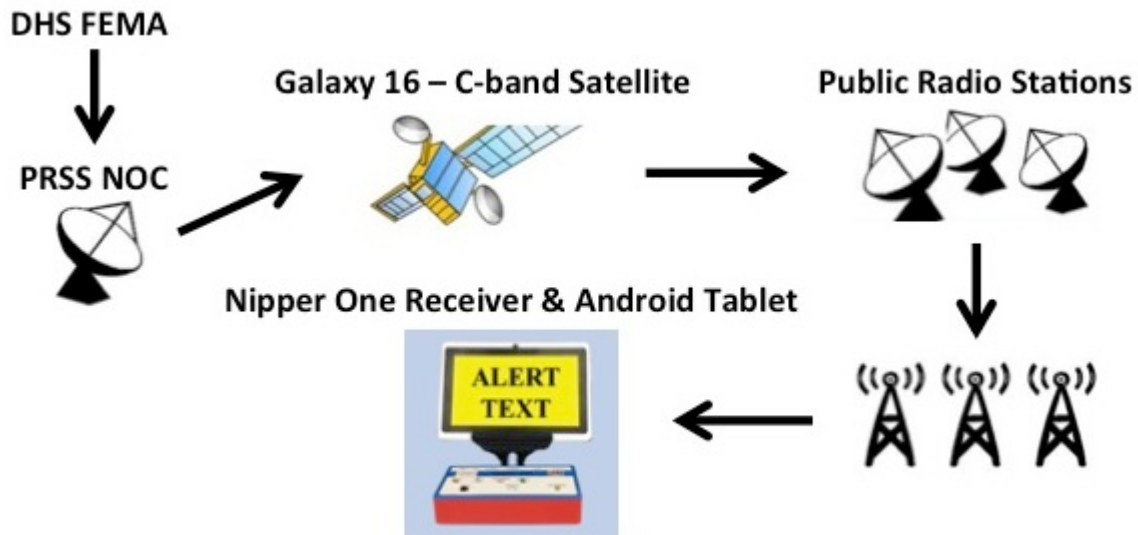
Figure 2: Overview Schematic
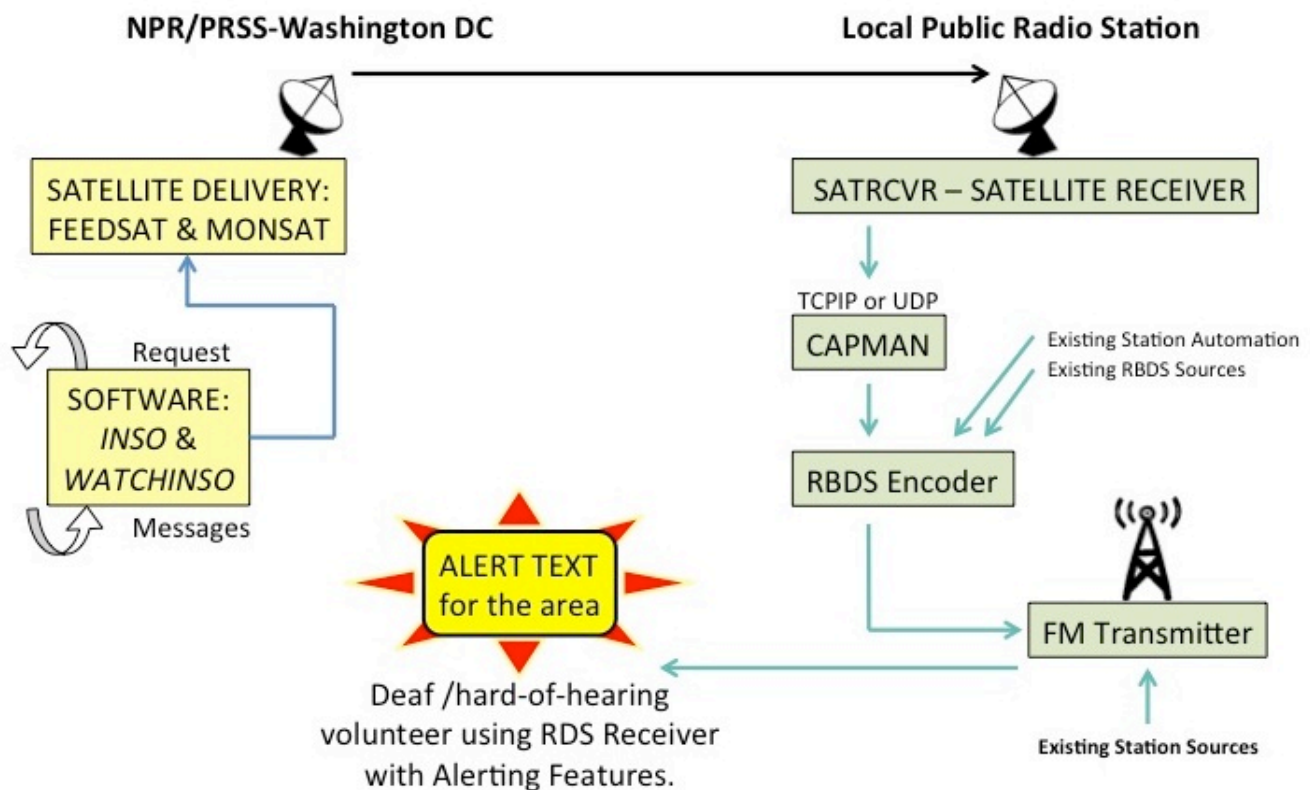
Figure 3: NPR Labs Emergency Alerting ODA System
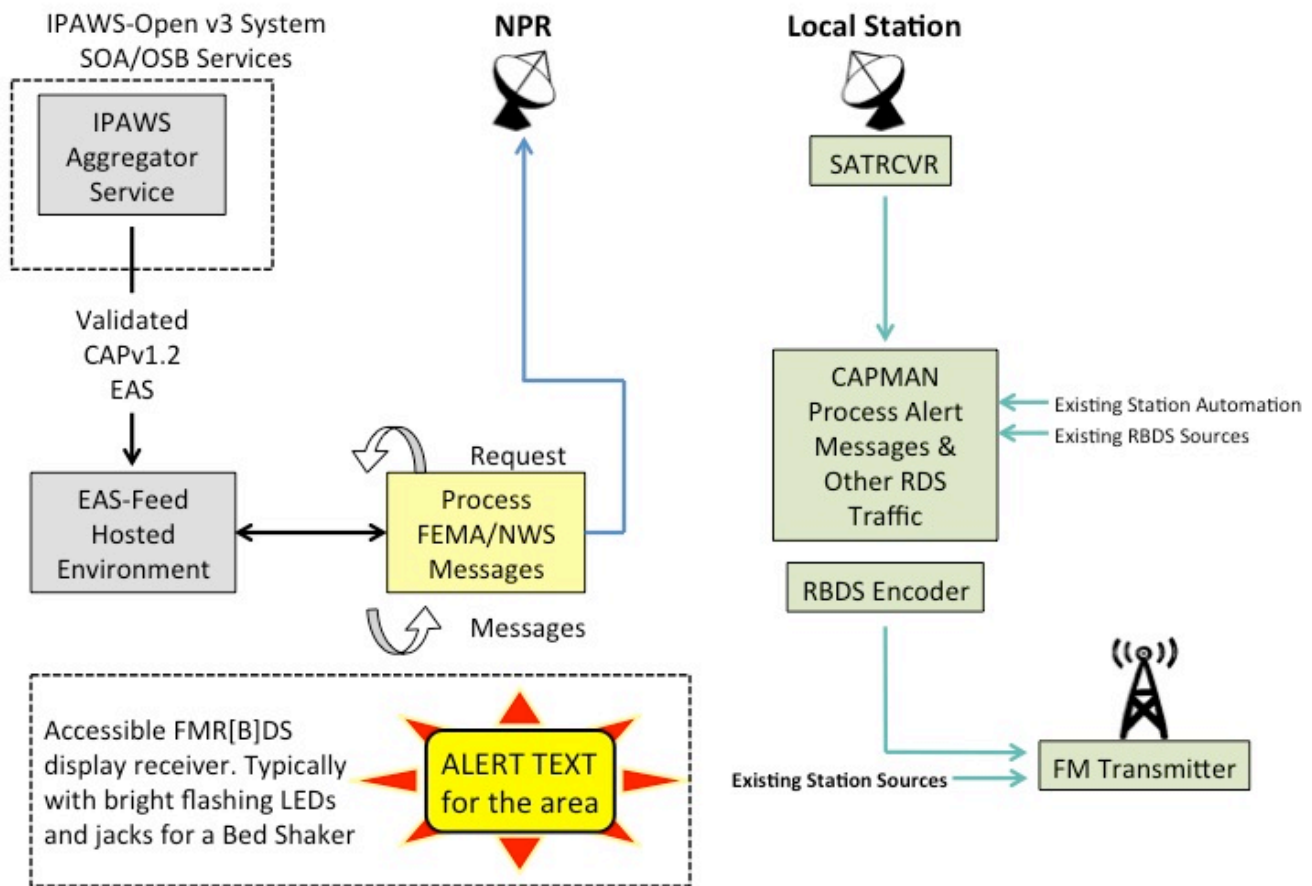
Figure 4: System block diagram for measuring ODA performance metrics
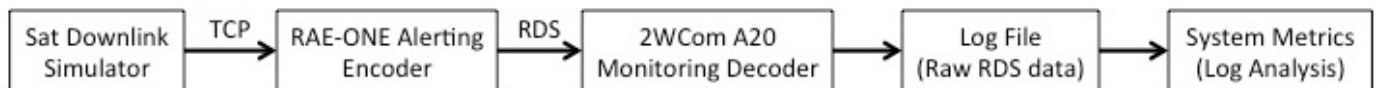
Figure 5: RAE ONE Front Panel Mechanical Design
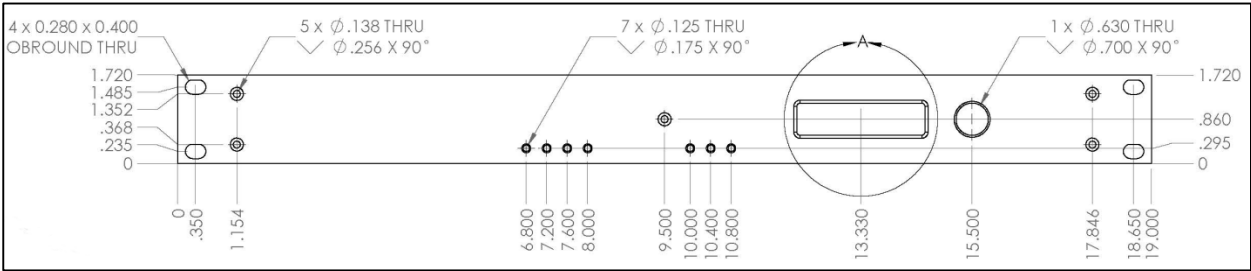
Figure 6: RAE ONE, top view
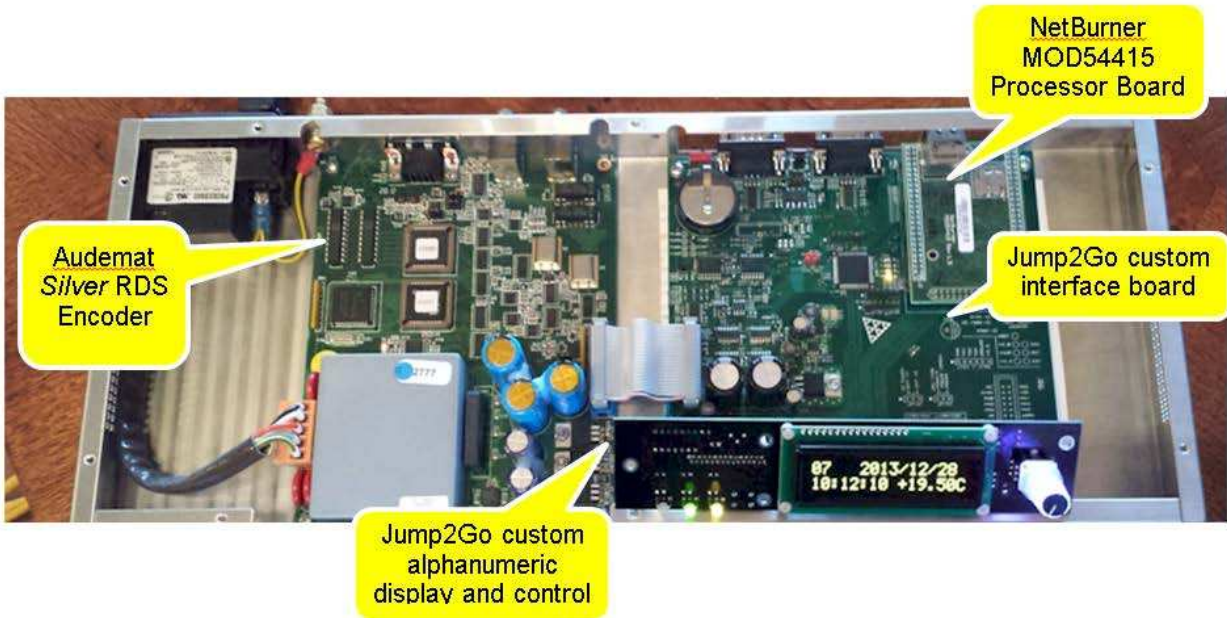
Figure 7: RAE ONE, front panel

Figure 8: Telnet Access to RAE ONE
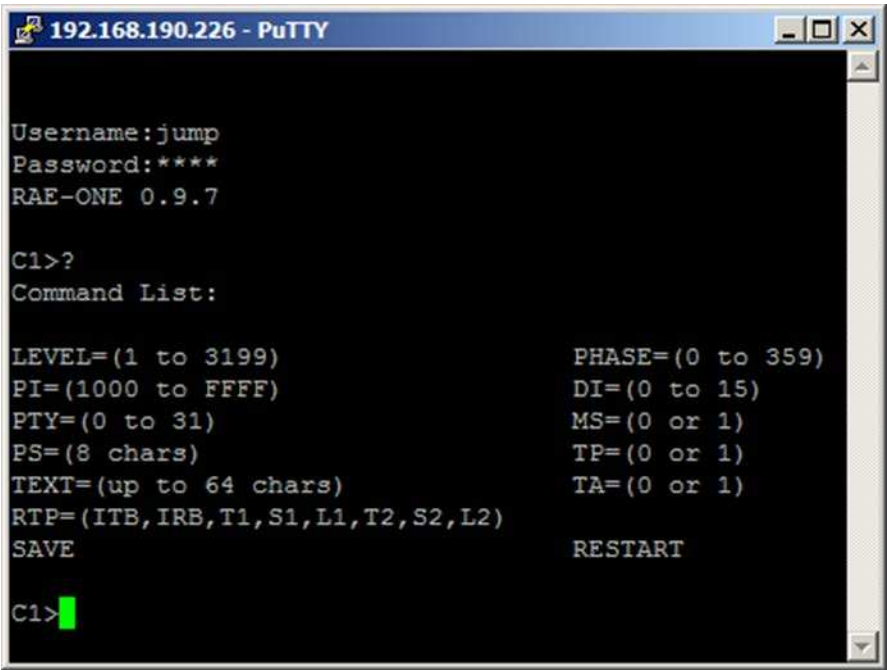
Figure 9: RAE ONE Live Status page

Figure 10: RAE ONE, Service Configuration Screen

Figure 11: The Accessible Receiver Enclosure Design

Figure 12: IDC SFX-4014 Multicast Routing Table
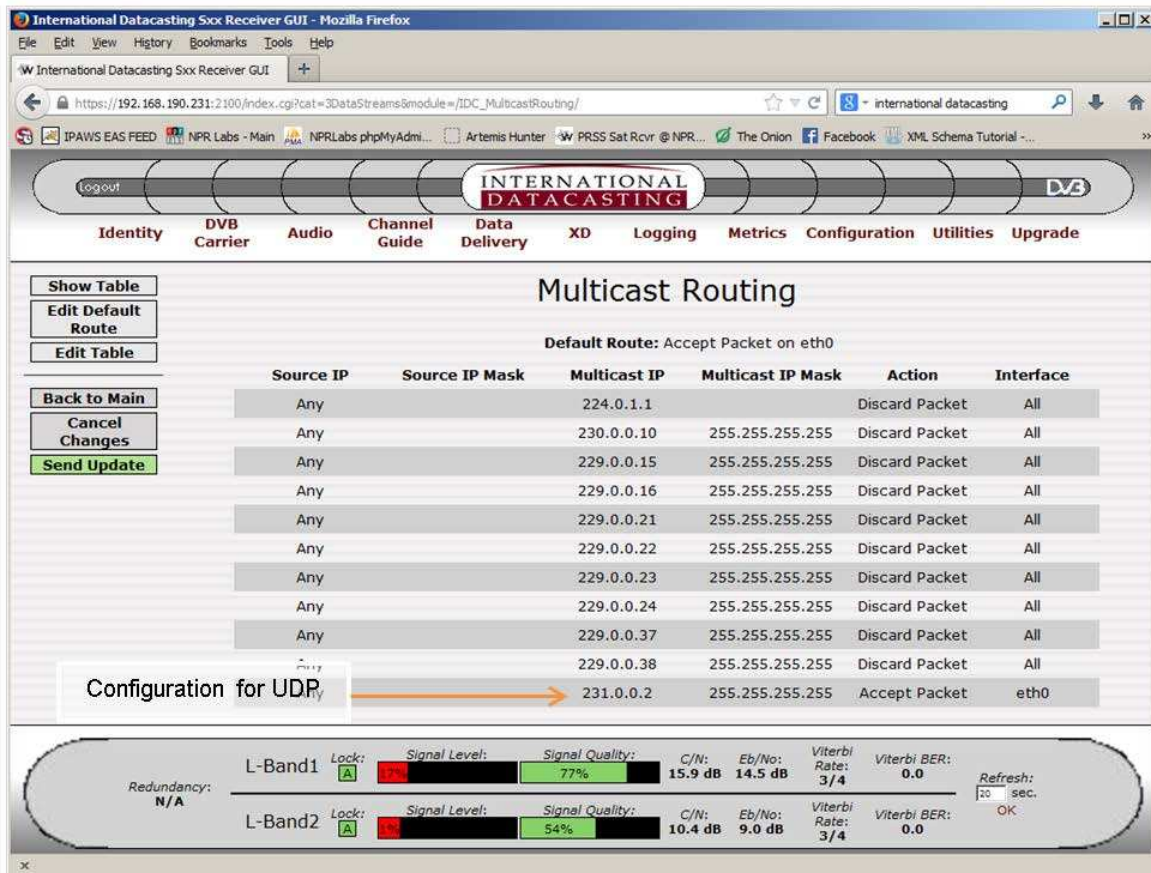
Appendix C: Tables from Methodology, Technical Configurations and Testing

Table 1: List of INSO/WATCHINSO Hardware Components

| Item	Qty
PowerEdge R320 (225-2955)	2
ProSupport: Next Business Day Onsite Service After Problem Diagnosis, 2 Year Extended (938-3254)	2
ProSupport: 7x24 HW / SW Tech Support and Assistance, 3 Year (938-3274)	2
Dell Hardware Limited Warranty Plus Onsite Service Initial Year (939-6767)	2
Dell Hardware Limited Warranty Plus Onsite Service Extended Year (939-6857)	2
Dell ProSupport. For tech support, visit http://support.dell.com/ProSupport or call 1-800-945-3355 (989-3439)	2
ProSupport: Next Business Day Onsite Service After Problem Diagnosis, Initial Year (995-8521)	2
On-Site Installation Declined (900-9997)	2
Proactive Maintenance Service Declined (926-2979)	2
Shipping Material, PowerEdge R320 (331-6952)	2
On-Board Broadcom 5720 Dual Port 1GBE (430-4715)	2
iDRAC7 Express (421-6084)	2
Chassis with up to 4, 3.5" or 2.5" Hot Plug Hard Drives (318-2038)	2
SAS Cable for 3.5" in Hot Plug Chassis (331-6959)	2
Bezel-4/8 Drive Chassis (318-1431)	2
RAID 5 for H710/H310 (3-8 HDDs) (331-7001)	2
PERC H310 Integrated RAID Controller (342-3528)	2
Intel Xeon E5-2420 1.90GHz, 15M Cache, 7.2GT/s QPI, Turbo, 6C, 95W (317-9803)	2
Heat Sink, PowerEdge (317-9826)	2
8GB RDIMM, 1333 MT/s, Low Volt, Dual Rank, x4 Data Width (317-9644)	8
1333 MHz RDIMMs (331-4422)	2
Performance Optimized (331-4428)	2
200GB Solid State Drive SATA Value MLC 3Gbps 2.5in Hot-plug Drive,3.5in HYB CARR-Limited Warranty (342-3361)	6
Enterprise Value SATA SSD drives assume system warranty up to 3 years—not extendable beyond 3 years (469-1615)	6
Electronic System Documentation and OpenManage DVD Kit for R320 (331-6962)	2

Item	Qty
DVD+/-RW, SATA, INTERNAL (313-9091)	2
ReadyRails Sliding Rails With Cable Management Arm (331-4765)	2
Dual Hot Plug Power Supplies 350W (331-7022)	2
Power Distribution Board for Hot Plug Power Supplies (331-7027)	2
Power Cord, NEMA 5-15P to C13, 15 amp, wall plug, 10 feet / 3 meter (310-8509)	4
No Operating System (420-6320), No Media Required (421-5736)	2

Table 2: Java software packages derived from the CAP1.2 XML Schema

Java package derived from CAP1.2 Schema	Description
oasis.names.tc.emergency.cap._1	Java source to parse/edit a CAP1.2 message
org.w3._2000.09.xmldsig	Java source code to parse/edit a secure signature
org.w3._2005.atom	Java source code to parse data returned from an IPAWS-OPEN Web service
services.ipaws.fema.gov.feed	Java source that is a container for objects in *oasis.names.tc.emergency.cap._1*

