Emergency Communications – 3Rs Reliable, Robust, Redundant

Laura Kong
Director, ITIC

David Coetzee
Manager, Capability & Operations, NZ MCDEM
Modelling Own data PTWC Modelling

WWW

Media

Media

NDMO, other Govt

NDMO, other Govt

Public

Public

WMO, AFTN, Email, Satellite

• SMS
• Email
• Phone

• Sirens
• SMS
• Apps

• Email
• Phone
Public Alerting: Toolbox, Assessment

- Options
- Advantages
- Limitations

BRITISH COLUMBIA
TSUNAMI WARNING METHODS

“A Toolkit for Community Planning”

Peter S. Anderson
Telematics Research Lab
Simon Fraser University
Burnaby, B.C.
Canada

July 2006
3Rs Required for Tsunami Warning

- **Robust** - capable of performing without failure under a wide range of conditions (*Miriam-Webster*); persistence of a system’s characteristic behavior under perturbations or unusual or conditions of uncertainty (*Wikipedia*)

- **Reliable** – giving the same result on successive trials, dependable (*Miriam-Webster*); ability of a system to perform and maintain its functions in routine circumstances, as well as hostile or unexpected circumstances (*Wikipedia*)

- **Redundant** - serving as duplicate for preventing failure of an entire system upon failure of single component (*Miriam-Webster*); duplication of critical components or functions of system with intention of increasing reliability of system, usually as backup or fail-safe (*Wikipedia*)
Warning Communications Are:

- Focused on the people at risk
- Ubiquitous - same message everywhere
- Reaches all people irrespective of what they are doing & where they are
- Easy to access and use
- Do not create added risk
- Reliable
- Issued with appropriate lead time
- Authenticated, authoritative
An Effective Warning Message Is:

- Clear & understandable
- Accurate
- Frequent
- Credible
- Specific to the situation
- Gives Action - specific advice
How public gets warning: Reality

Need to Manage Information - Information flows from many sources at same time

PUBLIC

- Internet
- Cell Phone
- Friends & Family
- Texting & Social Networks
- TV
- Radio
- National Agencies
- Regional Agencies
- Local Agencies

Regional Agencies

National Agencies

Friends & Family

Texting & Social Networks

TV

Radio

Internet

Cell Phone
Educate Public Before

- What communication systems/media will be used to issue warnings?
- Who will issue the warnings?
- How will the warnings be issued?
- When will the warnings be issued/cancelled?
- What will the warning messages say? What will be the actions to undertake upon receipt of warnings?
What Public Needs to Know

- Official sources of tsunami information
- Evacuation maps & routes
- Local / Distant tsunami response differences
- Natural Warning signs
- Warning systems for your community
- What sirens sound like and verbal message (regular testing)
- How to respond to siren sounding
- Community support network / orgs
Human Response to Warning

People response differently. Considerations are:

- Ages
- Ethnicities
- Genders
- Social status
- Previous experience of hazards
- Proximity to hazard
- Responses of others
Using Existing Infrastructures

- Radio
- TV
- Fire Service - Local sirens
- Police - PA loud-speaker, door-to-door notification
- Coast Guard & Port
- Lifeguards
- Schools, hospitals, retirement homes
Using Technology

Sound Alert
- Sirens
- Church Bells

Voice Alert
- Fixed PA loud-speakers
- Mobile PA loud-speakers
- Telephone auto dialler; telephone trees
- Tone-activated alert radio
- Cell Broadcast
- Aircraft (loud-speakers)

Visual Alert
- SMS text messaging
- Aircraft (Banners)
Assessing Technology

- Availability, serviceability
- Cost: now & on-going
- Time to reach target audience
- Start-up social/institutional effort
- Recurring social/institutional effort
- Based on examples of best practice
- Easy to understand/interpret
- Withstand
  - beach erosion, coastal instability
  - weather, sea level rise, criminal acts, fire, computer systems failure
Communication Technologies for Alert and Notification Applications
Evaluation Criteria and Considerations for Architectures and Systems

Laura Kong, ITIC
Ed Young, NOAA NWS Pacific Region
Kelly Sponberg, NOAA / UCAR JOSS IEPAS
Architecture Concepts of Redundancy: Eliminating Single Points of Failure

- **Circuit Type**: e.g., Cellular | FM Broadcast
- **Carrier**: e.g., Mobile Provider / Carrier | Station
- **Channel**: e.g., SMS | Frequency / Channel
- **Device**: e.g., Mobile Handset, GPRS Modem | Radio Receiver

