AN INTRODUCTION TO PROFESSIONAL EMERGENCY COMMUNICATIONS PREPAREDNESS
INTRODUCTION TO RADIO RELAY INTERNATIONAL

• International in scope
• Universal methods
• Technologically advanced
• Survivable
• Decentralized
• Flexible
HISTORY OF RRI

• Founded in 2016
• Created out of the assets of the old “National Traffic System”
• Dedicated solely to emergency communications preparedness
• Organic in nature. Management selected by election.
• Professional standards
RRI CORPORATE STRUCTURE

• An IRS 501(c)(3) registered nonprofit organization.
• Registered in the State of California as a public benefit corporation.
• Dedicated solely to the development of International emergency communications.
• E-mail reflector for discussion and distribution of news bulletins, etc.
SOME FUNDAMENTALS OF EMERGENCY COMMUNICATIONS:

Four vital characteristics are considered in order of importance:

• Survivability
• Flexibility
• Circuit Capacity
• Security
SURVIVABILITY

• “When all else fails”

• By definition, disasters are catastrophic

• The Amateur Radio Service is not needed unless damage is sufficient to destroy or disrupt commercial and/or government infrastructure.

• Survivability is therefore the FIRST and foremost responsibility of any emergency communications organization.

• Survivable networks facilitate the restoration of networks of greater flexibility or circuit capacity.
FLEXIBILITY

• A communications system is of little value unless it can be deployed where needed.
• Open architecture and network topology are essential to improvisation in time of emergency.
• Each emergency response function has unique requirements. Therefore, some modes better suited to certain emergency response functions.

A diversity of modes is essential to an effective emergency communications system.
CIRCUIT CAPACITY

• Occasionally mistakenly referred to as “bandwidth.”
• Quantity of message traffic that can be conveyed in a given time period.
• Survivability and flexibility are more important than circuit capacity.
• It matters not that one can send 100 encyclopedias per minute if it can’t be done from where it is needed.
• Large quantities of message traffic can be detrimental to the rather slow “human” decision-making process.
SECURITY

Two types:

1. Inherent (natural)
   - Frequency management
   - Mode specialization
   - Radiotelegraphy and digital modes

2. Designed
   - Encoding
   - Encryption (prohibited on Amateur Radio Service frequencies)

Communications security is usually of minimal concern outside of the military or national security environment. Inherent (natural) security is typically sufficient to avoid casual or media scrutiny.
MODE SELECTION

Criteria for mode selection includes:

• Universality (common denominators)
• Efficiency (particularly in the High Frequency Spectrum (3-30 mHz)).
• Suitability to emergency function based on the four basic characteristics.

Examples:

• Voice methods in a patrol car.
• Data communications between an EOC and Incident Command Post.
• HF Radiotelegraph under poor propagation conditions.
RADIOTELEGRAPH

• Narrow bandwidth – More “efficiency per watt.”

• Ideal for operation using long-term renewable energy resources.

• Simple equipment is ideal for field operations, particularly in hostile environments (heat, sandstorms, monsoons, etc.)

“CW” is a universal common denominator – every transmitter/receiver manufactured since the 1920s is CW capable.
CW AND “CASCADIA RISING”

• Major Federal exercise in which RRI members provided connectivity between Alaska, Northern California, Oregon, Utah, Washington State and the FEMA National Response Coordinating Center (NRCC) in the District of Columbia:

  • CW 99.998 percent accurate against five letter cipher groups.
  • CW faster than automated digital modes.
  • Message propagation time from origination to delivery in 10 to 15 minute range.
  • CW proved more reliable than automated digital modes.

*Is CW obsolete? You be the judge.*
CW AND Y2K ROLLOVER

During Y2K event, CW was one of several government and Amateur Radio modes used to provide hourly updates from EOCs, State Police Posts, Prisons and Prison Camps throughout Michigan.

- CW cleared traffic at a rate of 3.75 to 1 over voice methods.
- CW cleared traffic over digital (VHF packet) at a rate of 4 to 1.

*Is CW obsolete? You be the judge.*

*Note:* Data determined by independent third-party analysis.
VOICE METHODS (SSB, FM, ETC.)

- Large operator pool
- **Universal common denominator** - Nearly any HF radio manufactured since the mid 1960s is capable of HF-SSB communications.
- Retention of basic VHF-FM repeater infrastructure supports mutual aid and interchange of operators/volunteers throughout North America.
- Basic radiotelephone skills can be easily developed.