Table 3: Time Synchronization Message Example for RAE ONE Encoders

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<inso>
<time>
<utc>2014-05-24T09:00:32.35Z</utc>
<tz>
<id>1</id>
<name>US/Eastern</name>
<offset>04:00</offset>
<transit>241</transit>
</tz>
 .
(remaining time zones)
 .
</time>
</inso>
```

Table 4: INSO Command-line Parameters

Command Line parameters may be either single letter or descriptive word	Action
-c,--configuration	Display configuration and exit
-h,--help	Display this help and exit
-v,--version	Display INSO version and exit

Table 5: INSO Configuration File — Required Parameters and Default Values

Configuration Parameter	Required?	Value if missing	Type
`<pollDelayms>`	No	30000	Milliseconds
<heartbeatInterval>	No	2	Heartbeat sent every heartbeatInterval * pollDelayms
<heartbeatEnable>	No	True	
<httpsURLConnectTimeoutms>	No	5000	Milliseconds
<httpsURLReadTimeoutms>	No	5000	Milliseconds
<publicTimeStampMinuteOffset>	No	-3	Minutes
<eas><enable>	No	True	
<eas><useTDL>	No	True	
<public><enable>	No	True	
<public><useTDL>	No	False	
<runOnceAndExit>	No	True	Will run 1 session and exit
<stateFIPSFilter>	No	000000	All states, all counties
<useStateFIPSFilter>	No	True	
<enableFEEDSAT>	No	False	
<nicinterface>	Maybe	Fatal Error if missing AND **enableFEEDSAT=true**	IP address www.xxx.yyy.zzz
<prssPDACaddr>	Maybe	Fatal Error if missing AND **enableFEEDSAT=true**	Multicast address: www.xxx.yyy.zzz
<capport>	Maybe	Fatal Error if missing AND **enableFEEDSAT=true**	UDP Data port 00 to 65535

Configuration Parameter	Required?	Value if missing	Type
<useXMLFormattedOutput>	No	False	
<poll><production>	Maybe	Fatal Error if missing AND **easUseTDL=false**	URL
<poll><tdl>	Maybe	Fatal Error if missing AND **easUseTDL=true**	URL
<eas><production>	Maybe	Fatal Error if missing AND **easUseTDL=false**	URL
<eas><tdl>	Maybe	Fatal Error if missing AND **easUseTDL=true**	URL
<public><production>	Maybe	Fatal Error if missing AND **<public><enable>=false**	URL
<public><tdl>		Fatal Error if missing AND **<public><enable>=true**	URL

Table 6: The INSO Configuration File inso_config.xml

```
<?xml version="1.0" encoding="UTF-8"?>

<!--
=================================================================================
-->

<!-- inso_config.xml -->

<!-- INSO Configuration -->

<!-- RRarey 20131125 -->

<!--
=================================================================================
-->

<config>

<ipawsopen>

<!-- The URL to Poll, looking for the last updated time of the EAS Feed -->

<poll>

<live>https://apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/update</live>

<tdl>https://tdl.apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/update</tdl>

</poll>


<!-- The URL to the EAS Feed List. This returns a list of EAS Messages. -->

<eas>
```

```xml
<live>https://apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/feed</live>

<tdl>https://tdl.apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/feed</tdl>

</eas>


<!-- The URL to the NWS Public Feed, where NWS Messages are available. -->

<public>

<live>https://apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/public/recent/</live>

<tdl>https://tdl.apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/public/recent/</tdl>

</public>


<!-- The NPR PIN, as issued to NPR by FEMA. This information is confidential -->

<nprpin> ((the NPR Pin omitted in this report for security)) </nprpin>

</ipawsopen>


<inso>

<operation>

<!-- The Sleep time between gathering and processing messages (0 or greater) -->

<pollDelayms>15000</pollDelayms>

<!-- The wait time for a data connection to IPAWS-OPEN

 (0 or greater, where 0=infinite wait) -->

<httpsURLConnectTimeoutms>5000</httpsURLConnectTimeoutms>

<!-- The wait time for a response to a Read request from IPAWS-OPEN

 (0 or greater, where 0=infinite wait) -->

<httpsURLReadTimeoutms>5000</httpsURLReadTimeoutms>


<!-- Number of messages to hold -->

<messagesToCache>10</messagesToCache>

<!-- For the NWS Public Feed, the number of minutes in the past

 to look for messages (0 or less, where -20 is the practical maximum) -->

<publicTimeStampMinuteOffset>-3</publicTimeStampMinuteOffset>


<!-- Enable or disable the use of the EAS Feed,

 and select the Live or TDL Portal (TDL=Test Development Lab) -->
```

```xml
<eas>

<enable>true</enable>

<useTDL>true</useTDL>

</eas>


<!-- Enable or disable the use of the NWS Public Feed,
 and select the Live or TDL Portal (TDL=Test Development Lab) -->

<public>

<enable>true<</enable>

<useTDL>false</useTDL>

</public>


<!-- If true INSO runs once, sleeps, then exits (good for debugging).
 If false INSO keeps running after Sleep (normal operation). -->

<runOnceAndExit>true</runOnceAndExit>


<!-- Alabama(01), Florida(12), Louisiana(22), Mississippi(28), Texas(48) -->

<stateFIPS>01,12,22,28,48</stateFIPS>

</operation>

</inso>


<!-- The localhost's interface to use for sending messages to PRSS,
 and if it's enabled for use. -->

<feedsat>

<nicinterface>10.1.1.248</nicinterface>

<enableFEEDSAT>false</enableFEEDSAT>

<!-- The Address and Port to the PRSS Encapsulator -->

<network>

<prssPDACaddr>231.0.0.2</prssPDACaddr>

<capport>23002</capport>

</network>

</feedsat>

</config>
```

Table 7: IDC SFX-4104 Configuration of Services

Source IP	Source IP Mask	Multicast IP	Multicast IP Mask	Action	Interface	Description
Any	-	231.0.0.2	255.255.255.255	Accept Packet	eth0	Enable Alerting
Any	-	224.1.2.123	255.255.255.255	Discard Packet	All	Disable File Services
Any	-	224.1.2.124	255.255.255.255	Discard Packet	All	Disable File Services

Table 8: CAPMAN Configuration Parameters in RAE ONE

Configuration Setting	Purpose
Alerting Service	RDS Group that will contain the Alert message. RDS Group 9A is the default.
Service Port	The PRSS Satellite Receiver data port.
Service Address	The PRSS Satellite Receiver address.
TLB to ODA	Text Location Bit. When set, an accessible RDS receiver will look for alert messages within the ODA itself. When cleared, the accessible receiver will look for alerting messages in the RDS Radio Text field. In accessible receiver firmware version 1.11 and earlier, the meaning of this bit is reversed (see text).
FIPS Wildcards	If checked, RAE ONE will act upon FIPS geocodes for entire states.
FIPS Codes	A comma delimited list of 6-digit FIPS [county/parish] codes that are in this radio station's coverage area. An incoming alert message that contains a match to a FIPS code listed on this line will trigger the transmission of an alarm. The RAE ONE will compare up to 100 incoming FIPS codes in a message against the FIPS codes in this line.
Sync to INSO TZ	Time zone used by the RAE ONE.
FIPS Wildcards	If checked, RAE ONE recognizes FIPS codes for entire states (example: 048000 indicates the entire state of Texas).
FIPS Codes	Six digit codes for U.S. state and county within the station's broadcast coverage (example: Jasper, TX FIPS code is 048241). Multiple FIPS codes are separated by commas.
Encoder Type	Selects where an alerting message is sent for encoding into an RDS signal: The internal Audemat Silver RDS Encoder, or an external RDS encoder.
Encoder Port, Address	The IP address and port to use for network connection of an external RDS Encoder.
Encoder EID, SID	Identification of the RAE ONE alerts to external RDS encoders.
Encoder AGC, TGC	Parameters of the RAE ONE alerts to external RDS encoders.
Sync to INSO TC	When checked, the RAE ONE time of day is synchronized to NPR.
Syslog	When checked, RAE ONE logging data for the Alerting Service is available to logging applications on the same data network.

Table 9: Selection Table of Potential FM Receiver Manufacturers

Manufacturer/Supplier (Alphabetical)	Country	Products/Services offered	Contact Name	Company Declined Participation	7" display	Touch Screen	User-selected screen color/font	Bed-shaker trigger	Multiple message lines displayed before scrolling	Usable with PC and Android Tablet	Requires Proprietary RBDS Transmission Scheme	Requires Proprietary Technology licensing	RBDS Transmission scheme compatible with project	Open and public RBDS Transmission Scheme	Receiver upgradeable by the user	Receiver at or below $100/each	Receiver over $100/each or design cost exceeds budget	Additional or recurring fees (licenses \ royalties \ other)
Alertus Technologies	USA	Alertus Alert Beacon	Jason Volk (CEO), Ryan Ockley (Dir)								X	X					X	X
Carbon Design Group	USA	Industrial Design and Engineering	Eddie Kirschenbaum														X	
Catena Radio Design bv	Netherlands	Design and build 500 accessible RBDS receivers to specification.	Joop Beunders		X	X	X	X	X	X			X	X	X	X		
e-radio	USA	Programmable Communicating Thermostat with built-in RBDS FM receiver.	Jackson Wang	X														
GSS (AlertUS)	USA	AlertFM System	Matthew Straeb		X	X		X			X	X					X	X

56

Manufacturer/Design Company Specifics					Receiver: Accessible Features	Technical Concept	Receiver: Costs
Hansong Electronics (Hansong-China)	China	Original Design Manufacturing (ODM) and Original Equipment Manufacturing (OEM)	Helge Kristensen	X			
Kensen Technologies Ltd.	Hong Kong/China	Industrial Design, Engineering, and Manufacturing	Kenneth Wong				X
Musical	Hong Kong/China	Original Design Manufacturing (ODM) and Original Equipment Manufacturing (OEM)	HK Chan	X			
Wistron NeWeb Corp	Taiwan/USA	Design and manufacturer of advanced wireless communication products.	Michelle Lin	X			
Zylux America Inc.	Taiwan/USA	Original Design Manufacturer (ODM)	Wyatt Briant (President, Zulux-America, Inc.)	X			

Table 10: Audemat®Silver®RDS Encoder, General Specifications

RDS Encoding	
Sub-carrier	57 kHz(± 3 Hz)
Phase adjustment	± 180° in 6° increments
Output level	-60 dBu to 0 dBu in 1dB steps or (depending on set up) 2.5 mVcc to 3199 mVcc
Bandwidth	± 2.4 kHz (60 dB)
Bandpass rejection	Complies with standard IEC 62106
57 kHz suppression	Greater than 70 dB
UECP standard v7.05 compatibility	Partial. The following MEC are supported: 0x01,0x02, 0x03,0x04,0x0A,0x05,0x07,0x13,0x1E,0x22,0x0E,0x23, 0x27,0x2D,0x2C,0x1D,0x16,0x1C,0x2F,0x17
SYNC/MPX input signal	
Connector	BNC unbalanced
Max nominal input signal	+12 dBu
Peak input signal	18 dBu allowed
Max input signal	+22 dBu
Pilot frequency	19000 Hz ± 2 Hz
Retransmission gain	± 1 dB DC-100 kHz
RDS output signal	
Connector	BNC unbalanced
Output impedance	100 Ω
Typical load impedance	> 500 Ω
THD	< 0,02% (f=10 kHz)
	< 0,04% (f=57 kHz)
Communication Port(s)	
COM0(rear panel)	RS232 (9600 bits/s) (DB9)
Power Supply	
Supply voltage	115 V / 230 V
Voltage tolerance	± 10%
Main AC frequency	45-65 Hz
Main AC filter	yes
Parallel protection element	Gemov
Fuse	1 AT
Consumption	50 VA
Mechanical Aspects	
Height	1U (44,5 mm)
Width	483 mm

Depth	200 mm
Net Weight	~1.1 kg (without cables)
Chassis	Stainless steel, grounded
Top Cover	Stainless steel, removable for access to internal components
Ventilation	By natural convection through upper and lower openings
Environmental data	
Operating Temperature	0°C to 50°C ambient
Storage Temperature	-30°C to 80°C ambient
Altitude	0 to 5000 m
Humidity	class F, DIN50040
EMC Lab	Télédiffusion de France (C2R)
EMC	EN50022 and generic standard
Noise immunity	10 V/m minimum
Test fire	UL94 (UTAC) 95/28 CEE

Table 11: NetBurner MOD54415 Ethernet Core Module Specifications

Processor and Memory	32-bit Freescale ColdFire 54415 running at 250MHz with 64MB DDR2 RAM and 32MB Flash
Network Interface	10/100 BaseT with RJ-45 connector (100 Version)
Data I/O Interface	• Up to 8 UARTs • Up to 4 I2C • Up to 2 CAN 2.0b controllers • Up to 3 SPI • Up to 42 digital I/O + 2 digital inputs • Up to eight 12-bit analog-to-digital converters (ADC) • Up to two 12-bit digital-to-analog converters (DAC) • Up to 5 pulse width modulators (PWM) • Up to 4 external timer in or outputs • MicroSD flash card ready • 1-Wire® interface
Flash Card Support	FAT32 support for SD Cards up to 32GB
Physical Characteristics	Dimensions (inches): 2.95" x 2.00"

Table 12: INSO Metrics

```
2013-12-16 15:04:42.577 INFO ---| INSO v0.9.6 Initializing |---
2013-12-16 15:04:42.742 DEBUG --------| Configuration information |-------

 Using the EAS Test Development Lab (TDL) feed at: https://tdl.apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/feed

 EAS Test Development Lab (TDL) EAS Polling feed at: https://tdl.apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/update

 Using the Public Production feed at: https://apps.fema.gov/IPAWSOPEN_EAS_SERVICE/rest/public/recent/

 -----| Operation |-----

 EAS Feed Enabled: true

 Public Feed Enabled: true

 Delay between polls (ms): 5000

 Public Feed polls for messages sent -20 minutes before current time.

 Maximum Messages held in Cache: 10

 HTTPS URL Connect Timeout: 5000

 HTTPS URL Read Timeout: 5000

 State FIPS Filter List: [01, 12, 22, 28, 48]