- Redundancy leads to complexity. Take on only that which can be managed.
Promoting Diversity in the Architecture to Address

- Transition Threats
- **Time of Day Limitations**
- Geographic Coverage
- Reach of Device(s)
- Authentication (Cross Reference)
- Active and Passive Alert Purposes
- Opt In or All Within Coverage
- Device Multipurpose or Single Use
System Specific Considerations

- Costs
  - Differentiate Between Emergency Response and Alert / Notification Systems.
- Deployment
  - Equipment
  - Setup
  - License
  - Training
- Operation and Maintenance
  - Recurring Service Fees
  - Per Message / Use Costs
  - Replacement / Maintenance Costs, E.g.- Replace Batteries
Communication Technologies for Alert and Notification Applications

Int’l to National: EMWIN

ITIC TRAINING PROGRAMME HAWAII (ITP-HAWAII)
ITIC TRAINING PROGRAMME INTERNATIONAL (ITP-INTL)
TSUNAMI EARLY WARNING AND MITIGATION SYSTEMS

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EMWIN: What is it?

- **Emergency Managers Weather Information Network**

- EMWIN provides the emergency management community with access to a set of NWS warnings, watches, forecasts, and other products at no recurring cost.

- SATELLITE – INTL – NATL

- US NOAA GOES satellite constellation as its main dissemination mechanism
EMWIN: Generalized Benefits

- **Beyond equipment, no recurring fee or subscription cost.**
- Very **robust** system, allowing for information to be received via satellite, thereby avoiding many terrestrial hazards.
- **Relatively easy** to operate and deploy.
- Depending upon software, capabilities to re-tranmit, trigger alarms, send e-mails, archive warnings, etc.
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Cellular SMS in Early Warning

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Issues to Address When Using SMS for Alert and Notification

- **Weak Authentication**
  - **SMS sender identifications** (numbers, short codes, etc) easy to spoof. While spoofing in many countries illegal, this does not make it impossible or terribly difficult.
  - Many users may simply **not pay attention** or memorize sender address / ID, allowing spoofing of message formats.
  - Weak authentication can be addressed by **cross posting**, **educating users** on where to find additional information, and use of highly formatted content, user PINs, etc.
  - The more closed the group, the easier it is to address authentication vs. public messaging.
Issues to Address When Using SMS for Alert and Notification

- **Timeliness**
  - Cellular networks are vulnerable to congestion, although during congestion SMS is a better communication alternative to voice. E.g.- Australia wild fire SMS notifications took hours.
  - Timeliness is best addressed by limiting your messaging to a closed group (vs public), as well as entering into a dialog with mobile carriers.
  - Depending upon how messages are sent, you will need to set up your messaging system to scale effectively. Particularly an issue if using GSM modems, or if have weak internet connections to SMSC.
Issues to Address When Using SMS for Alert and Notification

- **Carrier Peering**
  - Carrier peering and agreements are what allow you to send an SMS from one carrier network to another. In some cases such peering and routing relationships do not exist.
  - This is mostly an issue if attempting to message internationally (one country to another) but in-country issues are not uncommon – one carrier not passing SMS from another.
  - Cross carrier messaging is best addressed in the long run through government dialog with the carriers.
  - In the short term it is addressed simply by establishing links (SMSC or modems) on multiple carriers.
Issues to Address When Using SMS for Alert and Notification

- Given issues of timeliness and network resiliency, it is perhaps best to consider cellular SMS as a quickly perishing capability.

- Put another way, after sending first message, do not count on the network being available or timely. Use it as long as you can, but assume in your overall strategy that the system will be ineffective at sending repeated multiple updates.
Issues to Address When Using SMS for Alert and Notification

• Cost
  • On a per message basis, SMS is pretty cheap, however, it is one of the most expensive means of sending information when viewed on a per byte basis.
  • Users in a few countries may be billed for receipt of message, as well as the sender.
  • Cost is easy to determine.
  • Some carriers may be willing to provide free messaging to government entities for alert and warning applications, but do not count on it.
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Terrestrial Radio

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Ed Young, NOAA NWS Pacific Region
Kelly Sponberg, NOAA / UCAR JOSS IEPAS
Multiple Application Scenarios

- **Relaying information on existing FM/AM stations** (commercial or community / non-profit owned).
  - Primarily requires development of partnership, with some consideration of how to timely and reliably pass information. Time intensive, but least expense.
  - **HAWAII EAS**

- **Community Radio Station Setup**
  - Time intensive and costly. Significant listener benefits and trust building.