 Use State FIPS Filter: false

 Formatted XML Output for PRSS: false

 Run Once and Exit: true

 ------| PRSS |-------

 PRSS PDAC Addr: 231.0.0.2

 PRSS PDAC Port: 23002

 FEEDSAT Interface: 10.1.1.248

 enableFEEDSAT: true

 ---------------------------------------------
2013-12-16 15:04:42.748 DEBUG ---| INSO is awake. Starting session. |---
```

60

2013-12-16 15:04:44.313 DEBUG easFeedEnabled. EAS Poll last change time: 2013-12-16T20:02:31.509Z

2013-12-16 15:04:45.200 DEBUG SENT bytesTransmitted: 5321 Elapsed Time before send (seconds): 0.519030546 bytesTransmittedElapsedTime (seconds): 0.000078306

2013-12-16 15:04:45.592 DEBUG SENT bytesTransmitted: 5321 Elapsed Time before send (seconds): 0.389444218 bytesTransmittedElapsedTime (seconds): 0.000037066

2013-12-16 15:04:46.011 DEBUG SENT bytesTransmitted: 7548 Elapsed Time before send (seconds): 0.418007642 bytesTransmittedElapsedTime (seconds): 0.000042956

2013-12-16 15:04:46.439 DEBUG SENT bytesTransmitted: 7045 Elapsed Time before send (seconds): 0.425749359 bytesTransmittedElapsedTime (seconds): 0.000039833

2013-12-16 15:04:46.853 DEBUG SENT bytesTransmitted: 9178 Elapsed Time before send (seconds): 0.412836096 bytesTransmittedElapsedTime (seconds): 0.000052323

2013-12-16 15:04:47.590 DEBUG SENT bytesTransmitted: 7026 Elapsed Time before send (seconds): 0.735498368 bytesTransmittedElapsedTime (seconds): 0.000042773

2013-12-16 15:04:47.998 DEBUG SENT bytesTransmitted: 7691 Elapsed Time before send (seconds): 0.405537649 bytesTransmittedElapsedTime (seconds): 0.000041817

2013-12-16 15:04:48.443 DEBUG SENT bytesTransmitted: 5321 Elapsed Time before send (seconds): 0.443350711 bytesTransmittedElapsedTime (seconds): 0.000038847

2013-12-16 15:04:48.849 DEBUG SENT bytesTransmitted: 4692 Elapsed Time before send (seconds): 0.404690026 bytesTransmittedElapsedTime (seconds): 0.00004119

2013-12-16 15:04:49.246 DEBUG SENT bytesTransmitted: 6250 Elapsed Time before send (seconds): 0.395699279 bytesTransmittedElapsedTime (seconds): 0.00004011

2013-12-16 15:04:49.670 DEBUG SENT bytesTransmitted: 6492 Elapsed Time before send (seconds): 0.422134788 bytesTransmittedElapsedTime (seconds): 0.000041473

2013-12-16 15:04:50.084 DEBUG SENT bytesTransmitted: 6246 Elapsed Time before send (seconds): 0.413251597 bytesTransmittedElapsedTime (seconds): 0.000040413

2013-12-16 15:04:50.505 DEBUG SENT bytesTransmitted: 6707 Elapsed Time before send (seconds): 0.418411447 bytesTransmittedElapsedTime (seconds): 0.000052143

2013-12-16 15:04:50.919 DEBUG SENT bytesTransmitted: 6556 Elapsed Time before send (seconds): 0.412949784 bytesTransmittedElapsedTime (seconds): 0.00004334

2013-12-16 15:04:51.247 DEBUG SENT bytesTransmitted: 7790 Elapsed Time before send (seconds): 0.326302504 bytesTransmittedElapsedTime (seconds): 0.000047594

2013-12-16 15:04:51.634 DEBUG SENT bytesTransmitted: 6454 Elapsed Time before send (seconds): 0.385610566 bytesTransmittedElapsedTime (seconds): 0.000044677

2013-12-16 15:04:52.037 DEBUG SENT bytesTransmitted: 4801 Elapsed Time before send (seconds): 0.400978392 bytesTransmittedElapsedTime (seconds): 0.000039076

2013-12-16 15:04:52.038 DEBUG publicFeedEnabled. Offset time stamp: 2013-12-16T19:44:52.38Z

2013-12-16 15:04:53.195 DEBUG SENT bytesTransmitted: 8909 Elapsed Time before send (seconds): 1.559120032 bytesTransmittedElapsedTime (seconds): 0.000060537

2013-12-16 15:04:53.224 DEBUG SENT bytesTransmitted: 4740 Elapsed Time before send (seconds): 1.587977788 bytesTransmittedElapsedTime (seconds): 0.000032387

2013-12-16 15:04:53.254 DEBUG SENT bytesTransmitted: 6784 Elapsed Time before send (seconds): 1.617879041 bytesTransmittedElapsedTime (seconds): 0.00003433

2013-12-16 15:04:53.284 DEBUG SENT bytesTransmitted: 7120 Elapsed Time before send (seconds): 1.647917372 bytesTransmittedElapsedTime (seconds): 0.000034346

2013-12-16 15:04:53.315 DEBUG SENT bytesTransmitted: 8590 Elapsed Time before send (seconds): 1.679294642 bytesTransmittedElapsedTime (seconds): 0.000039337

2013-12-16 15:04:53.344 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 1.708320056 bytesTransmittedElapsedTime (seconds): 0.00003375

2013-12-16 15:04:53.373 DEBUG SENT bytesTransmitted: 6025 Elapsed Time before send (seconds): 1.737655384 bytesTransmittedElapsedTime (seconds): 0.000034127

2013-12-16 15:04:53.402 DEBUG SENT bytesTransmitted: 6022 Elapsed Time before send (seconds): 1.766839695 bytesTransmittedElapsedTime (seconds): 0.00003433

2013-12-16 15:04:53.431 DEBUG SENT bytesTransmitted: 6023 Elapsed Time before send (seconds): 1.795408152 bytesTransmittedElapsedTime (seconds): 0.000036427

2013-12-16 15:04:53.460 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 1.824378342 bytesTransmittedElapsedTime (seconds): 0.000033217

2013-12-16 15:04:53.489 DEBUG SENT bytesTransmitted: 6023 Elapsed Time before send (seconds): 1.853118026 bytesTransmittedElapsedTime (seconds): 0.000035363

2013-12-16 15:04:53.518 DEBUG SENT bytesTransmitted: 6025 Elapsed Time before send (seconds): 1.882145463 bytesTransmittedElapsedTime (seconds): 0.000038037

2013-12-16 15:04:53.546 DEBUG SENT bytesTransmitted: 6026 Elapsed Time before send (seconds): 1.910328195 bytesTransmittedElapsedTime (seconds): 0.000033941

2013-12-16 15:04:53.565 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 1.929088678 bytesTransmittedElapsedTime (seconds): 0.000018327

2013-12-16 15:04:53.579 DEBUG SENT bytesTransmitted: 6025 Elapsed Time before send (seconds): 1.943839829 bytesTransmittedElapsedTime (seconds): 0.000020165

2013-12-16 15:04:53.594 DEBUG SENT bytesTransmitted: 6026 Elapsed Time before send (seconds): 1.958678335 bytesTransmittedElapsedTime (seconds): 0.000018538

2013-12-16 15:04:53.608 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 1.972859579 bytesTransmittedElapsedTime (seconds): 0.00001852

2013-12-16 15:04:53.623 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 1.987363343 bytesTransmittedElapsedTime (seconds): 0.00002309

2013-12-16 15:04:53.637 DEBUG SENT bytesTransmitted: 6026 Elapsed Time before send (seconds): 2.001590704 bytesTransmittedElapsedTime (seconds): 0.000018104

2013-12-16 15:04:53.652 DEBUG SENT bytesTransmitted: 6938 Elapsed Time before send (seconds): 2.016157687 bytesTransmittedElapsedTime (seconds): 0.000020429

2013-12-16 15:04:53.665 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.029852128 bytesTransmittedElapsedTime (seconds): 0.000019708

2013-12-16 15:04:53.679 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.043875834 bytesTransmittedElapsedTime (seconds): 0.000021734

2013-12-16 15:04:53.693 DEBUG SENT bytesTransmitted: 6025 Elapsed Time before send (seconds): 2.05767961 bytesTransmittedElapsedTime (seconds): 0.00002335

2013-12-16 15:04:53.708 DEBUG SENT bytesTransmitted: 6023 Elapsed Time before send (seconds): 2.0720774 bytesTransmittedElapsedTime (seconds): 0.00002859

2013-12-16 15:04:53.722 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.086126948 bytesTransmittedElapsedTime (seconds): 0.000022387

2013-12-16 15:04:53.736 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.100496811 bytesTransmittedElapsedTime (seconds): 0.000025865

2013-12-16 15:04:53.801 DEBUG SENT bytesTransmitted: 6023 Elapsed Time before send (seconds): 2.165741707 bytesTransmittedElapsedTime (seconds): 0.000030595

2013-12-16 15:04:53.842 DEBUG SENT bytesTransmitted: 6025 Elapsed Time before send (seconds): 2.206591584 bytesTransmittedElapsedTime (seconds): 0.000030477

2013-12-16 15:04:53.883 DEBUG SENT bytesTransmitted: 6023 Elapsed Time before send (seconds): 2.247601896 bytesTransmittedElapsedTime (seconds): 0.000033693

2013-12-16 15:04:53.924 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.288693441 bytesTransmittedElapsedTime (seconds): 0.000032017

2013-12-16 15:04:53.964 DEBUG SENT bytesTransmitted: 6022 Elapsed Time before send (seconds): 2.328366876 bytesTransmittedElapsedTime (seconds): 0.000031434

2013-12-16 15:04:54.003 DEBUG SENT bytesTransmitted: 6959 Elapsed Time before send (seconds): 2.367813274 bytesTransmittedElapsedTime (seconds): 0.000029106

2013-12-16 15:04:54.042 DEBUG SENT bytesTransmitted: 7208 Elapsed Time before send (seconds): 2.406820762 bytesTransmittedElapsedTime (seconds): 0.000029116

2013-12-16 15:04:54.081 DEBUG SENT bytesTransmitted: 8487 Elapsed Time before send (seconds): 2.44526918 bytesTransmittedElapsedTime (seconds): 0.000029472

2013-12-16 15:04:54.118 DEBUG SENT bytesTransmitted: 6023 Elapsed Time before send (seconds): 2.482312342 bytesTransmittedElapsedTime (seconds): 0.00002886

2013-12-16 15:04:54.154 DEBUG SENT bytesTransmitted: 6643 Elapsed Time before send (seconds): 2.518872415 bytesTransmittedElapsedTime (seconds): 0.000031122

2013-12-16 15:04:54.191 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.555363251 bytesTransmittedElapsedTime (seconds): 0.000027359

2013-12-16 15:04:54.226 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.59020385 bytesTransmittedElapsedTime (seconds): 0.000028094

2013-12-16 15:04:54.260 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.624738536 bytesTransmittedElapsedTime (seconds): 0.000021027

2013-12-16 15:04:54.295 DEBUG SENT bytesTransmitted: 6024 Elapsed Time before send (seconds): 2.659371086 bytesTransmittedElapsedTime (seconds): 0.000025328

2013-12-16 15:04:54.329 DEBUG SENT bytesTransmitted: 6027 Elapsed Time before send (seconds): 2.693740933 bytesTransmittedElapsedTime (seconds): 0.000019926

2013-12-16 15:04:54.363 DEBUG SENT bytesTransmitted: 6027 Elapsed Time before send (seconds): 2.727126915 bytesTransmittedElapsedTime (seconds): 0.000018689

2013-12-16 15:04:54.396 DEBUG SENT bytesTransmitted: 6026 Elapsed Time before send (seconds): 2.760178256 bytesTransmittedElapsedTime (seconds): 0.000019467

2013-12-16 15:04:54.430 DEBUG SENT bytesTransmitted: 7453 Elapsed Time before send (seconds): 2.794105674 bytesTransmittedElapsedTime (seconds): 0.000029865

2013-12-16 15:04:54.463 DEBUG SENT bytesTransmitted: 7203 Elapsed Time before send (seconds): 2.827658119 bytesTransmittedElapsedTime (seconds): 0.000020359

2013-12-16 15:04:54.496 DEBUG SENT bytesTransmitted: 6925 Elapsed Time before send (seconds): 2.860750367 bytesTransmittedElapsedTime (seconds): 0.000019683

2013-12-16 15:04:54.530 DEBUG SENT bytesTransmitted: 7840 Elapsed Time before send (seconds): 2.8941347 bytesTransmittedElapsedTime (seconds): 0.000020984

2013-12-16 15:04:54.530 DEBUG

---| Session summary |---

 Messages successfully transmitted to PRSS: 64

 Messages failed in transmission to PRSS: 0

 Messages in EAS FeedList: 17

 Messages in Public Feed: 47

2013-12-16 15:04:54.531 DEBUG ---| Session complete. Starting INSO sleep for 5000ms |---

2013-12-16 15:04:59.531 INFO ---| INSO is terminating |---

Table 13: Technical Testing Steps

Component and *Exercise Name*	Description
SATRCVR *test*	Participating Station tests the project-provided SATRCVR by monitoring its Web-based control interface.
RDS Encoder *test*	Participating Station tests its RDS encoder.
IPAWS-OPEN *get*	Test INSO ingest responsiveness by rapid, repeated access to IPAWS-OPEN.
INSO starve	Test WATCHINSO by disconnecting the network from INSO's access.
INSO *term*	Test WATCHINSO responsiveness by terminating the INSO process.
NPR Labs *gen*	Test IPAWS-OPEN responsiveness by rapidly and repeatedly generating NPR Labs test messages.
FEEDSAT *term*	Test MONSAT responsiveness by killing the FEEDSAT process.
FEEDSAT overflow	Test FEEDSAT by rapidly and repeatedly sending messages to it.
CAPMGR overflow	Test CAPMGR by rapidly and repeatedly causing it to receive messages from SATRCVR.
CAPMGR *wham*	Test CAPMGR by simultaneously and repeatedly sending data from every RDS source it is designed to handle.
RDS what	Verify CAPMGR's performance by observing the received RDS text on a reference receiver.
Receiver readme	Verify project prototype receiver behavior by transmitting to it RDS text strings, Warning Bit activation, memory recall. Use of NPR Labs facilities recommended.
Receiver *pickup*	Verify project prototype receiver RF sensitivity in NPR Labs facility.
System readmenow	Verify end-to-end system performance by originating an NPR Labs test message. Performed in NPR Labs facilities during development phase, regularly performed thereafter as a system check when system is deployed to stations.

Appendix D: Tables from Participant Testing

Table 14: List of alerts transmitted on the top of the hour between 7am and 9pm EST.

	Date of first test	Date of second test	Alert	Characteristics
Day 1	June 19	July 24	Hurricane	UPPER Long
Day 2	June 20	July 25	Wildfire	Mixed Case Short
Day 3	June 21	July 26	Water Swell	UPPER Short
Day 4	June 22	July 27	High Winds	Mixed Case Long
Day 5	June 23	July 28	Tornado	UPPER Long
Day 6	June 24	July 29	Blizzard	Mixed Case Long
Day 7	June 25	July 30	Earthquake	UPPER Short
Day 8	June 26	July 31	Tornado	Mixed Case Short
Day 9	June 27	August 1	Hurricane	Mixed Case Long
Day 10	June 28	August 2	Flash Flood	UPPER Short
Day 11	June 29	August 3	Wildfire	Mixed Case Short
Day 12	June 30	August 4	Blizzard	UPPER Long
Day 13	July 1	August 5	Earthquake	Mixed Short
Day 14	July 2	August 6	Brush Fire	UPPER Short
Day 15 (repeat of Day 1)	July 3	August 7	Hurricane	UPPER Long
Day 16 (repeat of Day 2)	July 4	August 8	Wildfire	Mixed Case Short
Day 17 (repeat of Day 3)	July 5	August 9	Water Swell	UPPER Short
Day 18 (repeat of Day 4)	July 6	August 10	High Winds	Mixed Case Long
Day 19 (repeat of Day 5)	July 7	August 11	Tornado	UPPER Long
Day 20 (repeat of Day 6)	July 8	August 12	Blizzard	Mixed Case Long
Day 21 (repeat of Day 7)	July 9	August 13	Earthquake	UPPER Short

Table 15: Daily Questions

What natural weather alert did you just read about?						
Tornado	Hurricane	Blizzard	High winds	Water swell	Brush fire	Earthquake

How long did it take you to read the message?			
30-60 seconds	1-2 minutes	3-5 minutes	Over 5 minutes

How easy was it to read the text?				
Very easy	Easy	Neither easy nor hard	Hard	Very hard

How tired did your eyes feel after reading the message?		
Very	Little	Not at all

How much did you feel you understood?				
All	Most	Half	Little	None

How clear and useful was the information presented during the alert?				
Very clear	Clear	Neither clear nor unclear	Unclear	Very unclear

Were the words displayed clearly, not broken up or hyphenated improperly?			
All words were clearly displayed	Most words were clearly displayed while a few words were broken up or hyphenated improperly	Few words were clearly displayed while most words were broken up or hyphenated improperly	All words were unclearly displayed

Did words remain on the screen for enough time to read the message?			
All of the time	Most of the time	Some of the time	None of the time

Table 16: Responses to Pre-Test Questionnaire

Question	Scale (1-10)	Percent of responses	Summary
Did you like the physical look and style of the receiver? (1 = Did not like; 10 Liked Very Much)	1	0.0%	In general, participants liked the physical look and style of the receiver.
	2	0.0%	
	3	0.0%	
	4	2.0%	
	5	12.5%	
	6	8.0%	
	7	27.5%	
	8	17.5%	
	9	22.5%	
	10	10.0%	
Were the set up instructions easy to understand? (1 = Hard; 10 Easy)	1	3.0%	In general, participants thought set-up instructions were easy to understand.
	2	0.0%	
	3	3.0%	
	4	3.0%	
	5	0.0%	
	6	8.0%	
	7	20.0%	
	8	15.0%	
	9	15.0%	
	10	35.0%	
Did the receiver find and tune to your local station easily? (1 = with difficulty; 10 = with ease)	1	20.0%	Participants had varying experiences of their receivers finding and tuning to local stations.
	2	8.0%	
	3	5.0%	
	4	3.0%	
	5	8.0%	
	6	10.0%	
	7	10.0%	
	8	5.0%	

Question	Scale (1-10)	Percent of responses	Summary
	9	15.0%	
	10	18.0%	
Was navigating around the tablet's touch screen easy? (1 = difficult; 10 = easy)	1	0.0%	In general, participants felt navigating the tablet's touch screen was easy.
	2	0.0%	
	3	0.0%	
	4	3.0%	
	5	10.0%	
	6	7.0%	
	7	25.0%	
	8	25.0%	
	9	13.0%	
	10	17.0%	
Was the tablet's touchscreen large enough to comfortably use? (1 = uncomfortable; 10 = comfortable)	1	3.0%	In general, participants felt the touch screen was comfortable to use.
	2	0.0%	
	3	0.0%	
	4	5.0%	
	5	8.0%	
	6	8.0%	
	7	17.0%	
	8	13.0%	
	9	18.0%	
	10	30.0%	
Did you connect your bed shaker to the receiver?	No, I didn't try	15.0%	
	No, I don't have one	80.0%	
	Yes, it worked	5.0%	
Would you rather have a physical keyboard or a touch	Yes	20.0%	
	No	35.0%	

Question	Scale (1-10)	Percent of responses	Summary
screen?	No Preference	45.0%	

Table 17: Concluding Questions

Did you have equipment problems that disallowed you from participating?
Did you ever receive the green beacon light?
Did you receive truncated messages which did not contain the information for you to fill out the surveys properly?
Did you receive garbled messages that disallowed you from filling out the surveys?
Did you like the notification scheme (flashing lights)? (Scale of 1-10)
Did you like the display size?
Did you like the alert look and feel?
How likely would you be to use this service? (Scale of 1-10)
How likely would you purchase a radio caption display if it were:

Under 25 dollars (1-10)	25-50 dollars (1-10)	50-100 dollars (1-10)	Over 100 dollars (1-10)

Are there any additional features that would be useful to include? (Open ended question)

Table 18: Gender

1	2	3		4	5
	Scale	Male	Female	Significantly different at $p<.05$	Summary of finding
Reading Speed	1 = 30-60 seconds 2 = 1-2 minutes 3 = 3-5 minutes 4 = Over 5 minutes	2.3*	2.0*	Yes	Females read alerts more quickly than males
Ease of Reading	1 = Very Easy 2 = Easy 3 = Neither easy nor hard 4 = Hard	2.3	2.3	No	Females and males found alerts similarly easy to read

69

1	2	3	4	5
	Scale	Male	Female	Significantly different at p<.05	Summary of finding
	5 = Very Hard				
Eye fatigue	1 = Not at all 2 = Little 3 = Very	1.2	1.3	No	Females and males found alerts similarly fatiguing
Ease of Comprehension	1 = None 2 = Little 3 = Half 4 = Most 5 = All	4.1	4.2	No	Females and males comprehended alerts similarly
Clarity	1 = Very unclear 2 = Unclear 3 = Neither clear nor unclear 4 = Clear 5 = Very clear	3.9	3.9	No	Females and males found alerts similarly clear
Memory Score	Percentage of correct answers	78%	78%	No	Females and males remembered details from alerts similarly

	Scale	Deaf	HOH	Significantly different at p<.05	Summary of finding
Reading Speed (1-5 scale)	1 = 30-60 seconds 2 = 1-2 minutes 3 = 3-5 minutes 4 = Over 5 minutes	2.3	2.0	No	Deaf and hard-of-hearing participants reported reading at similar speeds
Ease of Reading (1-5 scale)	1 = Very Easy 2 = Easy 3 = Neither easy nor hard 4 = Hard 5 = Very Hard	2.4	2.2	No	Deaf and hard-of-hearing participants found the texts similarly easy to read
Eye fatigue	1 = Not at all 2 = Little 3 = Very	1.5*	1.0*	Yes	Deaf participants found alerts more fatiguing to read
Ease of Comprehension	1 = None 2 = Little 3 = Half 4 = Most 5 = All	4.0*	4.3*	Yes	Deaf participants claimed they understood less in the alerts
Clarity	1 = Very unclear 2 = Unclear 3 = Neither clear nor unclear 4 = Clear 5 = Very clear	3.8	3.9	No	Deaf and hard-of-hearing participants reported messages were equally clear
Memory Score	Percentage of correct answers	72%*	84%*		Hard-of-hearing participants scored higher on the memory test than deaf participants did

Table 20: Age

	Scale	Under 50	50-65	Over 65	Significantly different at p<.05	Summary of finding
Reading Speed (1-5 scale)	1 = 30-60 seconds 2 = 1-2 minutes 3 = 3-5 minutes 4 = Over 5 minutes	2.1	2.2	2.2	No	All ages reported reading at similar speeds
Ease of Reading (1-5 scale)	1 = Very Easy 2 = Easy 3 = Neither easy nor hard 4 = Hard 5 = Very Hard	2.1	2.5	2.4	No	All ages reported reading was similarly easy
Eye fatigue	1 = Not at all 2 = Little 3 = Very	1.0*	1.4	1.4	Yes	Younger participants reported less eye fatigue than older participants
Ease of Comprehension	1 = None 2 = Little 3 = Half 4 = Most 5 = All	4.4*	4.0	4.0	Yes	Younger participants reported more comprehension than older participants
Clarity	1 = Very unclear 2 = Unclear 3 = Neither clear nor unclear	4.0	3.8	3.8	No	All ages reported messages were similarly clear

	Scale	Under 50	50-65	Over 65	Significantly different at p<.05	Summary of finding
	4 = Clear 5 = Very clear					
Memory Score	Percentage of correct answers	93%*	66%	76%	Yes	Younger participants remembered more details of alerts than older participants

Table 21: Short Messages vs. Long Messages

	SHORT	LONG	Scale	Significantly different at p<.05	Summary of finding
Reading Speed	2.0	2.2	1 = 30-60 seconds 2 = 1-2 minutes 3 = 3-5 minutes 4 = Over 5 minutes	Yes	Short alerts were read more quickly than long alerts
Ease of Reading	2.3	2.4	1 = Very Easy 2 = Easy 3 = Neither easy nor hard 4 = Hard 5 = Very Hard	No	Short and long alerts were equally easy to read
Eye fatigue	1.3	1.3	1 = Not at all 2 = Little 3 = Very	No	Short and long alerts were equally fatiguing
Ease of Comprehension	4.2	4.1	1 = None 2 = Little 3 = Half 4 = Most 5 = All	No	Short and long alerts were equally understandable
Clarity	3.8	3.8	1 = Very unclear	No	Short and long texts were

73

	SHORT	LONG	Scale	Significantly different at p<.05	Summary of finding
			2 = Unclear 3 = Neither clear nor unclear 4 = Clear 5 = Very clear		equally clear
Memory Score	76%	77%	Percentage of correct answers	No	Participants remembered equal numbers of details when reading text in short and long messages

Table 22: Block Text vs. Text with Line Breaks

	Block	Line Breaks	Scale	Significantly different at p<.05	Summary of finding
Reading Speed	2.3	2.0	1 = 30-60 seconds 2 = 1-2 minutes 3 = 3-5 minutes 4 = Over 5 minutes	Yes	Text with line breaks was read more quickly than block text
Ease of Reading	2.6	2.2	1 = Very Easy 2 = Easy 3 = Neither easy nor hard 4 = Hard 5 = Very Hard	Yes	Text with line breaks was read more easily than block text
Eye fatigue	1.4	1.1	1 = Not at all 2 = Little 3 = Very	Yes	Text with line breaks was less fatiguing than block text
Ease of Comprehension	4.0	4.2	1 = None 2 = Little 3 = Half 4 = Most 5 = All	No	Both text types were the same

	Block	Line Breaks	Scale	Significantly different at p<.05	Summary of finding
Clear	3.7	3.8	1 = Very unclear 2 = Unclear 3 = Neither clear nor unclear 4 = Clear 5 = Very clear	No	Both text types were the same
Memory Score	74%	79%	Percentage of correct answers	Yes	Participants remembered more details when reading text with line breaks than text in blocks

Table 23: UPPER CASE vs. Mixed Case

	UPPER	Mixed	Scale	Significantly different at p<.05	Summary of finding
Reading Speed	2.1	2.2	1 = 30-60 seconds 2 = 1-2 minutes 3 = 3-5 minutes 4 = Over 5 minutes	No	Upper Case text and Mixed case text were read at the same speed
Ease of Reading	2.4	2.4	1 = Very Easy 2 = Easy 3 = Neither easy nor hard 4 = Hard 5 = Very Hard	No	Upper and mixed case texts were equally easy to read
Eye fatigue	1.3	1.3	1 = Not at all 2 = Little 3 = Very	No	Upper and mixed case texts were equally fatiguing

	UPPER	Mixed	Scale	Significantly different at p<.05	Summary of finding
Ease of Comprehension	4.0	4.2	1 = None 2 = Little 3 = Half 4 = Most 5 = All	No	Upper and mixed cased texts were equally easy to read
Clarity	3.7	3.8	1 = Very unclear 2 = Unclear 3 = Neither clear nor unclear 4 = Clear 5 = Very clear	No	Upper and mixed case texts were equally clear
Memory Score	77%	77%	Percentage of correct answers	No	Upper and mixed case texts were equally memorable

Table 24: Participants who were not successful in receiving alerts and answered surveys

Question	Yes	Comments
Did you have equipment problems that disallowed you from participating?	70%	Unspecified problem area
Did you ever receive the green beacon light?	60%	Hardware problem indicated
Did you receive truncated messages which did not contain the information for you to fill out the surveys properly?	35%	Software problem indicated
Did you receive garbled messages that disallowed you from filling out the surveys?	30%	Software and coverage problems indicated

Table 25: Participants who successfully received alerts and answered surveys

Question:	Responses on a 1-10 scale (1 = least; 10 = most)
Did you like the notification scheme?	6.9
Did you like the display size?	6.8

Question:	Responses on a 1-10 scale (1 = least; 10 = most)
Did you like the alert look and feel?	6.5
How likely would you be to use this service?	6.2
How likely would you be to purchase a radio caption display if it were under $25?	7.3
How likely would you be to purchase a radio caption display if it were $25-$50?	6.1
How likely would you be to purchase a radio caption display if it were $50-$100?	3.8
How likely would you be to purchase a radio caption display if it were over $100?	2.6

Table 26: Issues Frequently Cited

Alert lights
Look-and-feel of fonts (font size, color, formatting)
System portability
Buffering and scrolling
Screen characteristics
Physical form of the equipment
Accessibility of information
Antenna issues

Table 27: Complication of open-ended comments; each P is a participant

Issue	Specific comments
Alert lights. Participants felt that alert lights needed to be more prominent, brighter and larger.	P1: Provide a strobe light to connect with the NIPPER ONE device. The lights, while bright, were not bright enough across the rooms to get our attention at times of alert. P2: A larger alert light is needed to show there is something coming in.
Look-and-feel of fonts. Participants were interested in using color, size and formatting to enhance their ability to read alerts quickly and accurately. Several commented on being able to individualize text, scrolling speed and background colors.	P1: I would like to see different color for each paragraph or code. Example: Red fonts (what kind of weather disaster); blue fonts: Safe place; Green: location Remaining information with white fonts. I think that the code will save our time due to emergency.

Issue	Specific comments
Use of pictures or icons was also cited.	P3: Larger screen size and different alert formatting, rather than straight-line text, would have made the alerts easier to comprehend. It was difficult to read at the delivery rate, then it was cumbersome to scroll and ensure full text had been read.

P5: Ability to make changes in size, font, color, etc. would be helpful. Words are difficult to see at night without contacts in. Also, older people may have a harder time with small font size. Is there a way to use pictures to communicate (hurricane, rain, snow, etc.).

P6: Larger text and inverted color options |
| Portability. Participants were appreciative of at-home services, but they were also interested in being able to receive alerts from NPR on their phones. Comments were in keeping with on-the-go and on-demand needs. | P1: Why use a stationary radio & tablet? Most cell phones these days are WiFi enabled. Why not just offer an app that will pick up the broadcast alert from NPR and display the text of the warning on my cell phone?

P2: I think this could be a helpful service for the deaf and hard of hearing in bad weather situations. I think it would be nice to even have it on our cell phones because everyone has those now, just a thought.

P3: What if the alert service was also based on texting? Deaf/HOH could sign up at a website to have alerts sent to them, based on their geographical location. If they happened to be traveling for a weekend, they could go to that site and change their settings to include the area they were traveling to, then switch back to their regular geographic settings when they returned home. Also, if the alerts were via phone text, then they would receive the texts even if they were not home, were running errands, etc. The idea of having an alert device like NIPPER ONE and the tablet is GREAT when you're home or if you can hook it up to your bed shaker or strobe light, so I wouldn't want to cast off that method entirely. It's going to take multiple avenues to get alert messages to Deaf/HOH people, just like it takes multiple ways to get it to hearing people |
| Buffering/Scrolling. Many participants felt that scrolling was too slow, and requested more opportunity for buffering so that they could read the alert at their own pace. | P1: It would be nice to be able to save the whole message to a text file before clearing the display. Maybe it would be better to just have the alert flashing until the whole message was downloaded, then display the message. It was very annoying to have the alert flashing and clicking and not really be able to read the message easily until the alert part stopped flashing.

P2: I still have concerns on how I would see multiple overlapping events in my area that often happen.

P3: It was much easier to read the text in color. It would also be helpful to be able to scroll through the text at your own pace. The scrolling was very slow. |
| Screen brightness. Participants felt that the display screen would have been more useful if users could adjust brightness. | P1: The screen is too bright during the night, even with the brightness dimmed. I had to cover it with paper, which defeats the purpose. |

Issue	Specific comments
	P2: The display lights could be brighter
Physical form and equipment. Comments range widely from equipment being too small, too large, awkward and not robust.	P1: It would be better if it could be smaller and not take up so much space and need to be left on all the time. Otherwise, the features were fine. I really liked the flashing light, I couldn't miss that!
	P2: Make sure participants can use whatever equipment they have (iPad, etc.) rather than using, say, an Android. The compatibility was challenging to set up (e.g. location-wise, not to mention software issues).
	P3: Perhaps add the doppler on the tablet?
	P4: The display needs to be larger and readable for easier access.
	P5: The display unit, tablet, needs to have a larger battery as it would only run for a day or two before needing to be recharged. it would be more convenient if the receiver and display were in one unit with a larger capacity battery so the unit would be portable for usage outside the home while visiting or traveling locally.
	P6: Very interesting to use this program but it needs lot of improvements e.g. Bigger screen
	P7: Make the tolerances closer for the stand. The assembly was very tenuous and the tablet frequently fell off. The Nipper box would not stay secure in the bottom part.
Accessibility of information. Participants felt that summary information would be helpful, and that no extraneous or additional information should be broadcast that would detract from the main alerting messages.	P1: May want to think about making message simpler. Some Deaf individuals do not comprehend written English. Shorter sentences that are to the point would benefit them. Some abbreviations I could not figure out.
	P2: It might be helpful to have a brief summary section so you don't have to reread the entire message. For example, the emergency, the area included and the action to be taken. The text was often very wordy and included a lot of numbers. It would be great to have the summary in color to identify it quickly.
	P3: The Deaf Nation would benefit more from the alert if the language was not cluttered with technical terms. The message should be brief concise and to the point. State the emergency, location, action to be taken and time lines to work within. The narrative used by the national weather service is not needed.
Antenna. Participants felt that the antenna was a weak link in the transmission chain, and that a more robust solution was needed.	P1: Need to improve the antenna channeling, messages...too many breaks in between to catch what is being said and then it scrolls over to the next one before finishing what needs to be read.

Table 28: Equipment and procedures to get CAP data onto the RDS

Questions on transmitting equipment	Scale	Percent of responses	Summary of findings	Detailed comments
Did all of the equipment arrive shipped to the correct location and in good working condition?	Yes	95%	All but one station received working equipment.	
To what extent were you made aware of the technical needs of implementation prior to the time you signed up for the project? (Scale: 1= no information received, 3= had a good general idea of what would be needed, to 5=knew exactly what we would have to do.)	1	0%	Most engineers had a good idea of what would be needed.	A concern was the extent to which the engineers were aware in advance about the requirements of the project. In general, those who were the only or chief engineer at the time the station signed up felt they had good or excellent knowledge of the requirements. Others, to whom the project was wholly delegated, often felt they had only a general idea of what would be needed, despite having full responsibility for it.
	2	6%		
	3	47%		
	4	24%		
	5	24%		
Once you had the equipment, how did NPR communicate about the installation requirements and procedures? (1=poor, 3=moderate, 5=excellent)	1	0%	The majority of station personnel felt communication was adequate, with three-quarters giving an "excellent" rating.	Station personnel who gave moderate or good ratings cited lack of detailed written materials, such as manuals, but still appreciated the careful and close telephone guidance given by NPR with the help of our equipment vendor Jump2Go, when needed.
	2	0%		
	3	11%		
	4	18%		
	5	71%		
How hard was the installation? (1 = difficult; 5 = very easy)	1	0%	Station personnel reported having a moderate to easy time with installation.	The largest group, 42% said "moderate." All of the responses that were less than "very easy" mentioned IT as the only challenge. Everyone found the actual equipment easy to install once data were properly flowing from the satellite receiver to the RAE ONE. Several also noted that the IT difficulties were normal and expected, typical of a new equipment installations involving data connections.
	2	0%		
	3	42%		
	4	29%		
	5	29%		

Was the transmitting equipment (RAE 1 and Satellite Receiver) reliable after it was installed and working?	1		The system was very solid once installed. (The only issues were a couple of receiver reboots needed.)	
	2			
	3			
	4	23%		
	5	77%		
How many total man-hours were expended by the station on this project?	< 8	24%	Average = 17.9	This was a difficulty question for radio personnel to answer. Personnel "guesstimated" in some cases. Those who seemed surer tended to be on average approximately 18 hours. IT issues took up the most time, followed by time spent going to transmitter sites.
	8 to 30	59%		
	> 30	17%		
Did the station incur any direct expense as a result of participation in this project?	None	72%	See description below.	In the majority of cases there was no direct cost to the station. Engineers were mostly on salary or contractors with a monthly retainer fee. In one case, a contract engineer was paid on an hourly basis, but said it was less than 10 hours work.
	< $25	22%		
	> $25	6%		

Table 29: The end-user and community experience

Questions	Scale	Percent of responses	Summary of findings	Detailed Comments
Did NIPPER ONE kit arrive shipped to the correct location and in good working condition?	Yes	89%	All but two stations received working equipment in the right place.	
	No	11%		
Would the station participate in a permanent project of this sort or in further testing?	Yes	100%	All want to be part of a permanent or real-use plan.	The answer was clearly "yes!" Any of these stations would participate in further testing, though a few expressed some concerns about whether such tests would involve significant additional effort. Everyone in the survey was quite willing to be a part of a permanent/real-use implementation. Stations are looking forward to this.
How important is this service in your community? (1-Unimportant, 3-Moderate, 5-Important)	1	0%	Many of those ranking the service as important emphasized it as "very." See description below.	Again, agreement was significant, rating this as an important public service. Most mentioned their part of the country as having a particular need because of the prevalence of hurricanes, heavy storms or tornados. Of those who gave it a top rating, many informally went beyond this, describing it as being at the core of the mission of Public Broadcasting.
	2	0%		
	3	11%		
	5	78%		

Table 30: High Bandwidth Alerting Service

Example #1 – High bandwidth alerting service
(group sequence also includes 2 low bandwidth ODAs)

Alerting GS=	9A	3A	9A	2A	9A	0A	9A	11A	9A	0A	9A	2A	9A	0A	9A	3A	9A	0A	9A	2A	9A	0A	9A	13A	9A	0A	9A
Normal GS=	0A	3A	2A	2A	0A	0A	2A	11A	0A	0A	2A	2A	0A	0A	2A	3A	0A	0A	2A	2A	0A	0A	2A	13A	0A	0A	2A
AID Seq=	9A,11A,9A,13A

				Count / Bandwidth (Alerting Active)			Count / Bandwidth (Alerting Idle)		
	Measured transmit time			0A	6	21.4%	PS	13	46.4%	PS
				2A	4	14.3%	RT	11	39.3%	RT
	128 char	512 char		3A	2	7.1%	AID	2	7.1%	AID
Preamble	10.5	10.5		9A	14	50.0%	Alerting	0	0.0%	Alerting
Geocodes	6.1	6.1		11A	1	3.6%	iTunes	1	3.6%	iTunes
Text + EOT	20.5	80.6		13A	1	3.6%	RT+	1	3.6%	RT+
Total	37.1	Sec	97.2	Sec	2.4522	28	100.0%		28	100.0%

	Max length message tx time	
	4032 char	
	10.5	Preamble
	6.1	Geocodes
	634.8	Text + EOT
	651.4	Sec	Total

Table 31: Alerting and TMC Combined

Example #2 – Alerting and TMC combined
(group sequence also includes 2 low bandwidth ODAs)

Alerting	8A 0A 3A 9A		8A 2A 13A 9A	8A 0A 2A 9A	8A 0A 3A 9A		8A 2A 11A 9A	8A 0A 3A 9A	8A 0A 2A
Normal GS=	8A 0A 3A 0A		8A 2A 13A 2A	8A 0A 2A 0A	8A 0A 3A 2A		8A 2A 11A 0A	8A 0A 3A 2A	8A 0A 2A
AID Seq=	8A,9A,11A,8A,9A,13A								

					Count / Bandwidth (Alerting Active)			Count / Bandwidth (Alerting Idle)		
				0A	5	17.9%	PS	9	32.1%	PS
	Measured transmit time			2A	4	14.3%	RT	7	25.0%	RT
				3A	3	10.7%	AID	3	10.7%	AID
	128		512	8A	7	25.0%	TMC	7	25.0%	TMC
Preamble	10.6		10.6	9A	7	25.0%	Alerting	0	0.0%	Alerting
Geocodes	10.9		10.9	11A	1	3.6%	BTC	1	3.6%	BTC
Text + EOT	39.1		156.1	13A	1	3.6%	RT+	1	3.6%	RT+
Total	60.6	Sec	177.6 Sec	2.4522	28	100.0%		28	100.0%	

Table 32: Dynamic Group Order with Alerting and TMC

Example #3 – Dynamic group order with Alerting and TMC
(2 low bandwidth ODAs stop during alert transmission)

Alerting	8A 0A 3A 9A		8A 2A 9A 9A	8A 0A 2A 9A	8A 0A 3A 9A		8A 2A 9A 9A	8A 0A 9A 9A	8A 0A 2A
Normal GS=	8A 0A 3A 0A		8A 2A 13A 2A	8A 0A 2A 0A	8A 0A 3A 2A		8A 2A 11A 0A	8A 0A 3A 2A	8A 0A 2A
AID Seq=	8A,9A,11A,8A,9A,13A								

		Count / Bandwidth (Alerting Active)			Count / Bandwidth (Alerting Idle)	
	0A	5	17.9%	PS	9	32.1% PS

Example #3 – Dynamic group order with Alerting and TMC
(2 low bandwidth ODAs stop during alert transmission)

Measured transmit time									
			2A	4	14.3%	RT	7	25.0%	RT
			3A	2	7.1%	AID	3	10.7%	AID
128		512	8A	7	25.0%	TMC	7	25.0%	TMC
Preamble	10.6	10.6	9A		1035.7%	Alerting	0	0.0%	Alerting
Geocodes	8.3	8.3	11A	0	0.0%	BTC	1	3.6%	BTC
Text + EOT	27.6	111.2	13A	0	0.0%	RT+	1	3.6%	RT+
Total	46.5 Sec	130.1 Sec	2.4522	28	100.0%		28	100.0%	

Table 33: Low Bandwidth Alerting with TMC

Example #4 – Low bandwidth Alerting with TMC
(group sequence also includes 2 low bandwidth ODAs)

Alerting GS=	8A 0A 3A 9A	8A 2A 13A 0A	8A 9A 2A 0A	8A 0A 3A 9A	8A 2A 11A 0A	8A 9A 3A 2A	8A 0A 2A 0A
Normal GS=	8A 0A 3A 0A	8A 2A 13A 0A	8A 0A 2A 0A	8A 0A 3A 2A	8A 2A 11A 0A	8A 0A 3A 2A	8A 0A 2A 0A
AID Seq=	8A,9A,11A,8A,9A,13A						

				Count / Bandwidth (Alerting Active)			Count / Bandwidth (Alerting Idle)		
			0A	7	25.0%	PS	10	35.7%	PS
	Measured transmit time		2A	5	17.9%	RT	6	21.4%	RT
			3A	3	10.7%	AID	3	10.7%	AID
	128 char	512 char	8A	7	25.0%	TMC	7	25.0%	TMC
Preamble	10.6	10.6	9A	4	14.3%	Alerting	0	0.0%	Alerting
Geocodes	17.9	17.9	11A	1	3.6%	BTC	1	3.6%	BTC
Text + EOT	67.6	268.8	13A	1	3.6%	RT+	1	3.6%	RT+
Total	96.1 Sec	297.3 Sec	2.4522	28	100.0%		28	100.0%	

Note: This scenario is illustrative of low bandwidth performance and is not recommended for use in Alerting Services due to the long latency in getting important information to the user.

Table 34: RAE ONE Firmware Revisions

RAE ONE Firmware Version	Release Date	Description
RAE-ONE-7	2/10/2014	Change radiotext with the TEXT= command. The real group sequencer is running now and the 3A beacon is included in the sequence. The first two tabs of the Web interface are partially working.
RAE-ONE-8	2/13/2014	The "service" tab is almost complete. A button was added to translate call sign letters to RDS Standard PI code.
RAE-ONE-8c	2/18/2014	Configuration settings can be saved (either from the Web interface or from the console port/telnet connection). The task to monitor the satellite receiver is running and will parse incoming CAP XML message.
RAE-ONE-8e	2/21/2014	The attached update should parse the incoming CAP XML and (assuming a matching FIPS code) should transmit that data in the ODA. The UDP terminal app can be used to view debug strings. There are debug messages displayed when the CAP XML is parsed as well as debug messages for each stage of the ODA transmission (preamble, geocode, text segments, EOT). The front panel group status (9A) indicates the bandwidth used and the increase as an alert is transmitting, etc. The ".N" indicates the group variant being transmitted. The text-splitting function is not very good. (It literally follows the line breaks within the XML to generate the ODA text segments.) This will be improved in the next update so the ODA text segments are more efficiently filled. Incoming messages of type "alert" and "update" are both transmitted as "new" alerts. Proper support for the new/update/cancel functionality will be added in the next update. Currently, alerts are transmitted only once. The next update will include the option to retransmit the active alert periodically using its sent and expired time stamps. (The Web setup has two parameters that are associated with retransmission: a delay between each retransmission and a maximum retransmit count.)
RAE-ONE-8f	2/21/2014	The previous version had a bug (a resource leak) where after sending several alerts out over the ODA, incoming XML continued to be parsed but no further alerts were transmitted over RDS. The attached version was designed to fix this.

RAE ONE Firmware Version	Release Date	Description