- **Dedicated Gov / Warning Authority Station**
  - Less time intensive and some significant cost.
  - Very useful for establishing cross-reference authentication, providing detailed message information, and supports many passive roles.
  - **JAPAN JMA NHK**
Cost of Stations

- **Varies widely** depending upon broadcast power, sophistication and automation of equipment, etc.

- A minimal low-power / community FM radio station can be purchased for $6-8K, however, deployment expenses, spare parts, etc., likely means a budget of $25K a station.

- **Licensing with national regulatory agency** may require additional one time or recurring fees.

- **Power, if using solar, wind, or generator, adds another significant upfront and recurring cost.**
NOAA Weather Radio (NWR)

- Nationwide network of radio stations broadcasting continuous weather information directly from the nearest National Weather Service Office
- Broadcasts official National Weather Service warnings, watches, forecasts and other hazard information 24x7
- In conjunction with Federal, State, and Local Emergency Managers and other public officials, NWR also broadcasts post-event information
- With Federal Communication Commission’s (FCC) Emergency Alert System, NWR is an "All Hazards" radio network - Single source for comprehensive weather and emergency information.
NOAA Weather Radio (NWR)

Includes 1000 transmitters, covering all 50 states, adjacent coastal waters, Puerto Rico, the U.S. Virgin Islands, and the U.S. Pacific Territories.

Requires special radio receiver. Broadcasts found in VHF public service band at 7 frequencies (MHz 162.400 162.425 162.450 162.475 162.500 162.525 162.550)
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High Frequency (HF) Radio

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Ed Young, NOAA NWS Pacific Region
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HF Radio: What is it?

- High Frequency (HF) radio is an ‘old’ technology often used in emergency situations for its robustness and ability to transmit over large distances.

- HF is typically used for two-way audio/voice services, but data applications are available and common.

- Bandwidth over HF is extremely limited, so if used for data services, the application should be limited to short text messages.
HF Radio: What is it?

- HF likely already exists in many government entities (police, military, etc), and weather services typically have been licensed some frequencies to use for data recording and exchange.

- Large amateur radio networks exist, which can make HF a valuable tool pre- and post-disaster for getting messages to and from communities.

- Note, however, that day-to-day operations cannot and should not run under ‘HAM’ / amateur licenses.
Communication Technologies for Alert and Notification Applications

Extensible Data Formats

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TSUNAMI EARLY WARNING AND MITIGATION SYSTEMS

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Honolulu, Hawaii USA

Ed Young
Kelly Sponberg
Extensible Formats (XML)

• What is it?
  • Generally associated with web applications
  • Structured data formats widely used as a means of exchanging information in reliable / predictable manner.

• Example
  • **RSS (Real Simple Syndication)** - distribute (syndicate) updated information streams such as news reports, however widely used by meteorological services.
  • **Common Alerting Protocol (CAP)** - XML based data format for exchange of warnings and emergency info.
    • Intent is to ensure a warning / alert can be disseminated over multiple platforms while retaining message integrity.
    • Recognized by ITU. Promoted as part of WIS.
Chatty Beetle: What is it?

- The RANET Chatty Beetle is a text-based alert and messaging device designed by RANET for remote applications where other communications do not exist, are unreliable, or where a simple notification is needed. It is not designed to replace formal means of communicating alerts, but rather serves as a “heads up” notification.
Chatty Beetle: Basic Functionality

- RANET developed the Chatty Beetle in response to needs articulated by the Pacific Communications Steering Committee.
- Uses Iridium Short Burst Data (satellite)
- Hardened terminal designed to operate in harsh environmental conditions.
- Can operate in both fixed and mobile applications.
- Two-way messaging.
- Audible and visual cues for alarms on terminal.
Sending a Alarm from Control Terminal: The control terminal types an alert message with codes to target terminals and set alarm level. This is routed to the Iridium gateway. RANET picks up the message, identifies the associated network, and sends to target terminal(s) AND copies to control node.
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Effective Comms must be Robust, Reliable, Redundant

- **Realistic effectiveness** – robust, reliable
- **Planning for system failure** - redundant
- **Realistic ongoing costs and commitment** - reliable
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Reliable, Robust, Redundant
Alert Communication Technologies
Evaluation Criteria and Considerations

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