RAE-ONE-8h	2/24/2014	The attached version adds a mostly functional "status" tab to the Web interface. (The state of the alerting process is displayed as well as a bar chart for RDS group usage. The generic "RDS" section at the bottom is not yet functional.) Note that the syslog (debug message) check boxes are now active so these must be checked to enable debug message. (There are two check boxes on the "boot config" page and three on the "service config" page. The "verbose" check box controls the level of detail in the debug messages.) An update is available for the TCP/IP library specific to the 54415 CPU being used. The update claims to fix an issue that can cause the TCP stack to stop responding when opening a connection to a device that is not in the listening state. This "8h" update is compiled against this new TCP library in the off chance it could explain the crash when switching configuration between data sources.
RAE-ONE-8i	2/25/2014	The previous version had a minor bug related to the status tab. The bug was in the Java script that updates the bar chart and resulted in the chart being unpainted for a few seconds when the status tab is first opened. The callback from the first ajax request was set incorrectly and so the first paint request got lost. Eventually the error handler kicks in and the chart starts updating. This is now fixed. Ajax is a Web development technique used to create interactive Web applications. A "peak reset" feature is added. Clicking anywhere on the bar chart resets the peak values to zero. Eventually, it may be changed allowing individual bars can be reset. The biggest change in this version is that the diagnostic tab of the Web interface is now present. From the diagnostics tab, the following actions are possible: run basic network connectivity tests, ping an IP address, perform a DNS lookup, send an HTTP request and view the headers returned and view some operating system diagnostic counters. Also, the diagnostics tab displays some hardware values (power supply voltages and ambient operating temperature as sensed by the RTC chip). Finally, some General Purpose Input/Output (GPIO) pin states are displayed (contact closure inputs on the auxiliary port, bypass switch state, etc.).
RAE-ONE-8j	2/25/2014	The attached version is functionally equivalent to the 8i version sent earlier today, i.e., it adds the diagnostic tab to the Web interface. A bug in the RDS process is discovered: rarely a write to a file handle can fail and that state was not correctly handled. (Essentially, if a hardware peripheral is busy, a "write all" of 15 bytes might only be able to process the first 5 at that particular instant and a delay and retry is required for the remainder.) The result of this bug is that one RDS group in a long sequence occasionally may not be transmitted. This is now fixed.
RAE-ONE-8k	2/26/2014	Attached is an additional bug fix version, again for the RDS sequencer. On cold start (from power off) the FMB10 initialization sequence sometimes failed. (Whereas on a soft restart it is always successful.) This is now fixed. No other visible changes from the

RAE ONE Firmware Version	Release Date	Description
		previous version.
RAE-ONE-8m	3/4/2014	Added a write after the socket connects (to satellite receiver). An error code may appear in the debug log.
RAE-ONE-8n	3/4/2014	The attached version fixes the FIPS code matching AND adds wildcard matching. (A checkbox enables wildcard matching. Wildcard match works for "state with any county" where the last 3 digits are zero as well as for "global" alerts with an all zero code. Entering a code for the global match is not required.)
RAE-ONE-8o	3/5/2014	The attached version has an improved text parser to more efficiently fill the transmitted text segments.
RAE-ONE-8p	3/7/2014	I was calling a function with parameters in the wrong order (the "aid code" and "message bits" parameters were swapped). Fixed in the attached version. I will look at the captures and see if I spot any other differences.
RAE-ONE-8q	3/9/2014	The attached update adds: 1. RDS section of "live status" tab is now functional. (Displays current state of RT, PS, etc.) The Clock Time section includes a button to let you switch between the raw RDS form (MJD, UTC time, local offset) and the decoded form (YMD and local time). 2. Group 4A (Clock Time) is now transmitted on the minute transition. Be sure you have the "CT Local Offset" on the service configuration tab set to match your local time zone. 3. RT+ ODA is also being transmitted and there is a new command (RTP) to markup a radio text message. (I will add a method to do RT+ markup from the service config tab in a future version.)
RAE-ONE-8r	3/17/2014	The attached firmware update listens for these new heartbeat messages. Related to this, the "alert" and "service" LEDs on the front panel are now functional. The "service" LED currently has these states: 1. off = "CAPMGR" process is not running (IP address or port not configured on service tab.) 2. red = unable to open connection to sat receiver 3. yellow = connection open but no data yet or no data for at least 11 minutes 4. green = connected and messages being processed 5. blinks each time a new message is received The "alert" LED currently has these states:

RAE ONE Firmware Version	Release Date	Description
		1. off = alerting ODA is idle
		2. red = ODA is transmitting an alert
		3. blinks as each section of an alert is completed (wakeup, geocodes, each text segment)
		Two new items on the "Service Config" tab related to the system heartbeat messages:
		1. "Sync to INSO TZ" selects a time zone entry within the heartbeat message. If an entry for the selected time zone is found AND the indicated offset differs from the current RDS CT local offset, the CT local offset is automatically adjusted to match. As such, the CT local offset broadcast over RDS will always be accurate.
		2. "Sync to INSO TC" enables synchronization of the local clock with the UTC value contained in the heartbeat message. Synchronization occurs at the first heartbeat message received in a new hour. (That is, local clock is adjusted once per hour.)
		Normally both of these items should be enabled.
RAE-ONE-8s	3/20/2014	Attached version removes the two unnecessary time zones to match the updated INSO message.
		No other changes in this version.
RAE-ONE-091	3/27/2014	This was the initial version used in the early station deployments. It was compatible with NIPPER ONE version 1.11 only.
RAE-ONE-092	4/5/2014	This was intended to correct TLB to ODA status, but was scrapped and replaced with the next version because it was incompatible with the "older" receiver firmware NIPPER ONE version 1.11.
RAE-ONE-093	5/5/2014	The attached version adds a checkbox to the service configuration tab allowing the state of the TLB flag to be changed. The state of this checkbox directly corresponds to the state of the TLB. (That is, if the checkbox is set, the TLB is also set.)
		The default state is unchecked. This should be the correct state for use with "older" receiver firmware.[NIPPER ONE version 1.11 which was mistakenly shipped to the field-test participants]
		The checkbox has since been checked at most stations for use with "newer" receiver firmware NIPPER ONE version 1.20, though receivers with the "older" version will also work, using an upgraded tablet app of ver. 0.9.23 or higher having the "line feeds" option has been checked.
RAE-ONE-094	5/6/2014	I have attached new RAE ONE firmware (v0.9.4) that includes both a bug fix and an improvement for FIPS wildcards. (The national

RAE ONE Firmware Version	Release Date	Description
		level matching was correct but the state level was too permissive.)
		As of this version the state level wildcard logic can be used in two ways:
		First case: if the CAP message contains a state wildcard (example, "051000") and the RAE ONE configuration includes any FIPS code for that state (example, "051179") a match occurs and the alert is transmitted.
		Second case: if the RAE ONE configuration includes a state level wildcard (example, "051000") and the CAP message contains any FIPS code for that state (example, "051179") a match occurs and the alert is transmitted.
		A national level CAP message (all zero FIPS code) is always transmitted if wildcard matching is enabled.
		This version should be deployed while verifying that the FIPS wildcard function is enabled for each encoder.
RAE-ONE-095	5/13/2014	The attached RAE ONE firmware update (v0.9.5) adds UECP output for FMB-80
		Summary of updates:
		"Live Status" tab includes "Service State" (equivalent to front panel service LED)
		"Live Status" tab includes "External RDS" status. Left indicator is AID (beacon) state, right indicator is ODA state. Green = FMB80 responds with ok. Yellow = FMB80 responds with error code. Red = FMB80 does not respond.
		Note that when running against an external RDS generator the "alert" section of the status tab is valid. (Indicates live state of alerting service) However, the group usage bar graph and RDS section continues to show status of the *internal* RDS generator.
		"Service Config" tab includes new settings for connecting to an external RDS generator:
		"Encoder Type" switched between internal modulator and external FMB80
		"Encoder Port" set to the UDP port for the FMB80 (default 5250)
		"Encoder Address" set to the IP address of the FMB80
		"Encoder EID" set to the UECP encoder ID of the FMB80 (typically 0)
		"Encoder SID" set to the UECP site ID of the FMB80 (typically 0)
		"Encoder AGC" set to the count of 9A (alert) groups in the FMB80 group sequence

RAE ONE Firmware Version	Release Date	Description
		"Encoder TGC" set to the total number of groups in the FMB80 group sequence
		The AGC and TGC parameters are critical to successful transmission of alerts! They must accurately reflect the group sequence configuration of the FMB80. This is because there is no way to query the state of an ODA transmit buffer. Instead, a calculation based on group sequence must be made to estimate worst case transmit time for each buffer to be transmitted. For this reason it is also important that the 9A (alerting) groups be as uniformly distributed within the overall group sequence as practical.
		The FMB80 must be configured with a group sequence agreed upon by GSS that includes 3A and 9A groups. (GS, EXTGS and SEQ3A commands)
		A UDP port must be configured to receive UECP commands. The FMB80 has 5 available slots for UECP input. Configuration (assuming slot 3) looks like this:
		UDP3.PROTOCOL=UECP2
		UDP3.PORT=5250
		UDP3.MODE=BI
		UDP3.USERLEVEL=SUPER
		To check configuration use the command "?UDP"
		To check that UECP commands are received "?UECP"
		To check that ODA is active "?RDS.ODA"
RAE-ONE-096	5/23/2014	The attached RAE ONE firmware update (v0.9.6) adds a FIFO for incoming alerts as well as basic support for UECP input ("now playing" radio text and RT+)
		The input FIFO is 8 entry allowing up to 7 alerts to wait in a transmit pending state.
		The input port for UECP is configured at the bottom of the service config tab. To feed the RAE ONE"now playing" data from a JumpGate, configure the JumpGate RDS output as "UECP / UDP / RDi-20" with a matching port number that is handshake enabled.
RAE-ONE-097	6/3/2014	The attached firmware update adds an option (to the boot config tab) that allows forcing the Ethernet link speed (100M or 10M) and the duplex (full or half). The normal operation is to auto negotiate the link type with the switch.

RAE ONE Firmware Version	Release Date	Description
		Forcing the Ethernet port to a specific link state may resolve an issue where the encoder is not recognized by a specific brand or model of Ethernet switch. (Generally this occurs if the link auto negotiation fails.)
RAE-ONE-098	6/16/2014	This version added the capability to use the RAE ONE as a CAP-MGR driving a 2WCom RDS encoder, using the serial port for UECP.
RAE-ONE-099	7/10/2014	In this version, the capability for the RAE ONE to accept unidirectional UDP was added.
RAE-ONE-0910	7/31/2014	An additional option was added allowing the RAE ONE to use multicast UDP data as its input.

Appendix E: Modernized Emergency Alerting ODA Schema

Alerting ODA Introduction

Specified herein is a system for the transmission of *Emergency Alerts* in the context of a VHF/FM terrestrial radio broadcast. The system is realized in the form of an RDS ODA and is proposed as a modernization of the "Annex Q" EAS ODA originally published in the RBDS 1998 standard. Specific goals of this modernization effort include:

- Adopting modern conventions for the transmission of an ODA. Specifically, the 3A Beacon shall be transmitted at a constant rate and use of its message bits limited to static configuration data. All dynamic data is transmitted within the application group. Group 9A is commonly used for emergency alerting, but this ODA may be transmitted using any available mode 1.1 application group. Since RDS bandwidth is limited, no data is transmitted in the application group when the alerting system is idle.
- Providing a mechanism such that a text message associated with an emergency alert can be transmitted within the alerting ODA itself.
- Providing a mechanism such that non-generic data types (such as geo codes) can be redefined for logical geographic regions. For example, the United States utilizes several types of geo codes for emergency alerts including FIPS codes for the identification of state and county. These state and county FIPS codes are not useful outside the United States.
- For the United States region, adopting new features of the IPAWS / CAP system while retaining the ability to transmit SAME data as specified in the original "Annex Q" EAS ODA.

Technical Overview

Central to any ODA is the RDS group type 3A, the application identification for open data also referred to as the AID Group or 3A Beacon. This group announces the transmission of a specific ODA (by Application ID number), includes 16 message bits for use by the ODA (block C) and indicates the Application Group Type (if any) used for transmission of additional ODA data. The alerting ODA is transmitted in mode 1.1, meaning a broadcaster must allocate an unused "type A" group (typically 9A) for transmission of emergency alerts. For broadcasts where emergency alerting is the only ODA running, the minimum recommended transmission rate is 24 (twenty-four) 3A Beacons per minute. For broadcasts where multiple ODAs are running, the minimum transmission rate remains 24 (twenty-four) 3A Beacons per minute with the Alerting Beacon present a minimum of once every five seconds within the 3A sequence.

*Figure 13: Bit-level definition for Alerting ODA 3A Beacon*
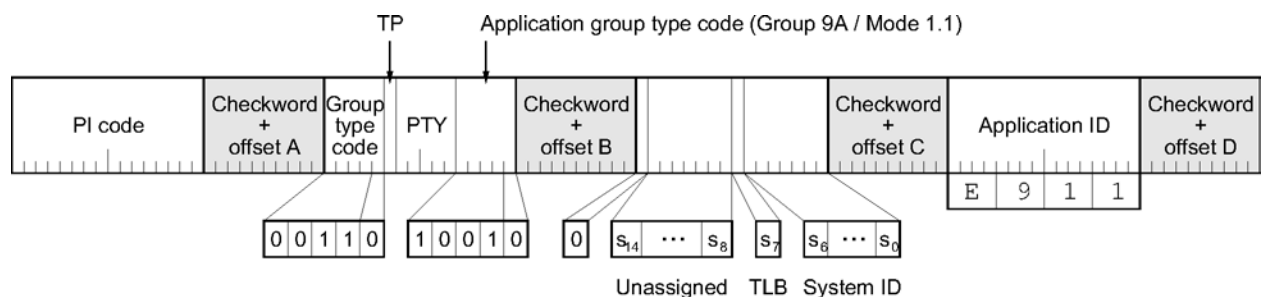
The message bits of the 3A Beacon convey the global configuration of the alerting ODA to the receiver. The System ID (bits s6 to s0) identifies a particular variant of the alerting ODA. (A System ID of 1 indicates the variant with geo codes appropriate to the United States.) When set, the Text Location Bit (TLB) (bit s7) indicates that an alert related text is transmitted within the ODA. When cleared, the TLB indicates that alert text is transmitted using RT or eRT. The unassigned message bits (s14 to s7) are available for definition by variants of the alerting ODA.

The bulk of data transmitted by the alerting ODA occurs within the application group. The recommended transmission sequence can be broken into four parts: 1. receiver wake-up preamble, 2. rapid geo-code sequence, 3. text interleave sequence, and 4. End Of Transmission (EOT) marker. The wake-up preamble is transmitted for 10 seconds prior to the start of rapid geo-code sequence. Data included in the wake-up preamble allows the receiver to

make an initial determination as to whether the alert is meaningful to a particular user, and it also allows time for battery-powered receivers to wake from a low-power state prior to transmission of the geo codes. The rapid geo-code sequence indicates the geographic area or areas targeted by the alert.
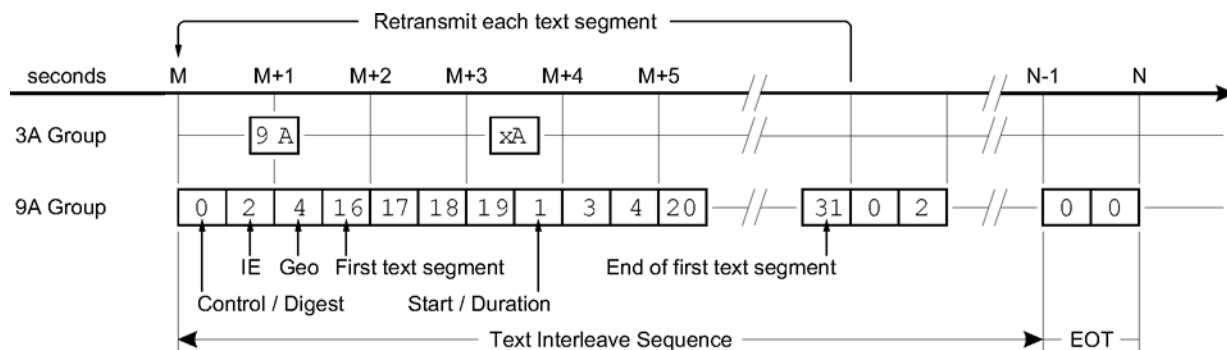
The text interleave sequence transmits the complete set of alert data with priority given to the text portion of the alert. The EOT marker terminates the alert sequence. The minimum recommended transmission rate is two alerting application groups per second. The RDS group sequence is typically configured to replace the alerting application group with some other group type when the alerting ODA is idle. For example, the 9A groups become 2A or 0A groups.

Figure 14: Typical Wakeup Preamble and Geo Code Sequence
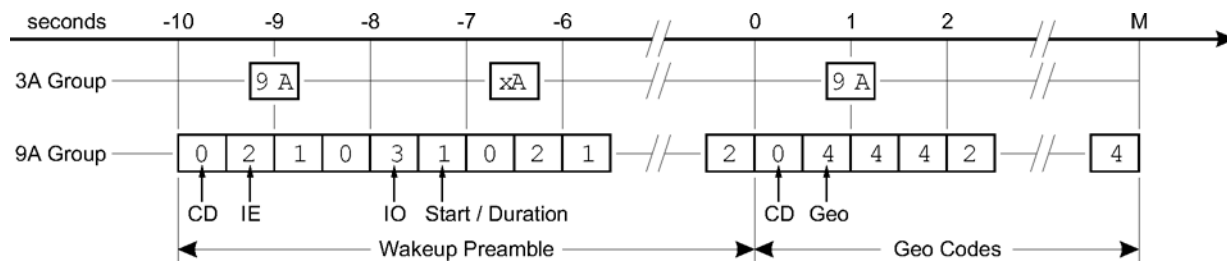
The receiver wake-up preamble sequence must contain address 0 and 2 known as Alert Control / Digest and Alert Identity Even, respectively. The preamble may also contain address 1, *Alert Start / Duration and address 3, Alert Identity Odd.* The rapid geo-code sequence gives priority to the actual geo-code addresses—4, 5 and 6—but should also contain address 0 and 2. Each geo code should be transmitted at least twice as part of this sequence.

Figure 15: Typical Text Interleave Sequence and EOT

The text interleave sequence includes the same data as the wake-up preamble and geo-code sequence along with any text associated with the alert. Priority is given to transmission of the text segments during this sequence. When alert text is transmitted within the ODA, each text segment should be retransmitted at least twice before advancing to the next segment. Address 2 includes a total count of text segments associated with the alert as well as an indication as to the text segment currently being transmitted. When transmission of the alert is complete, an EOT marker is sent, and the application group goes silent.

Alerting ODA Application Group

Figure 16: Application Group Overview
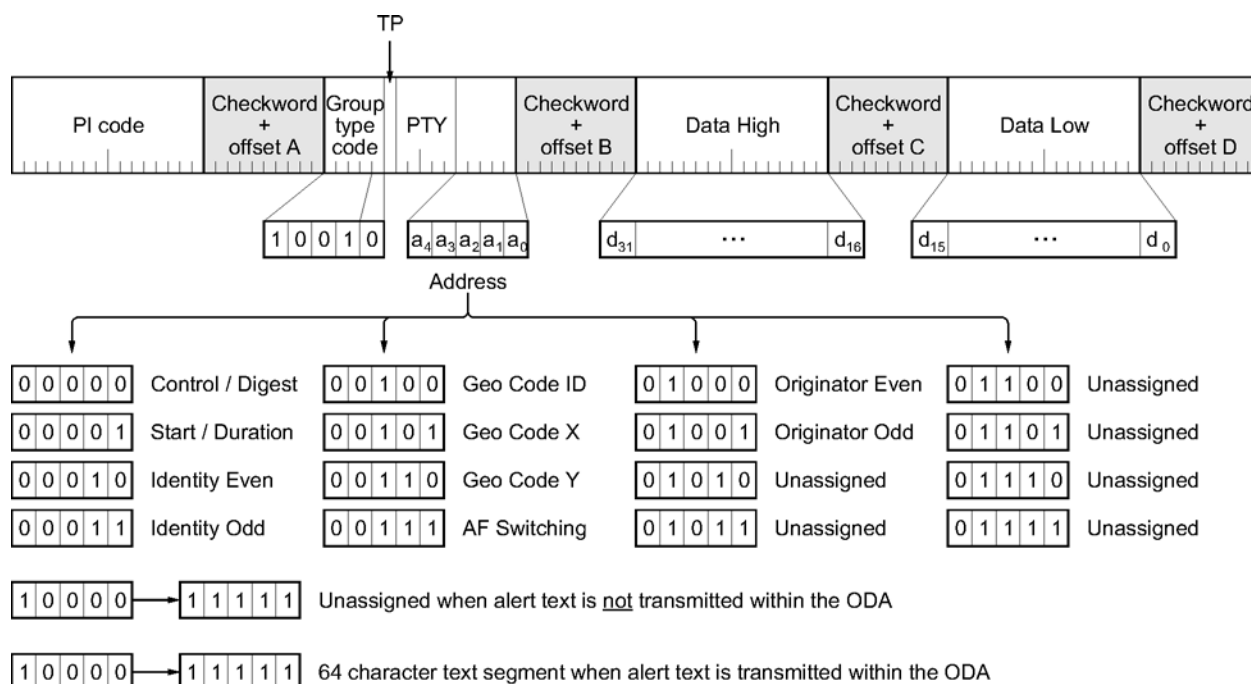
Alert data is transmitted using a "type A" application group, also referred to as the ODA Group, as depicted in Figure 16: Application Group Overview. The "Address" code (bits a4 to a0) indicates the specific type of alerting data carried by an instance of the ODA Group. Each address code is associated with 32-bits of data split between two 16-bit words: Data High (bits d31 to d16) and Data Low (bits d15 to d0.) The unassigned address codes are available for custom use by variants of the Alerting ODA.

Alert Control / Digest (address 0)

Figure 17: Bit-level definition for Alert Control / Digest
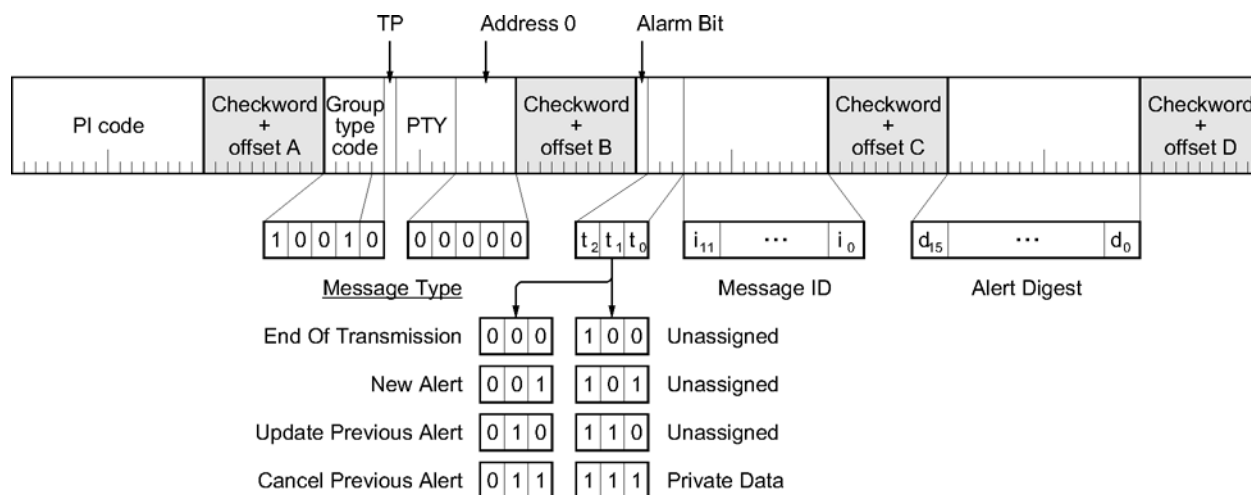
With the exception of a matching geo code, the "Alert Control / Digest" contains all of the data required by a receiver to determine applicability of an alert to the end user. The Control / Digest <u>must</u> be included as part of every alert during the wakeup preamble, rapid geo-code and text interleave sequences.

The "Alarm Bit" arms the user-wakeup feature of a receiver. If the "Alarm Bit" is set AND a geo code matching the receiver location is found AND the receiver is processing the alert for the first time, then the user-wakeup feature is activated and the alert text is displayed as it is received. If the "Alarm Bit" is <u>not</u> set AND a geo code matching the receiver location is found, then the alert text is displayed as it is received, but the wakeup feature is <u>not</u> activated.

The "Message Type" (bits t2 to t0) specifies the type of message being transmitted. "New Alert" indicates transmission of a newly issued alert message. "Update Previous" indicates transmission of an update to a previously issued alert, and "Cancel Previous" explicitly cancels a previously issued alert prior to the specified event duration. "Private Data" is used for any message that should not be directly displayed to the end user, for example, to wake a receiver and transmit alternate frequency data independent of an actual alert. The three unassigned message types are available for custom use by variants of the Alerting ODA.

The "Message ID" (bits i11 to i0) is a temporally unique identifier used in combination with the "Alert Digest" code to enable the alert update / cancel functionality. That is to say, each "New Alert" includes a Message ID that is considered unique for the life of that alert. The receiver keeps a table of known Message IDs and the associated Alert Digest and event duration. When the event duration has elapsed, the receiver automatically removes that Message ID from its table. For an Update, the receiver updates its table with the new event duration if it has changed and displays the updated alert to the user. For a Cancel, the receiver removes the indicated ID from its table of known Message IDs and informs the user that the alert has been canceled.

The "Alert Digest" (bits d15 to d0) is a numeric code that uniquely identifies the content of an alert. The transmit process must guarantee that for each active Message ID, if the content of that alert changes (by way of an update) the Alert Digest code must also change to a value unique to that update. The receiver utilizes the combination of Message ID and Alert Digest to ignore any retransmission of alerts or alert updates that it has already processed. Specifically, a retransmission is detected when an alert is received where the Message ID is already known to the receiver and the Alert Digest associated with that Message ID has not changed.

Alert Start / Duration (Address 1)

Figure 18: Bit-level definition for Alert Start / Duration
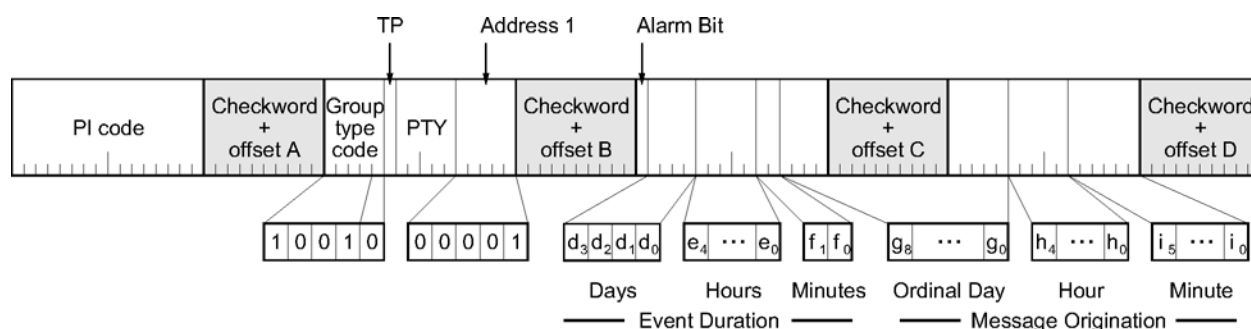
The "Message Origination" indicates the start of this alert as UTC Ordinal Day, Hour and Minute. A receiver may translate UTC to local time using the local offset information transmitted in the 4A Clock Group. The "Event Duration" indicates the expected duration of this event in Days, Hours and 15-Minute intervals. The Start / Duration address must be transmitted in the text interleave sequence and is also recommended in the wakeup preamble.

96

Alert Identity Even (Address 2)

Figure 19: Bit-level definition for Alert Identity Even
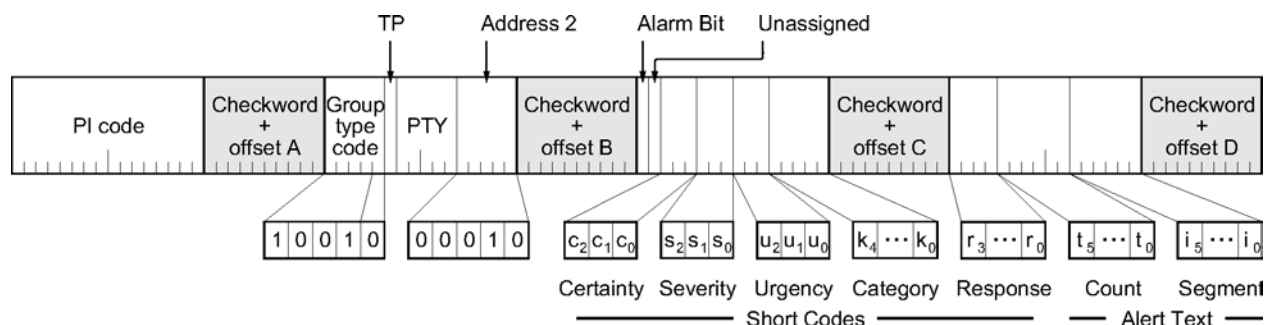
"Alert Identity Even" is the first of a pair of addresses containing key information related to the alert. Identity Even <u>must</u> be included as part of every alert during the wakeup preamble and the text interleave sequences.

The "Segment" (bits i5 to i0) indicates the text segment currently being transmitted where the "Count" (bits t5 to t0) indicates the total number of text segments associated with the alert. A segment code of 0 indicates that no text is currently being transmitted where a count of 0 indicates that there is no text associated with the alert.

The "Certainty" code (bits c2 to c0), "Severity" code (bits s2 to s0), and "Urgency" code (bits u2 to u0) indicates the relative certainty, severity and urgency of the alert as defined in the following table:

Table 35: Relative Certainty, Severity and Urgency

b2	b1	b0	ID	Certainty	Severity	Urgency
0	0	0	0	Not Set	Not Set	Not Set
0	0	1	1	Observed	Extreme	Immediate
0	1	0	2	Likely	Severe	Expected
0	1	1	3	Possible	Moderate	Future
1	0	0	4	Unlikely	Minor	Past
1	0	1	5	Unassigned	Unassigned	Unassigned
1	1	0	6	Unassigned	Unassigned	Unassigned
1	1	1	7	Unknown	Unknown	Unknown

The "Response" code (bits r3 to r0) indicates the appropriate response (if any) to this alert as defined in the following table:

Table 36: Response Codes

r3	r2	r1	r0	ID	Response
0	0	0	0	0	Not Set
0	0	0	1	1	Shelter
0	0	1	0	2	Evacuate
0	0	1	1	3	Prepare
0	1	0	0	4	Execute
0	1	0	1	5	Avoid
0	1	1	0	6	Monitor

| r3	r2	r1	r0	ID	Response
0	1	1	1	7	Assess
1	0	0	0	8	All Clear
1	0	0	1	9	Unassigned
				...	...
1	1	1	0	14	Unassigned
1	1	1	1	15	None

The "Category" code (bits k4 to k0) indicates the broad class of events this alert belongs to as defined in the following table:

Table 37: Category Codes

k4	k3	k2	k1	k0	ID	Category
0	0	0	0	0	0	Not Set
0	0	0	0	1	1	Geophysical
0	0	0	1	0	2	Meteorological
0	0	0	1	1	3	Safety
0	0	1	0	0	4	Security
0	0	1	0	1	5	Rescue
0	0	1	1	0	6	Fire
0	0	1	1	1	7	Health
0	1	0	0	0	8	Environmental
0	1	0	0	1	9	Transportation
0	1	0	1	0	10	Infrastructure
0	1	0	1	1	11	CBRNE
0	1	1	0	0	12	Unassigned
					...	...
1	1	1	1	0	30	Unassigned
1	1	1	1	1	31	Other

Alert Identity Odd (Address 3)

Figure 20: Bit-level definition for Alert Identity Odd
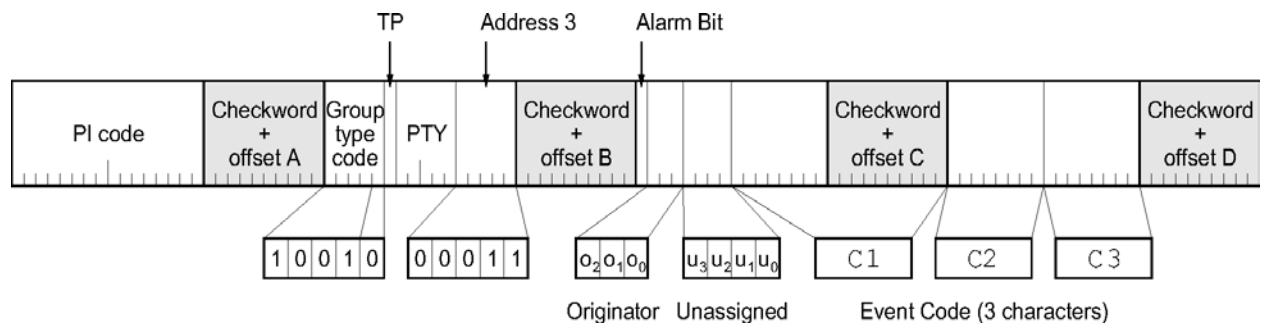
"Alert Identity Odd" is the second of a pair of addresses containing key information related to an alert. Identity Odd is optional, but is normally transmitted as part of the wakeup preamble and text interleave sequences. Unassigned bits (u_3 to u_0) are available for custom use by variants of the Alerting ODA.

The "Originator" code (bits o2 to o0) indicates the organization responsible for issuing the alert. The originator codes may be customized for each variant of the Alerting ODA. For System ID 1 (United States) the originating codes are defined in Table 38.

Table 38: Originator Codes

| o2	o1	o0	ID	ORG Code	Description
0	0	0	0	EAS	Participant (Broadcast level test message)
0	0	1	1	CIV	Civil Authorities (Governor / State / Local)
0	1	0	2	WXR	National Weather Service
0	1	1	3	PEP	Primary Entry Point Station (President / National)
1	0	0	4	Unassigned	
1	0	1	5	Unassigned	
1	1	0	6	Unassigned	
1	1	1	7	Unassigned	

The "Event Code" (C1, C2, and C3) is a three-character code classifying the type of event associated with an alert. C1 is the left most character and C3 is the right most character. The table of event codes may be customized by each variant of the Alerting ODA. For System ID 1 (United States), the IPAWS-OPEN and SAME specifications define the following event codes:

Table 39: Event Codes

| Code	Description	Code	Description
ADR	Administrative Message	LAE	Local Area Emergency
AVA	Avalanche Watch	LEW	Law Enforcement Warning
AVW	Avalanche Warning	NAT	National Audible Test
BZW	Blizzard Warning	NIC	National Information Center
CAE	Child Abduction Emergency	NMN	Network Message Notification
CDW	Civil Danger Warning	NPT	National Periodic Test
CEM	Civil Emergency Message	NUW	Nuclear Power Plant Warning
CFA	Coastal Flood Watch	RHW	Radiological Hazard Warning
CFW	Coastal Flood Warning	RMT	Required Monthly Test
DMO	Demonstration Message	RWT	Required Weekly Test
DSW	Dust Storm Warning	SMW	Special Marine Warning
EAN	Emergency Action Notification	SPW	Shelter In-place Warning
EQW	Earthquake Warning	SVA	Severe Thunderstorm Watch
EVI	Evacuation Immediate	SVR	Severe Thunderstorm Warning
FFA	Flash Flood Watch	TOA	Tornado Watch
FFW	Flash Flood Warning	TOE	911 Telephone Outage Emergency
FLA	Flood Watch	TOR	Tornado Warning
FLW	Flood Warning	TRA	Tropical Storm Watch
FRW	Fire Warning	TRW	Tropical Storm Warning
HMW	Hazardous Materials Warning	TSA	Tsunami Watch
HUA	Hurricane Watch	TSW	Tsunami Warning
HUW	Hurricane Warning	VOW	Volcano Warning
HWW	High Wind Warning	WSW	Winter Storm Watch

Alert Geo Codes (Address 4 – 6)

Figure 21: Bit-level definition for alerting geo codes
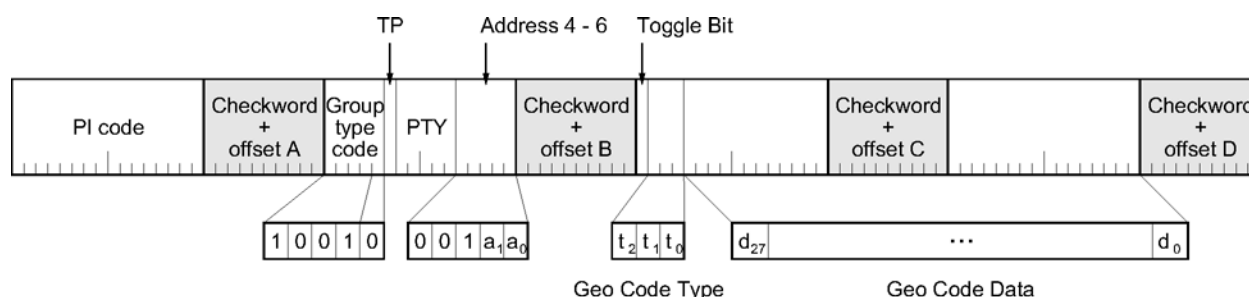
Three addresses are reserved for the transmission of the geo codes associated with an alert message. Each address includes a "Toggle Bit," 3-bits (t_2 to t_0) indicating the type of geo code and 28-bits (d_{27} to d_0) of data specific to that geo-code type. All geo-codes types must transmit address 4 (the Geo Code ID). When 28-bits of data cannot fully define a geo code, address 5 and 6 (geo code X and Y) are used in sequence for transmission of additional data. The "Toggle Bit" changes state for each instance of a geo code. For codes that make use of address 5 and 6, the state of the toggle bit in address 5 and 6 should match that of address 4. Geo-code types may be customized for each variant of the Alerting ODA. (See section 2.1.x for geo-code types defined by System ID 1 / United States.)

Alert AF / ON Switching (Address 7)

Figure 22: Bit-level definition for Alerting AF / ON Switching
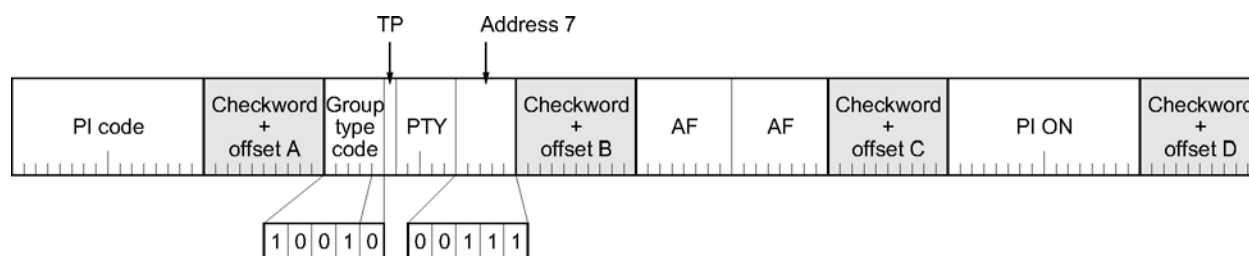
"Alert AF / ON Switching" allows for transmission of an Alternate Frequency list specific to emergency alerting. The list is transmitted using the method defined in RDS group 14A (EON) variant 4.

Alert Originator Even / Odd (Address 8 and 9)

Figure 23: Bit-level definition of Alert Originator Even / Odd
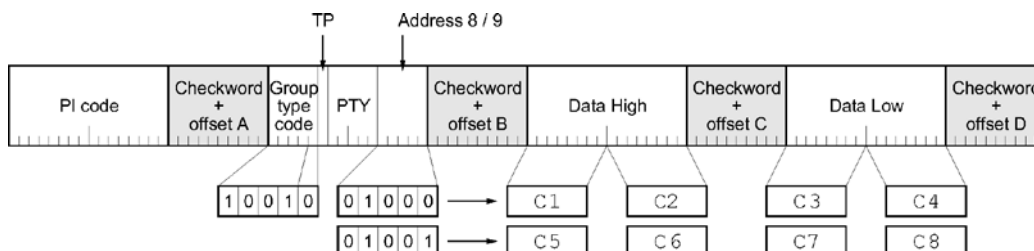
The "Alert Originator" is an eight-character code (C1 to C8) identifying the originating agency for the alert. (C1 is the left most character and C8 is the right most character.) Alert Originator is optional and may be transmitted as part of the text interleave sequence. (For example, "NOAA-NWS" for "National Weather Service.")

Alert Text Segment (Address 16 to 31)

Figure 24: Bit-level definition for Alert Text Segment
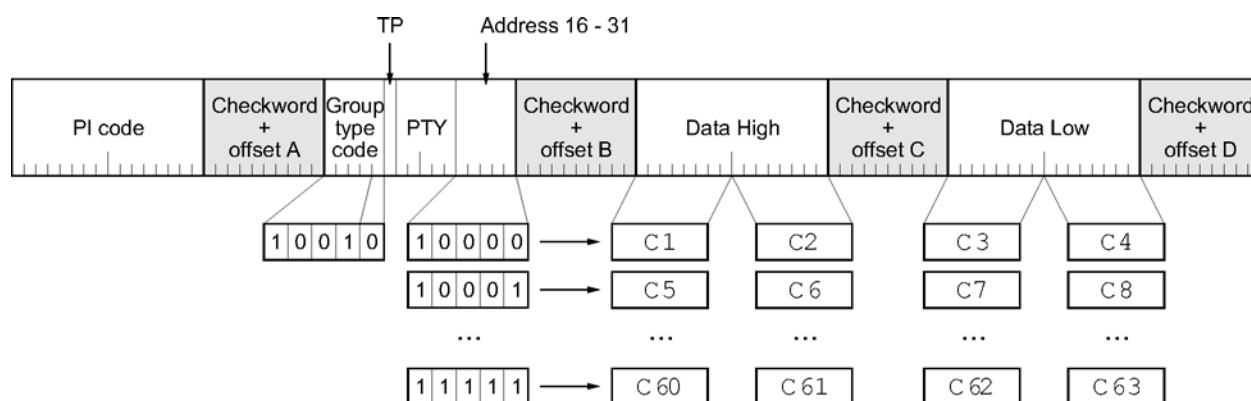
When text segments are transmitted within the alerting ODA, addresses 16 to 31 transmit a 64-character text segment. (C1 is the left most character and C63 is the right most character.) The conventions, including character table, match those of standard Radio Text. (Character code 0x0D terminates a text segment shorter than 64 characters. Character code 0x0A indicates a preferred line-break location.)

**System ID 1 "SAME" Geo Code (United States)**

Figure 25: Bit-level definition for SAME geo-code type
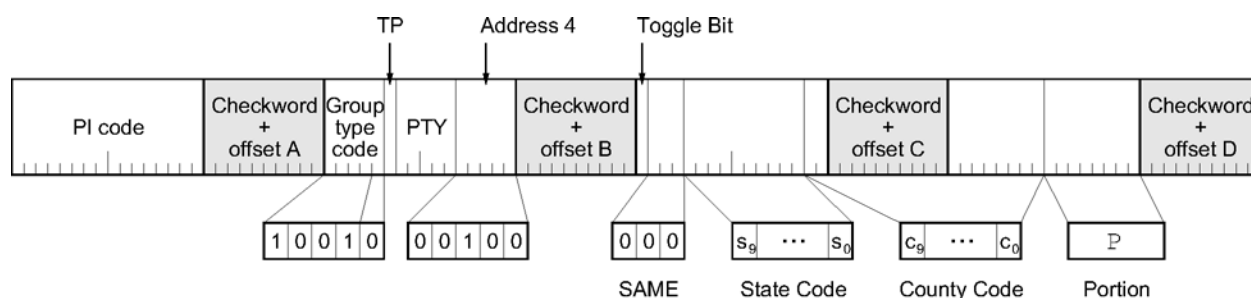
The "SAME" geo code (type 0) transmits the U.S. FIPS codes for a State (bits s9 to s0), County (bits c9 to c0) and a Portion character (P.) For a SAME code where the County is set to zero, relevance is assumed to be the entire State. For a SAME code where the State is set to zero, relevance is assumed to be the entire country. The Portion character indicates relevance to only a portion of the Country, State or County. ("0" = All or Unspecified, "1" = Northwest, "2" = North, "3" = Northeast, "4" = West, "5" = Central, "6" = East, "7" = Southwest, "8" = South, "9" = Southeast. Note that Portion character "0" is the integer value 48, "1" is the integer 49, etc.)

**System ID 1 "ANSI" Geo Code (United States)**

Figure 26: Bit-level definition for ANSI Geo Code Type
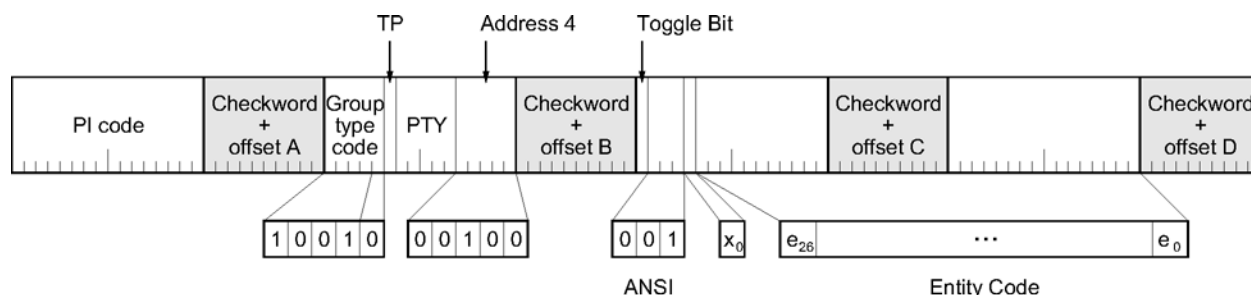
The "ANSI" geo code (type 1) transmits the United States "ANSI Entity" code of up to 8-digits (bits e26 to e0). Should entity codes with greater than 8-digits become required, a future version of this standard will define a method for the transmission of longer codes using additional geo code addresses. For standard 8-digit entity codes, bit x0 is set to zero. For future (longer) entity codes, bit x0 will be set to one. A receiver implementing the current version of this specification <u>must</u> ignore entity codes where bit x0 is set to one.

**System ID 1 "CIRCLE" Geo Code (United States)**

Figure 27: Bit-level definition for CIRCLE Geo Code Type
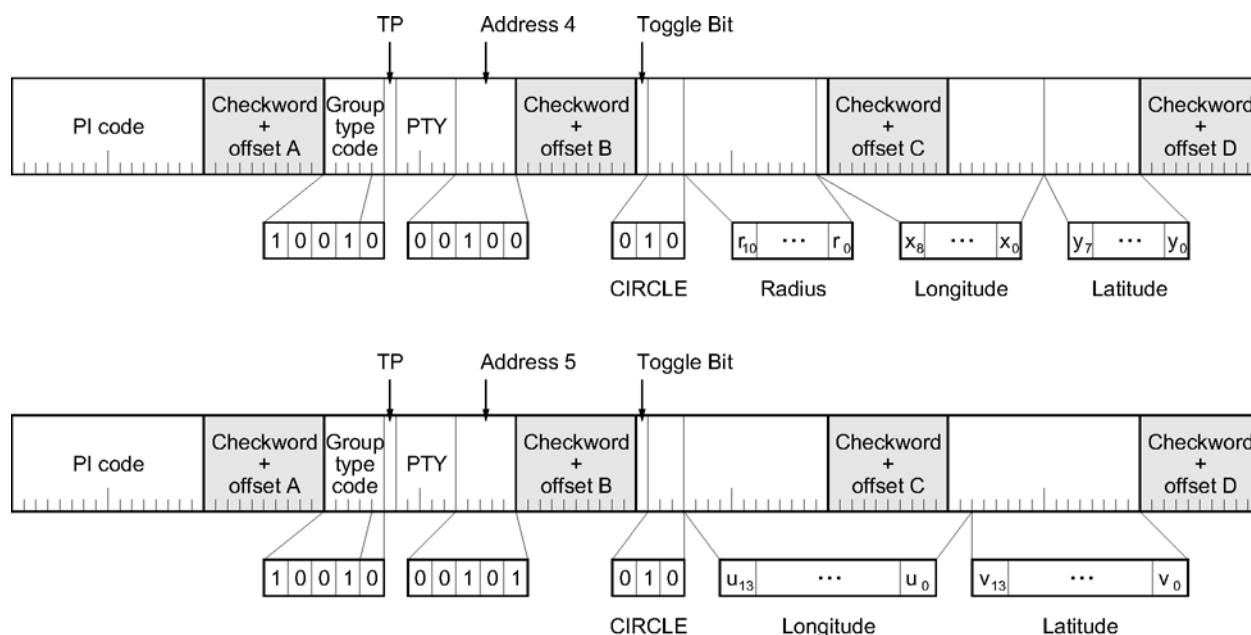
The "CIRCLE" geo code (type 2) delineates the affected area of an alert in the form of a circle. The radius is given as an unsigned integer value (bits r10 to r0) of half-kilometer resolution transmitted in address 8. The central point of the circle is given as a WGS 84 coordinate pair. The integer portion of longitude (bits x8 to x0) and latitude (bits y7 to y0) are two's-complement signed values transmitted in address 8. The fractional portion of longitude (bits u13 to u0) and latitude (bits v13 to v0) are unsigned values transmitted in address 9. The allowed range for longitude and latitude is therefore +180.0000 to -180.0000 and +90.0000 to -90.0000 respectively. Note that the fractional portions of latitude and longitude are transmitted as integer values in the range of 0 to 9999.

102

System ID 1 "POLYGON" Geo Code (United States)

Figure 28: Bit-level definition for POLYGON Geo Code Type
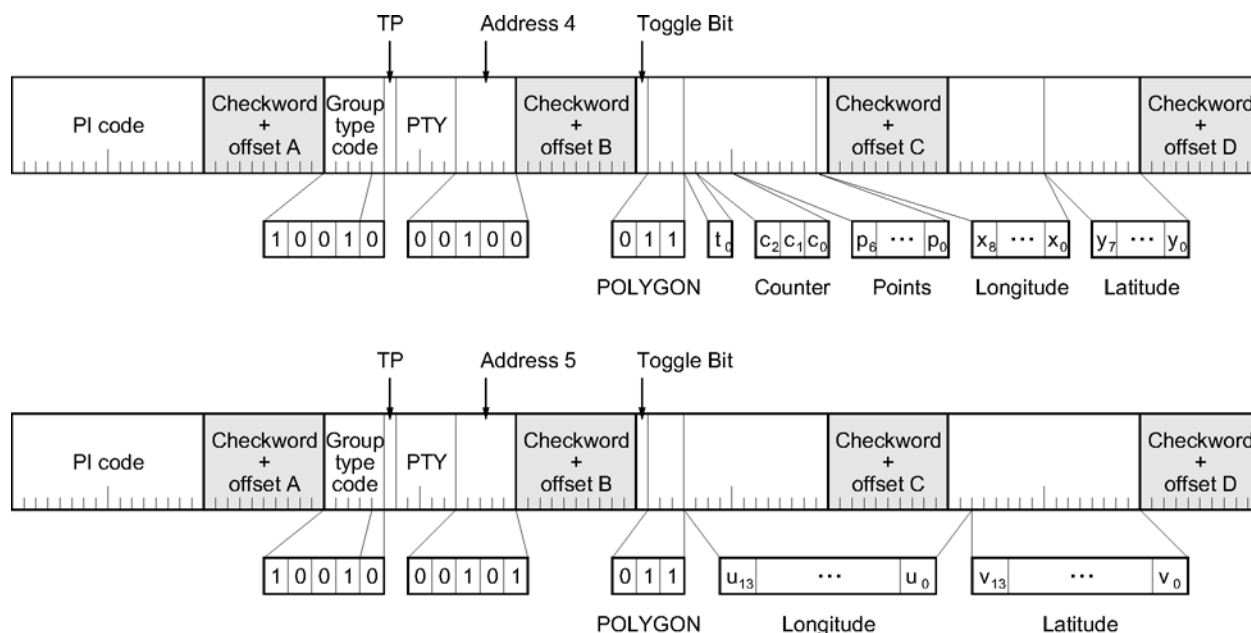
The "POLYGON" geo code (type 3) delineates the affected area of an alert as a closed polygon. The points of the polygon are given as WGS 84 coordinate pairs. The integer portion of longitude (bits x_8 to x_0) and latitude (bits y_7 to y_0) are twos-complement signed values transmitted in address 8. The fractional portion of longitude (bits u_{13} to u_0) and latitude (bits v_{13} to v_0) are unsigned values transmitted in address 9. The allowed range for longitude and latitude is therefore +180.0000 to -180.0000 and +90.0000 to -90.0000 respectively. Note that the fractional portions of latitude and longitude are transmitted as integer values in the range of 0 to 9999.

The termination flag (bit t_0) indicates transmission of the last point in a polygon. The polygon is closed by an implied connection from the last point to the first point. The total number of points in the polygon is specified by the "Points" value (bits p_6 to p_0.) As each coordinate point is transmitted, the toggle bit changes state and the "Counter" value (bits c_2 to c_0) increments by one. (Counter starts from 0 for the first coordinate transmitted.)

103

Appendix F: Participating Public Radio Stations

The following is a list of the 26 public radio stations in five Gulf Coast states involved in the project. The station name, central location, contact information are included, as well as the station's biographical information from its respective website.

ALABAMA

WBHM, Birmingham, AL
About WBHM from its website (www.wbhm.org):
WBHM 90.3 FM
650 11th Street, South
Birmingham, AL 35233
800-444-9246
205-934-2606
Fax: 205-934-5075

WBHM is a listener-supported service of the University of Alabama at Birmingham. More than half of the station's financial support comes from listeners, with additional support from corporate underwriting and the Corporation for Public Broadcasting (CPB). WBHM is "Your NPR News Station" and home to the Alabama Radio Reading Service, a resource for the blind and print-impaired. WBHM programming also can be heard in North Central Alabama on WSGN 91.5 FM through a partnership with Gadsden State Community College and on 104.7 FM in Fort Payne.

Since 1978, the Alabama Radio Reading Service (ARRS) has served North Central Alabama's blind and print-impaired community from its home at Public Radio WBHM 90.3FM/WSGN 91.5 FM, a listener-supported service of the University of Alabama at Birmingham. Support also comes from a grant from *The Eyesight Foundation of Alabama*, a nonprofit foundation whose mission is to serve as a catalyst to improve eyesight through education, research and access to care.

WBHM's participation in the *Southern Education Desk*, a consortium of public media stations, (is) committed to exploring the challenges and opportunities confronting education in the Southern United States in the 21st century.

WJAB, Huntsville, AL
About WJAB, from its website (http://www2.aamu.edu/wjab/):
Alabama A&M University
Telecommunications Center
PO Box 1687
Normal, AL 35762

WJAB-FM is a professional, non-commercial radio station serving the interest of the citizens of Huntsville and surrounding areas. A mixture of various forms of jazz and blues dominates WJAB-FM's twenty-four hour, seven-day-a-week format.

WHIL, Mobile, AL
About WHIL and Alabama Public Radio, from its website (www.apr.org):

The Digital Media Center
920 Paul W. Bryant Drive
Bryant Denny Stadium Room N460
Tuscaloosa, AL 35487

University of Alabama (U.A.) to serve as a local affiliate for its Alabama Public Radio network … Alabama Public Radio is a network of public radio stations based in Tuscaloosa, Alabama that serves roughly the western half of the state of Alabama with classical music, folk music, jazz, and nostalgic music programs, as well as news and feature programs from the National Public Radio, Public Radio International, and American Public Media networks.

The network is operated by the University of Alabama, with studios in Tuscaloosa. Since the station is licensed to a university, students in the U. A. College of Communication and Information Sciences get opportunities for practical training in announcing and other varied production duties. Nonetheless, APR maintains a small professional staff, as well as several volunteer announcers from the larger community.

U. A. started *WUAL-FM (91.5 FM)* in January 1982 as the state's fifth public radio station. It emphasized service to the immediate western Alabama area in its first several years, since most of the region had no other access to the public radio medium. However, the university soon realized the potential for expansion into other parts of the state that similarly lacked NPR service.

Since Birmingham, Huntsville, southeastern Alabama, and Mobile already had existing stations, station and university officials focused on developing relay transmitters to send WUAL's signal into northwestern and south central Alabama. Thus, *WQPR (88.7 FM)***,** originally a joint project with the University of North Alabama in Florence, appeared in the late 1980s. It was followed in the early 1990s by *WAPR (88.3 FM)*, which is jointly owned by Alabama State University, Troy University (both of which already held station licenses of their own) and U.A. In September 2007, WQPR received a grant from the Corporation for Public Broadcasting to assist in its conversion from analog to digital broadcasting.

In 2011, due to the desire of licensee Spring Hill College to get out of public broadcasting, an existing station, *WHIL-FM (91.3 FM)* in Mobile, joined APR, effective July 1, 2011.

FLORIDA

WGCU, Fort Myers, FL
About WGCU, from its website (www.wgcu.org):
WGCU 91.1 FM
Florida Gulf Coast University
10501 FGCU Blvd. South
Fort Myers, FL 33965
239-590-2300
WGCU Public Media is Southwest Florida's source for PBS and NPR.

WGCU provides quality programming 24-hours a day and is a trusted story teller, teacher, theater, library and traveling companion. As a member-supported service of Florida Gulf Coast University, WGCU's mission is to provide educational programming that inspires, informs and engages our community.

Serving seven counties, one-fifth of the state of Florida, with three distinct digital TV channels, two FM radio channels and two HD radio channels, one subcarrier and a monthly magazine, WGCU delivers national and international programming and develops, produces and delivers relevant, informative and educational local programs to the Southwest Florida community.

WGCU's educational programs, community-based initiatives and informative and entertaining events make public media integral to the vitality of Southwest Florida. WGCU is reaching beyond its service area to the country and the world through Web-based applications.

Many of its locally produced programs have been broadcast throughout the country. WGCU has received numerous national, regional, state and local awards for its locally produced television and radio programs.

WGCU Public Media and its predecessor WSFP-TV/FM have served Southwest Florida with the finest in public television and radio programming for over 30 years. Originally a satellite operation licensed to the University of South Florida, *WGCU Public Media* became an independent entity in 1996 when the broadcast licenses were transferred to Florida Gulf Coast University, a new public university that was being built to serve the Southwest Florida region. The stations' call letters were changed to *WGCU-TV/FM*, and a new state-of-the-art broadcast facility was built as part of the new university's campus. Since that time we have dramatically strengthened and expanded the physical infrastructure, the financial base and the media services that now comprise *WGCU Public Media***:**

Provided the region with the first full-day public radio News and Information programming service

105

Launched a 24-hour-a-day Adult Album Alternative programming service on HD radio

Organized staff to reflect an integrated media model for production, dissemination and programming rather than a traditional television and radio model

Developed an award-winning website, wgcu.org, that incorporates digital archives of all locally produced TV and FM programs, streaming FM service, access to national sites, and social media tools

Earned numerous national and regional awards, including a Peabody Award, for our radio news programming

> *WQCS, Fort Pierce, FL*
> About WQCS, from its website (www.wqcs.org):
> WQCS 88.9 FM
> 3209 Virginia Avenue
> Fort Pierce, FL 34981
> 772-465-8989
> 888-286-8936
> Fax: 772-462-4743

WQCS 88.9 FM is licensed to Indian River State College. At 100,000 watts, the station serves a listening area from northern Palm Beach County to Melbourne. Its format is news and classical music programming. It is a member of National Public Radio and Florida Public Broadcasting Service, and affiliated with Public Radio International, American Public Media and the Associated Press.

WQCS provides local news and weather information throughout the day and works closely with non-profit organizations to promote their activities through public service announcements, and the show "Treasure Coast Happenings." A local public affairs segment at 6:01 PM deals with people and issues in the communities served by the station. "Floridays" is a special feature each Friday that offers original voices and stories from the area.

The station also operates the *WQCS* Radio Reading Service on a closed-circuit sub-carrier. Approximately 500 blind and visually and physically impaired listeners receive the reading service. Each morning, volunteers read local newspapers and other publications. The service requires a special receiver that WQCS provides free of charge.

WQCS went on the air in March 1982 at 3,000 watts of power. It increased its power to 100,000 watts in April, 1986 and moved to its current facility in May 1993. WQCS is the state-designated Emergency Alert System serving St. Lucie, Martin, Indian River and Okeechobee counties and northern Palm Beach County.

> *WUFT, Gainesville, FL*
> About WUFT, from its website (www.wuft.org):
> WUFT 89.1 FM
> P.O. Box 118405
> Gainesville, Florida, 32611
> 352-392-5551
> Fax: 352-392-5731

WUFT-FM and its repeater station, WJUF-FM, provide 24/7 news and talk to a large section of north central Florida. WUFT-FM is a 100,000 watt public radio station serving 16 counties in North Central Florida, while WJUF-FM is a 20,000 watt repeater station that serves the residents of Citrus, Hernando and Pasco counties. Signing on in September 1981, WUFT quickly garnered a reputation as one of the top public radio stations in the country. Broadcasting on 89.1 in stereo from studios located in the University of Florida College of Journalism and Communications, WUFT-FM presents a 24/7 news/talk service. The College also provides opportunities for students in Spanish language programming on WUFT Ahora, a WUFT HD station that features news and public affairs including Spanish language newscasts produced by the College's students.

Both stations broadcast three digital streams over the air and online. HD1 features the main news/talk signal; HD 2, Classic 89, features classical music; and HD3, Ritmo Latino, features Spanish language programming and music.

Over the years, 89.1 and 90.1 have become a vital part of the communities they serve—both by the programming enjoyed by listeners, and by hosting special events throughout the region. For example, every summer WUFT-FM—in partnership with sister station WUFT-TV and the City of Gainesville—presents the Gainesville Independence Day celebration _FANFARES & FIREWORKS_. And the station's annual fundraiser—_A Celebration of Wine_—has grown to be a major community gathering. Both stations are an integral part of the culture of North Central Florida, serving communities with quality programming for more than three decades.

> _WJCT, Jacksonville, FL_
> About WJCT, from its website (www.wjct.org):
> WJCT 89.9 FM
> 100 Festival Park Ave.
> Jacksonville, FL 32202
> 904-353-9528

WJCT's mission is to use our unique assets as a resource for citizens to come together to celebrate human diversity, experience lifelong learning, and actively engage in matters of civic importance, all to improve the quality of our lives and our community.

Our vision for WJCT is to be regarded as an indispensable community resource, connecting citizens to content, sharing ideas, and setting the standards through which the community learns and grows.

Community Enrichment We are committed to providing intelligent, innovative programming and services of the highest quality. We deliver arts, education and entertainment directly into First Coast homes and serve as an accessible forum for public dialogue and debate. We seek to open minds, promote intellectual curiosity and enrich the quality of life on the First Coast.

Public Service From our first television broadcast in September 1958 and first radio broadcast in April 1972, we have worked to reflect and respond to the many voices of our First Coast community with distinction, balance and respect. We appreciate the power of public broadcasting and honor our heritage by remaining responsive to citizens of all ages, abilities, cultures and values.

Stewardship As stewards of a true community asset, we value each and every contribution of time, talent and treasure from staff members, individual and corporate supporters, board members, and volunteers. We take seriously our charge to build a better community, seek opportunities to make a difference in today's First Coast community, and strive to enhance our legacy for the citizens of tomorrow.

> _WLRN, Miami, FL_
> About WLRN, from its website (www.wlrn.org):
> WLRN 91.3 FM
> 172 NE 15th St.
> Miami, FL
> 305-995-1717
>
> WLRN-Miami Herald newsroom:
> 3511 NW 91 Ave.
> Doral, FL
> 305-376-3490
> radionews@miamiherald.com

WLRN Public Radio and Television is committed to being the most trusted source of information and entertainment in South Florida's diverse community. Licensed to the school board of Dade County, WLRN is best known for its award winning public radio and television programs, but its services go well beyond the airwaves. It's a complex media enterprise consisting of radio and television stations and educational channels offering you a variety of high quality programming and advanced learning services making WLRN a valuable public media source.

WLRN Radio signed on in 1948 as a non-profit, non-commercial broadcast station licensed to the School Board of Dade County. WLRN-TV followed in 1955. Since then, WLRN has grown steadily to become an integral part of the

community it serves, offering a rich and varied mix of news and information, arts and culture, childhood education and lifelong learning.

WLRN is a multifaceted media enterprise comprising a television and a radio station, cable services, and closed-circuit educational channels. New digital television and radio channels now complement more traditional broadcast services, ushering in the next stage of WLRN's evolution. Today, WLRN continues to provide quality public radio and television services to a combined weekly audience of well over a million people in South Florida, from Palm Beach to Key West. WLRN also provides media support to Miami-Dade County Public Schools, whose 320 schools have an enrollment of over 319,000 students.

WLRN Radio is the oldest FM station in South Florida and a National Public Radio (NPR) member station. From 5 in the morning until 7 at night, 91.3 FM is the first choice among South Floridians who keep abreast of world events through NPR's Morning Edition and All Things Considered …
…Now, in a powerful news partnership with The Miami Herald, WLRN presents the most comprehensive local and regional news every half hour during Morning Edition, middays, and All Things Considered.

Since January 1999, when the news/talk emphasis was added to WLRN's programming, the audience has more than doubled WLRN also manages the Radio Reading Service, an invaluable resource for the visual and print handicapped in the community. Twenty-four hours a day, this unique service provides vital news, information, and literary enrichment for those who are not able to read for themselves. The service is broadcast over a private frequency and heard on special receivers provided to listeners without cost or obligation. Volunteers make this effort possible by reading newspapers, current periodicals, and books.

WMFE, Orlando, FL
About WMFE, from its website (www.wmfe.org):
WMFE
11510 East Colonial Drive
Orlando, Florida 32817

WMFE is a non-profit, member-supported, community-based public broadcasting company that operates 90.7 WMFE-FM, metro Orlando's primary provider of NPR programming; and 90.7-2 Classical. Part of the community since 1965, WMFE focuses on providing quality national and local news and programming.

WFSU, Tallahassee, FL
About WFSU, from its website (www.wfsu.org):
WFSU/Florida State University
1600 Red Barber Plaza
Tallahassee, FL 3231-
850-487-3170
E-mail: fpr@wfsu.org

Established in 1975, the Florida Public Radio Network is the oldest public radio network in the United States. Its mission is to provide public radio listeners with in-depth coverage of the Florida legislature, state government, and other issues that affect the state. FPRN serves thirteen public radio stations across Florida. Each week these stations provide public radio services to over one million listeners spanning Florida from Pensacola to Miami, leaving virtually no Floridian out of reach of the FPRN signal.

WUSF, Tampa, FL
About WUSF, from its website (www.wusf.usf.edu):
WUSF 89.7 FM
University of South Florida Tampa
4202 E. Fowler Ave.
Tampa, FL 33620-6870

Enhancing quality of Life

WUSF Public Media's mission is to provide meaningful and relevant content that enhances our community's quality of life. As the only public media organization in the Tampa Bay area, we are able to deliver a unique blend of news and information, jazz and classical music, as well as educational content programming for children and adults. We also provide a wide range of original, cross platform content with a focus on education, healthcare, the environment and military affairs. The high quality programming we provide has been a valuable resource in our community for 50 years. We are committed to providing creative, entertaining, responsive, educational and trustworthy programming and dedicated to serving our listeners and viewers for years to come.

WUSF Mission: To provide meaningful and relevant content that enhances our community's quality of life

WUSF 89.7 broadcasts local, statewide and national news, and all night jazz. Locally produced programs like Florida Matters provide listeners local content on local issues. As West Central Florida's NPR station, we carry flagship programs *Morning Edition* and *All Things Considered*, that bring you national news as its best. We serve members and listeners from Crystal River in the North, to Port Charlotte in the South and Osceola County to the East.

WSMR 89.1 and 103.9

WSMR 89.1 and 103.9 are West Central Florida's only stations devoted to classical music. We broadcast live performances in additional to well-known classical music shows like From the Top and Sunday Baroque. The stations can be heard from Tampa Bay to the north to Ft. Myers in the south. The station is also available online at *www.wsmr.org* and on HD radio on WUSF 89.7.

WUSF New Media

New Media uses Internet technology to support WUSF's mission and the core values of public broadcasting. WUSF offers daily and weekly podcasts of local newscasts and public affairs programming, video podcasts, RRS feeds and live streaming audio of our two radio program channels—WUSF 89.7, and WUSF 89.7².

WPBI, West Palm Beach, FL
About WPBI, from its website (classicalsouthflorida.publicradio.org):
Classical South Florida
330 SW Second Street, Suite #207
Fort Lauderdale, FL 33312
89.7 WKCP Miami; 90.7 WPBI West Palm Beach; 101.9 W270AD West Palm Beach; 88.7 WNPS Southwest Florida
888-448-3897

Classical South Florida is a nonprofit 501(c)(3) public radio organization dedicated to broadcasting classical music. Its fulltime schedule of classical music includes broadcasts of nationally renowned programs such as Performance Today®, SymphonyCast®, Classical Live, The Metropolitan Opera and Pipedreams®. Classical South Florida began broadcasting in South Florida in October 2007. Its program service can be heard on WKCP 89.7 FM in the upper keys, Miami and Fort Lauderdale, on WPBI 90.7 in the Palm Beaches and the Treasure Coast, and on WNPS 88.7 in Fort Myers, Naples, Marco Island and Southwest Florida.

In the Palm Beaches, Classical South Florida also provides an all-news program service, WPBI News at 101.9 FM and on WPBI HD2. This service broadcasts a schedule of the best programs from National Public Radio, American Public Media, Public Radio International, the Canadian Broadcasting Corporation and the British Broadcasting Corporation including Morning Edition, All Things Considered, Marketplace, and A Prairie Home Companion, as well as regular local programming.

Both Classical South Florida and WPBI News are available worldwide on the Internet at www.ClassicalSouthFlorida.org and www.WPBINews.org.

Classical South Florida is a listener-supported organization affiliated with American Public Media. We are governed by a Board of Trustees who live in South Florida, along with a representative of American Public Media.

LOUISIANA

WRKF, Baton Rouge, LA
About WRKF, from its website (www.wrkf.org):
WRKF 89.3 FM
3050 Valley Creek Drive
Baton Rouge, LA 70808
225-926-3050
225-926-3105

Mission: WRKF informs and entertains its audience through local, national and international news and cultural programming.

WRKF's 28,000-Watt signal reaches a 60-mile radius around Baton Rouge depending upon terrain. That's why you hear WRKF in Lafayette, Hammond, Ponchatoula, New Iberia, Morgan City, Opelousas, south of LaPlace and even in Woodville, MS.

WRKF was the first community-licensed public radio station news, information and classical music station based in Baton Rouge. The station launched on January 18, 1980. Initial programming was typical for a community-based public radio station of that time and included classical music, jazz, folk, big-band standards, and NPR news. The studios were in a temporary building at the transmitter site on Frenchtown Road. In 1986, the station moved to its current location on Valley Creek Drive in the city.

KRVS, Lafayette, LA
About KRVS, from its website (www.krvs.org):
KRVS/Radio Acadie 88.7 FM
Room 145, Burke Hall, Hebrard Blvd.
University of Louisiana at Lafayette
Lafayette, LA 70503
Mailing address:
P.O Box 42171
Lafayette, LA 70504
800-892-6827
337-482-KRVS (482-5787)
Fax: 337-482-6101

Mission Statement: KRVS should be the indispensable source of information, ideas and cultural experience that enables people to fulfill their potential as citizens of south Louisiana.

We are a listener-supported, public radio station, located in Lafayette, Louisiana. We broadcast live annually from the Cajun Music Festival and the Festival International de Louisiane, as well as producing and airing live broadcasts of the Louisiana Crossroads series. We play Cajun music, Zydeco, Blues, Jazz, Swamp Pop, Swamp Rock, Louisiana singer/songwriter music, and many other types of music created and played in Louisiana. Countless numbers of musicians have come into our studio, Cypress Lake Studios, to play live and talk about their work — musicians such as Sonny Landreth, Michael Doucet, Zachary Richard, Steve Riley, David Greely, Christine Balfa and Dirk Powell, the Magnolia Sisters, Keith Frank, the late Beau Jocque, Mark Broussard, Henry Butler, the Red Stick Ramblers, Terrance Simien, Marcia Ball, Buckwheat Zydeco, and many others!

KRVS serves a region known as Acadiana due to its distinct French language, culture and traditions. By focusing on indigenous Louisiana programming, KRVS provides an important local resource for the Creole and Cajun residents of south Louisiana. Broadcasting from the heart of French Louisiana, KRVS is committed to artists and performances unique to the language, culture and music of south Louisiana. We also air programs synonymous with public radio such as Morning Edition, All Things Considered, Fresh Air, World Café, Thistle and Shamrock, American Routes and This American Life.

KRVS is a regional public radio facility licensed to the University of Louisiana at Lafayette. Housed on the campus, KRVS began broadcasting in 1963 with a power of 10 watts and a coverage area of about six city blocks. Located in

Burke-Hawthorne Hall, KRVS now broadcasts at 100,000 watts providing service to 651,000 Louisiana residents in 12 parishes across the southern portion of the state. In addition, KRVS' programming is available worldwide via www.krvs.org.

> *KEDM, Monroe, LA*
> About KEDM, from its website (www.kedm.org):
> KEDM 90.3 FM University of Louisiana at Monroe
> 318-342-5556
> FAX: 318-342-5570

KEDM is the listener-supported public radio station for Monroe, West Monroe, and all or parts of eleven parishes of northeast Louisiana and four counties in southeast Arkansas. The station broadcasts a lineup of in-depth news, Classical, Jazz and a variety of other musical genres, along with special entertainment and other enriching programs.

KEDM began serving the Northeast Louisiana and Southeast Arkansas area on April 23, 1991. On the station's 18th birthday, April 23, 2009, KEDM became the first station in its region broadcasting in digital *HD Radio™*.

Mission: The University of Louisiana at Monroe operates KEDM as a public service.

We work to provide the citizens of our coverage area with quality news and entertainment programs, so that the public is informed about the events that shape our lives and enriched by the culture that stirs our souls.

We support the region's local arts groups, civic groups, and other organizations that seek to increase the quality of life in our community.

Our work strives to enhance the social, educational and cultural reputation of the listening area.

KEDM is affiliated with two public radio networks: *National Public Radio* (NPR) and *American Public Media* (APM). NPR provides KEDM with programs such as Morning Edition, All Things Considered, and Car Talk. APM provides quality programs such as Companion and Marketplace. KEDM also utilizes programming from independent producers, and produces a number of local programs and features as well.

KEDM broadcasts jazz programming 24/7 on HD2 channel KEDM2 Jazz, and information programming 24/7 on HD3 channel KEDM3 Ideas.

> *WWNO, New Orleans, LA*
> About WWNO, from its website (www.wwno.org):
> WWNO 89.9 FM
> 2000 Lakeshore Drive
> New Orleans, LA 70148
> 504-280-7000
> Fax: 504-280-6061

WWNO is the NPR member station for New Orleans and the 13 parishes of southeast Louisiana … a population of 1.5 million people … broadcasting on 89.9 FM — and on KTLN 90.5 FM in the Houma-Thibodaux area — as a public service of the University of New Orleans.

WWNO broadcasts news and information from NPR, PRI and other sources on weekdays, with classical music weeknights; 24-hour classical on HD channel WWNO2; and 24-hour jazz on WWNO3. A growing audience turns to WWNO for trusted, balanced news, thought-provoking analysis, and lively high quality entertainment, making WWNO one of the top stations in metro New Orleans. All of WWNO's programs, including its growing local news coverage, are available online at WWNO.org.

Mission: WWNO serves our communities by broadcasting NPR news, information, classical music, jazz, variety programs, and unique local content.

Organizational Structure: WWNO is licensed to and operated by the University of New Orleans as a public service, with oversight by a 20-member Community Advisory Board. The station employs nine full-time staff; 10-15 part-time, contract and student staff; and appreciates the help of about 40 volunteers.

WWNO is a leader in digital broadcasting — one of the first in the nation to employ digital broadcasting to expand the range of programs available to our diverse audience. We broadcast our familiar schedule on 89.9FM and digital WWNO1. WWNO2 plays classical music when 89.9FM carries news, and vice versa—a schedule designed to give our news and classical listeners more freedom to create the listening schedule they prefer. WWNO3 airs jazz throughout the day. All of WWNO's broadcasts stream on our website, _WWNO.org_.

> _KDAQ, Shreveport, LA_
> About KDAQ, from its website (www.redriverradio.org):
> KDAQ 89.9 FM
> Red River Radio
> 8675 Youree Drive
> Shreveport, LA 71115
> Mailing address:
> Red River Radio
> P.O. Box 5250,
> Shreveport, LA 71135
> 318-798-0102
> 800-552-8502
> Fax: 318-798-0107

The Red River Radio Network is a community-supported service of LSU-Shreveport and is the non-commercial source for NPR News, classical music, jazz, blues and more for East Texas, Louisiana, Arkansas and parts of Mississippi. We also broadcast _3_ HD radio streams. _HD1_ is a high quality broadcast of our main channel, _HD2_ is 24 hours a day of classical music and _HD3_ is 24 hours a day of news and talk. _Our stations are:_

> _KDAQ_ Shreveport at 89.9 FM
> _KLSA_ Alexandria at 90.7 FM
> _KBSA_ El Dorado at 90.9 FM
> _KLDN_ Lufkin at 88.9 FM
> and translator K214CE Grambling

Mission: Red River Radio's mission is to provide a trusted source of information, music and entertainment for curious and thoughtful people, in an efficient, sustainable way, strengthening the civic and cultural life of the communities we serve.

> **MISSISSIPPI**

> _WMPN, Jackson, MS_
> About WMPN/Mississippi Public Broadcasting, from its website (www.mpbonline.org):
> WMPN 91.3 FM
> 3825 Ridgewood Road
> Jackson, MI 39211
> 601-432-6565

In 1969, the Mississippi Authority for Educational Television (MAET) was established by the Mississippi State Legislature with the mission of providing "educational and instructional professional growth and public service programs for the students and citizens of Mississippi." MAET first hit the airwaves in 1970 as Mississippi Educational Television (ETV), and has served Mississippi ever since, providing quality educational _television_ programming that links our state's communities together. Over the years the face of the organization has evolved as we have added _radio_ and news programming and established a robust _education_ department focused on providing educational resources and curriculum to Mississippians of all ages.

Since 1985 MPB has been Mississippi's source for news and entertainment on the radio. MPB Think Radio features thought provoking news and analysis programs as well as shows that entertain and inspire. MPB's HD channel, MPB Music Radio, features music from an array of musical genres. Our diverse lineups on both MPB Think and Music radio offer something for every listener.

112

Known as Mississippi Public Broadcasting (MPB) since 2003 when Mississippi ETV and Public Radio in Mississippi (PRM) merged, the organization has been a leader in informational broadcasting. Through our award-winning productions, our educational resources, and our acclaimed hurricane coverage and response operation, MPB has exhibited a commitment to educating and informing Mississippians.

The Radio Reading Service of Mississippi (RRSM) features on-the-air readings of newspapers, books and magazines for persons who are unable to read the printed word, either because of visual handicaps or because of other physical handicaps, such as the inability to turn pages.

TEXAS

KUT, Austin, TX
About KUT, from its website (www.kut.org):
KUT 90.5 FM
300 W. Dean Keeton (A0704)
Austin, TX 78712-1061
512-471-1631

Established in 1958, KUT is licensed by the Federal Communications Commission to The University of Texas at Austin and operates as a service of the College of Communication. The station is committed to supporting civic and cultural life in Central Texas through daily news coverage, high-quality documentary production, and exceptional music programming that reflects the Austin experience. KUT supports the mission of the University to educate and foster a more civil society, and provides public radio service to Central Texas via 90.5 FM in Austin and globally through *http://www.kut.org/*.

… KUT launched Central Texas' first full-time public radio news operation in 2002. The following year, the KUT Advisory Board was established by KUT … Get Involved, KUT's community service program highlighting Central Texas non-profit organizations in need of volunteers, began broadcasting during the first week of each month in 2006. In the following year, KUT launched HD channel KUT2, an all-news and public affairs programming channel, and KUT3, a mostly jazz channel. Additionally, KUT, NPR, and 11 public radio stations launched an online music site, NPRmusic.org. In 2008, KUT launched an iPhone listening application designed to stream all three signals in HD, along with a fully functional mobile site.

The University of Texas Board of Regents approved the design and construction of the Belo Center for New Media in 2009, including the new *KUT Public Media Studios*. Today, KUT is one of the best performing public radio stations in the country, and routinely has the largest per capita public radio listening audience among the top 200 cities in the nation. More than 250,000 people listen to KUT in Central Texas each week.

KVLU, Beaumont, TX
About KVLU, from its website (www.kvlu.org):
KVLU 91.3 FM
Lamar University
PO Box 10064
Beaumont, TX 77710
409-880-8164

KVLU, the public radio voice for Southeast Texas is licensed to Lamar University, with studios on the campus. KVLU (91.3 FM) is a listener supported public radio station providing classical, jazz, alternative music and NPR programming to southeast Texas from the campus of Lamar University since 1974. KVLU is the first station in the Golden Triangle area to offer multi-channel digital broadcasts.

KETR, Commerce, TX
About KETR, from its website (www.ketr.org):
KETR 89.9 FM
1500 Education Drive
Commerce, TX 75428
Mailing address:

113

PO Box 4504
Commerce, TX 75429
903-886-5848

KETR's studios and offices are on the first floor, east wing of historic Binnion Hall on the campus of Texas A&M University-Commerce.

KETR is committed to providing Northeast Texas citizens and the *Texas A&M University-Commerce* community with entertaining, educational and informative programming. The station also serves as a learning environment for university students to pursue excellence in broadcasting.

KETR News strives to highlight stories that impact the lives of our listeners. We are committed to informing you of the latest and relevant municipal government, school, public safety, community development and crime-related news event. KETR also feels it is important to touch on lighter news stories that can inspire, intrigue and influence.

KETR takes severe weather very seriously. We provide important, and in some cases, LIFE-SAVING information to people who may not have a reliable alternative source. In our experience, commercial media organizations in DFW have to make tough decisions about how much broadcast time is dedicated to Northeast Texas, which is a relatively small portion of their audience. KETR is not beholden to commercial advertising dollars, and chooses instead to prioritize the safety and informed status of its listeners over any programming schedule. KETR will always interrupt regularly scheduled programming to share vital severe weather information as soon as our staff is aware. In particularly severe or dangerous instances, KETR will offer non-stop weather coverage until the storm(s) has vacated KETR's primary listening region, which includes Hunt county and all contiguous counties.

In the early 1980s, [KETR] … obtained FCC approval and a grant to raise KETR's tower height and to increase power from about 7,500 watts to 100,000 watts. This increased the station's broadcast range from about 20 miles to 75 miles.

> *KEDT, Corpus Christi, TX*
> About KEDT, from its website (www.kedt.org):
> KEDT 90.3 FM
> 4455 S Padre Island Drive, Suite 38
> Corpus Christi, TX 78411
> Phone: 361 855-2213
> Fax: 361 855-3877

South Texas Public Broadcasting System, Inc. is committed to educating, enlightening and inspiring all communities of South Texas.

South Texas Public Broadcasting System Inc. was organized in 1972 by a group of community-minded citizens who worked to bring KEDT-TV, Channel 16 to the Coastal Bend as a reflection of the cultural heritage of its citizens. Ten years later, through a desire to offer quality music programming and to fill a listener void, KEDT-FM 90.3 began broadcasting.

For over 40 years, South Texas Public Broadcasting System (STPBS) has provided education and entertainment to the people of South Texas, a region that is extensively rural, with a higher poverty and lower educational level than most of the state. The population is young and diverse, and a significant percentage is of Hispanic origin. The only non-commercial media capable of reaching nearly all South Texans every day, STPBS uses the power of radio, television, and the Internet to bring ideas, information, and lifelong learning to our diverse community.

> *KERA, Dallas, TX*
> About KERA, from its website (www.kera.org):
> KERA 90.1 FM
> 3000 Harry Hines Boulevard
> Dallas, TX 75201
> 214-871-1390

114

KERA is a not-for-profit public media organization that serves the people of North Texas. The station broadcasts to the fourth largest population area in the United States. KERA produces original multimedia content and news, carries the best in national and international public television and radio programs, and provides online resources at www.kera.org and www.keranews.org. The station's extensive coverage of the arts can be found at www.artandseek.org. KERA-TV broadcasts on Channel 13.1. KERA WORLD broadcasts on 13.2. KERA-FM broadcasts on 90.1 in Dallas/Fort Worth/Denton, 88.3 in Wichita Falls, 100.1 in Tyler and 99.3 in Sherman. KXT 91.7 FM, KERA's Triple A music station, KXT 91.7, is streamed online at www.kxt.org.

KERA's public radio station 90.1 FM went on the air in 1974, serving Dallas, Fort Worth and Denton. In subsequent years, the station expanded its broadcast reach to Wichita Falls (88.3), Tyler (100.1) and Sherman (99.3), and to a global audience via _kera.org_, the _KERA app_, _Facebook_ and _Twitter_.

North Texas Public Broadcasting, KERA's parent organization, is a not-for profit 501(c)(3) educational organization that, from its earliest days, has largely been funded through the _generous financial support_ from individuals and foundations. NTPB is governed by a volunteer _Board of Directors_. President and CEO Mary Anne Alhadeff leads a staff of approximately 70 full-time employees.

>_KMBH, Harlingen, TX_
>About KMBH, from its website (www.kmbh.org):
>KMBH 88.9 FM
>RGV Educational Broadcasting Inc.
>PO Box 2147
>Harlingen, TC 78550
>956-421-4111
>Studios:
>1701 Tennessee Avenue
>Harlingen, TX 78551

[Mission Statement] _Education, culture, spiritual values,_ and _arts_ give meaning and sense to the gift of our lives. RGV Educational Broadcasting, Inc. is committed to further all levels of education, to promote the arts, spiritual values and cultural development by means of electronic media, specifically for the communities of the Rio Grande Valley in Texas.

For over twenty years, RGV Educational Broadcasting has been an effective instrument of education for pre-school children, elementary, secondary and college students, junior and senior professionals and citizens through its daily programming. By implementing more and better technologies, in the present digital era, and by developing a comprehensive plan for community involvement RGV Educational Broadcasting will become a powerful, constant stream of educational opportunities for everybody, through its daily programming and added services, data-casting and multicasting, providing the best in knowledge, science, arts and culture to the communities of the Rio Grande Valley of Texas.

RGV Educational Broadcasting, Inc. is a nonprofit corporation, founded on September 19, 1983 in Brownsville, Texas, under the auspices of the Catholic Diocese of Brownsville to serve the communities of the Valley of the Rio Grande with educational TV and Radio programming.

RGV Educational Broadcasting, Inc. operates KMBH-DT38, KMBH-FM 88.9, KHID-FM 88.1 as noncommercial entities supplying Public Broadcasting to the Rio Grande Valley. RGV Educational Broadcasting's mission is to provide high-quality, educational, cultural and informational programming to the Valley.

Public Radio 88FM offers award-winning news and information programming from NPR. Programs like "Morning Edition" "All Things Considered", "Car Talk" and, our local production, combine to create a broadcast schedule that is truly "One-of-a-kind."

>_KUHF Houston, TX_
>About Houston Public Media, from its website (www.houstonpublicmedia.org):
>KUHF 88.7 FM
>Houston Public Media

4343 Elgin
Houston, TX 77204-0008
713-748-8888

Houston Public Media provides informative, thought-provoking and entertaining content through a multi-media platform that includes TV 8, News 88.7 and Classical 91.7 and reaches a combined weekly audience of more than 1.5 million.

Focused on delivering high quality local, regional and national content in the areas of news and information, arts and culture, and education, Houston Public Media utilizes its broadcast and online outlets to provide audiences with unprecedented access to the content that is meaningful to them—on air, online, at home and everywhere they go.

Houston Public Media is built on 60 years of success in public radio and television, including TV 8's distinction as the nation's first educational public television station. Houston Public Media's ongoing operation is made possible through the generous support of members, sponsors and underwriters through _Houston Public Media Foundation_ a non-profit 501(c)(3).

Throughout its history, Houston Public Media has remained committed to service, which educates children, informs citizens and lifts the spirits of the community. Houston Public Media's goal, through quality content, is to serve as the catalyst that takes audiences beyond the ordinary, beyond Houston and beyond the world they know. The organization is a community service of the University of Houston.

Appendix G:Materials Sent to Participants

Instructions Sent to the First Round Participants

Step-by-step guide to setting up Nipper One

Equipment inside the box
(Please set aside the 2 extra cables and the extra decal, if any. You will not need them for this test.)

NipperOne

Android Tablet

100% Assembled
(Follow the directions below)

Step #1

Step #2

Step #1: Plug the Android tablet's power supply into the tablet
Step #2: Plug the power supply into a wall outlet

Step #3

Step #4

Step #3: Find the shortest cable in the package- the USB cable
Step #4: Using the USB cable, plug it into the slot labeled "USB" in the NipperOne

Step #5

Step #6

Step #5: Plug the other end of the USB (shortest) cable into the Android tablet, into the hole next to where the power cable is plugged in
Step #6: Plug the antenna cable into the "Antenna" slot in the NipperOne

Step #7

Step #8

Step #7: Check to make sure it looks the same as the photo shown above
Step #8: Press and hold the little button on the top right edge of the Android tablet to turn it on. When it's turned on, touch and using your finger, slide up on the "padlock" icon that appears on the screen until it appears the icon is unlocked. At this point, the POWER light, which is AMBER colored, on the NipperOne should be illuminated

118

Step #9

Step #10

Step #9: On the Android tablet screen, touch the ::: icon on the upper right of the screen and several apps (applications) will appear

Step #10: Touch the NPR Labs app labeled "NipperOneAlerter." If the app asks for permission for the NipperOne to use the app, touch the NPR Labs icon, and then touch the "Always" button
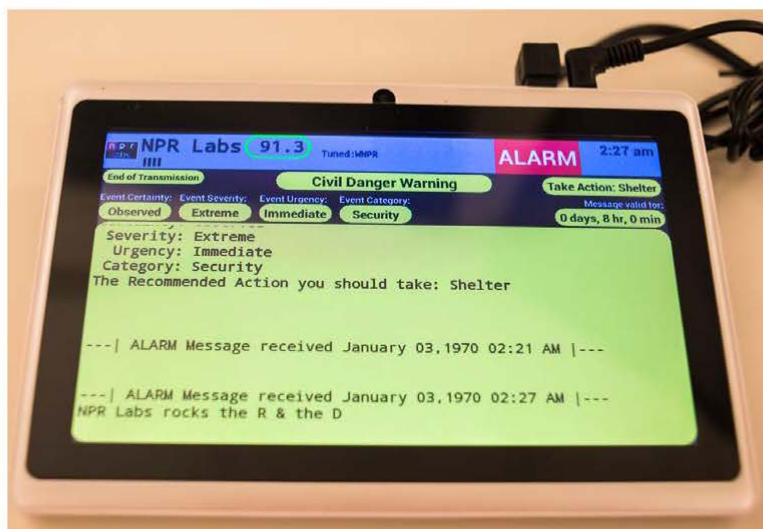

Step #11

Step #12

Step #11: The Emergency Alerting screen will appear, showing the activity of the receiver. The receiver will scan the FM Radio band looking for your local station. The "No Signal" light on the receiver will blink until it finds the station signal

Step #12: Once the receiver finds the station, the GREEN light, which is labeled "BEACON," will stay illuminated and the tablet will show the station's call letters for example, WNPR, and frequency, 91.3

Step #13: When an alert arrives, the RED "ALARM" light and BLUE "ALERT" light on the receiver will flash, and the Android tablet will display the alert text. If you want to stop the flashing of the lights for a while, press the "SNOOZE" button on the receiver

Step #13 – View of sample emergency alert on tablet

Please Note:

The two longest cables will be extras at the end of assembly. They are not needed for this test.

Instructions Sent to the Second Round Participants

Step-by-step guide to setting up your NIPPER ONE Receiver and Tablet

Equipment inside the box

(Please set aside the 2 extra cables and the extra decal, if any.

You will not need them for this test.)
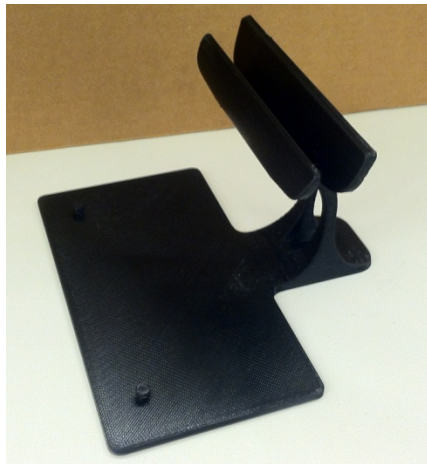

NIPPER ONE Receiver

Android Tablet

100% Assembled

(Follow the directions below)

The stand to hold the tablet and receiver.
It can be found wrapped up in the shipping box.

Step #1: Plug the Android tablet's power supply into the tablet. Make sure the plug is inserted into the socket all the way.

Step #2: Plug the power supply into a wall outlet.

Step #3: Find the shortest cable in the package - the USB cable.

Step #4: Using the USB cable, plug it into the slot labeled "USB" in the NIPPER ONE. Make sure the USB plug is inserted into the socket all the way.

Step #6: Plug the antenna cable into the "Antenna" jack on the NIPPER ONE. The Antenna plug is just pushed onto the NIPPER ONE antenna jack.

Step #5: Plug the other end of the USB (shortest) cable into the Android tablet, into the hole next to where the power cable is plugged in. Make sure the USB plug is inserted into the socket all the way.
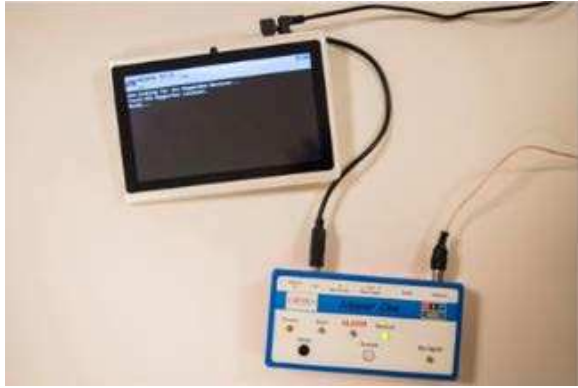
Step #7: Check to make sure it looks the same as the photo shown above.

[There should be two things plugged into the tablet, power and the cable to the NIPPER ONE, and two things plugged into the NIPPER ONE, the antenna and the other end of the USB cable.]

Step #8: Press and hold the little button on the top right edge of the Android tablet to turn it on. When it's turned on, touch and using your finger, slide up on the "padlock" icon that appears on the screen until it appears the icon is unlocked. At this point, the orange POWER light on the NIPPER ONE will blink slowly on and off.

Step #9: will appear, showing the activity of the receiver. The receiver will scan the FM Radio band looking for your local station. The yellow "No Signal" light on the receiver will blink quickly until it finds your local station's signal.

Step #10: Once the receiver finds your local station, the GREEN light, which is labeled "BEACON," will stay on and the tablet will show the station's call letters. For example, in the picture of the tablet (left) Station WNPR, and frequency, 91.3 is shown in the top left corner of the tablet screen.
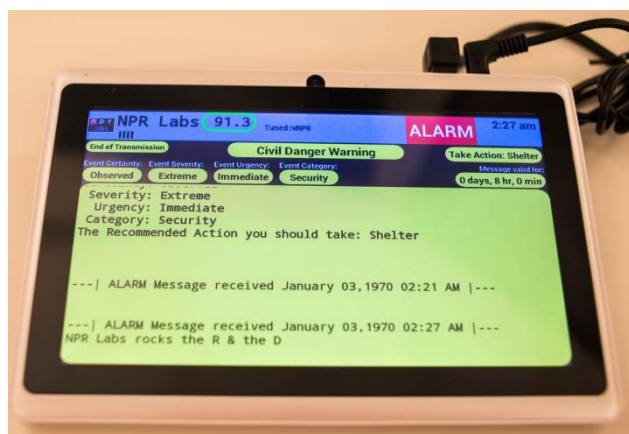
Step #11: When an alert arrives, the RED "ALARM" light and BLUE "ALERT" light on the receiver will flash, and the Android tablet will display the alert text. If you want to stop the flashing of the lights for a while, press and release the "SNOOZE" button on the receiver.

You can scroll up and down through the message by touching the screen and moving your finger up or down.

To exit the NIPPER ONE Alerter app, touch the screen and then touch the back arrow icon at the lower left of the screen. **Normally, the NIPPER ONE Alerter app should be running all the time**.

How to see the apps on the tablet.
On the Android tablet screen, touch

the ⦂⦂⦂ icon on the upper right of the screen

and the tablet's apps (applications) will appear.

How to restart the Alerter app. Touch the NPR Labs app labeled "NIPPER ONEAlerter." If the app asks for permission for the NIPPER ON to use the app, touch the NPR Labs icon, and then touch the "Always" button.

EXTRA HELP WITH THE ANTENNA, IF NEEDED

We will begin sending test messages in the coming weeks. Until then, we would like you to get familiar with the equipment and allow the NIPPER ONE to automatically find and then tune to your local station.

The antenna is a critical to receiving the radio signals! Therefore, we suggest the following:

Plug the antenna that came in the NIPPER ONE receiver box into the NIPPER ONE antenna connector and completely unfurl the antenna wire.

Place (tape or thumbtack or hang) the antenna wire high and clear of large metallic objects (like steel shelving, refrigerators, etc.) and orient its broadside toward the approximate direction of your station. That is, don't point an *end* of the antenna wire toward your station, but point *the whole length* of the antenna toward your station, as shown in the picture below.

Imagine our colleague Marty is facing the general direction of his local station's transmitter.
It's OK if you don't know or aren't sure in which direction your local station is, it's just important to try different directions to get the best signal.

If reception is poor or nonexistent, move the antenna, tablet and NIPPER ONE to another location in the home and retry.

You may need to try different antenna orientations and wait for the NIPPER ONE to find your local station.

After your NIPPER ONE finds and tunes to the station—you can find a more convenient location for your antenna, NIPPER ONE and tablet if you like.

When the NIPPER ONE is tuned to your local station the green Beacon indicator will light up and the No Signal indicator will *not* light up. **If you have any questions please write us at alerting@npr.org**

Appendix H:Example Alert Messages

Test Message Without Line Breaks

THIS IS A TEST MESSAGE FROM N-P-R. DO NOT TAKE ACTION BASED ON THIS MESSAGE. THIS IS JUST A TEST. . A BRUSH FIRE ON SUNRISE HIGHWAY AND OLD HIGHWAY 80 HAS CHARRED OVER 75 ACRES, IPN REPORTS AND AERIAL RESOURCES ARE ON THE SCENE, WITH A STRIKE TEAM POSITIONING IN PINE VALLEY. INTERSTATE IS SHUT DOWN FROM THE SUNRISE HIGHWAY EXIT TO BUCKMAN SPRINGS, CHP REPORTS. THERE IS ALSO A CLOSURE AT HIGHWAY 79 JUST SOUTH OF LODGE. THE FIRE IS IN THE CLEVELAND NATIONAL FOREST AND HAS BEEN NAMED THE GUN FIRE, DUE TO ITS PROXIMITY TO A SHOOTING RANGE. AS OF 2 P.M. THERE IS A LARGE HEADER OF SMOKE VISIBLE ACROSS EAST COUNTY. IPN REPORTED AN EARLIER FIRE AT STATE ROUTES 944 AND 188 (TECATE ROAD). . MULTIPLE RESOURCES WERE DISPATCHED TO THE FIRE WHICH WAS ESTIMATED TO HAVE A POTENTIAL OF TEN ACRES PER THE INCIDENT COMMANDER. EVACUATING KITCHEN CREEK AND CIBBETTS FLAT IN CLEVELAND NATIONAL FOREST. HIKERS AND CAMPERS IN THE AREA ARE URGED TO LEAVE. THE FIRE IS NOW 100 ACRES AND DUE TO HIGH WINDS, SOME FIXED WING AIRCRAFT HAVE BEEN TEMPORARILY GROUNDED THOUGH HELICOPTERS CONTINUE DOING WATER DROPS. . THIS WAS A TEST MESSAGE FROM N-P-R. DO NOT TAKE ACTION BASED ON THIS MESSAGE. THIS WAS JUST A TEST. . PLEASE GO TO NPRLABS.ORG/ALERTING AND FILL OUT THE SURVEY.

Test Message With Line Breaks

THIS IS A TEST MESSAGE FROM N-P-R.

DO NOT TAKE ACTION BASED ON THIS MESSAGE. THIS IS JUST A TEST.

A BRUSH FIRE ON SUNRISE HIGHWAY AND OLD HIGHWAY 80 HAS CHARRED

OVER 75 ACRES, IPN REPORTS AND AERIAL RESOURCES ARE ON THE

SCENE, WITH A STRIKE TEAM POSITIONING IN PINE VALLEY.

INTERSTATE IS SHUT DOWN FROM THE SUNRISE HIGHWAY EXIT TO

BUCKMAN SPRINGS, CHP REPORTS. THERE IS ALSO A CLOSURE AT

HIGHWAY 79 JUST SOUTH OF LODGE. THE FIRE IS IN THE CLEVELAND

 NATIONAL FOREST AND HAS BEEN NAMED THE GUN FIRE, DUE TO ITS

PROXIMITY TO A SHOOTING RANGE. AS OF 2 P.M. THERE IS A LARGE

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COMMANDER. EVACUATING KITCHEN CREEK AND CIBBETTS FLAT IN

CLEVELAND NATIONAL FOREST. HIKERS AND CAMPERS IN THE AREA

 ARE URGED TO LEAVE. THE FIRE IS NOW 100 ACRES AND DUE TO

HIGH WINDS, SOME FIXED WING AIRCRAFT HAVE BEEN TEMPORARILY

GROUNDED THOUGH HELICOPTERS CONTINUE DOING WATER DROPS.

THIS WAS A TEST MESSAGE FROM N-P-R. DO NOT TAKE ACTION

BASED ON THIS MESSAGE. THIS WAS JUST A TEST.

PLEASE GO TO NPRLABS.ORG/ALERTING AND FILL OUT THE SURVEY.