“Have radio will travel.”
DIGITAL METHODS

• Some digital modes offer narrow bandwidth and excellent propagation resistance.
• Some incorporate automatic error correction (except for the “human interface”).
• Capability to convey binary files (documents, photos, spreadsheets, etc.).
• Require additional equipment (laptop, tablet, etc.).
• Value diminishes in the emergency operations environment unless there is access to a printer so hard-copy messages can be delivered.
RRI DIGITAL TRAFFIC NETWORK

- International network infrastructure utilizing PACTOR-3.
- PACTOR-3 backward compatible to PACTOR-1.
- PACTOR affords:
  - Complete automation
  - Error correction
  - Propagation resilience

The RRI “Digital Traffic Network” uses a hybrid mesh, all-RF network topology ideally suited to infrastructure purposes.
OTHER DIGITAL MODES

• Local and state (“section”) emergency communications units and traffic nets are at liberty to build networks around other digital modes.

• The RRI Digital Traffic Network (DTN) supports any digital (or manual) mode network via the “Digital Traffic Station” (DTS) function.

• Standardization is essential at higher levels to facilitate universal interfacing and the automatic routing of message traffic.

Standardization is essential to support mutual aid and interoperability. Emergency communications organizations operating at the local and state level should consider the impact of mode and software selection on mutual aid and interoperability.
DIGITAL TRAFFIC STATION (DTS)

• A properly trained operator or station equipped with PACTOR-1 or greater equipment.

• Registered with the RRI and authorized to access the network.

• Responsible for providing interface between manual mode common denominator (voice/CW) mode or unique digital mode networks and the Radio Relay International DTN infrastructure.

• May be associated with an EMCOMM group, traffic net, agency or NCERT.
DIGITAL TRAFFIC NET EQUIPMENT BANK

- Basic PACTOR modems loaned to DTS appointees.
- RRI retains ownership of modems.
- Modem to be returned if DTS resigns.
- Program intended to rapidly expand DTN operations.
NCERT – “NATIONAL COMMUNICATIONS EMERGENCY RESPONSE TEAM”

• A team of self-sufficient, properly trained operators equipped with:
  • PACTOR for DTN access – Team registered as DTS
  • Radiotelegraph
  • Radiotelephone
  • VHF and UHF-FM
  • Other modes pertinent to local EMCOMM environment within service area

NCERT is NOT a substitute for local emergency communications programs. Rather, it is a team of specialists responsible for supporting major agencies or dedicated to supporting specialized communications functions.
MANUAL MODE NET STRUCTURE

• Facilitates common-denominator (universal) access – Larger pool of operators.
• Provides hands-on training in the management of third party traffic.
• Proven reliability.
• Greater flexibility than digital infrastructure:
  • Point-to-point circuits
  • Special Routings
  • Superior “last mile” connectivity.
  • Ability to respond organically to unpredictable emergency communications problems.

*Manual mode nets offer camaraderie, an operating challenge and universality.*
RRI Central Network topography showing traffic flow and temporal relationship between manual mode net sessions.

Outgoing routine traffic originates at state level at 0100Z.

Incoming routine traffic posted at state level for routing to delivery at 0400Z.

State (section) net times approximate.
Area Nets Cover Western, Central and Eastern Areas of North America
INTER-AREA TRAFFIC NETWORK (IATN)

• Specialized circuits facilitating the exchange of message traffic between Area Networks.

• Radiotelephone (day) and Radiotelegraph (night).

• CW proven to be the most reliable method, particularly under poor propagation conditions.

• Capable of specialized configuration using a National Communications Response Plan to speed traffic throughput.
Inter-Area Traffic Network (IATN) point-to-point circuits linking manual mode networks. Note Cycle 2 (daytime) and Cycle 4 (nighttime). Additional cycles can be added to facilitate 24-hour operations.
DIGITAL TRAFFIC NETWORK

• Infrastructure operates primarily at region, area and International level.

• Interface between state (section) and region/area manual mode nets via DTS.

• DTN gateways optional (encouraged) at local/state level.

• DTN gateways optional (encouraged) at served agency facilities.

• A VHF/UHF DTN gateway is an ideal addition to an ARES® or AUXCOMM unit.
DTN Topography showing modified mesh network. Gateways may be established locally on VHF/UHF. Manual mode networks interface via the DTS function.
EMERGENCY OPERATIONS

Radio Relay International utilizes two network configurations:

• **Routine**: Daily operations time sequenced to route routine message traffic. This configuration is designed to route routine radiograms in a few hours.

• **Emergency**: Networks configured to clear message traffic ASAP. Manual mode nets utilize special routings and network configuration as defined in *National Communications Emergency Response Plan*. 
NATIONAL RESPONSE PLAN - NRP

• Mode/Frequency Matrix specifies frequencies for manual modes.

• Mode/Frequency Matrix specifies region and area DTN hubs with scan frequencies.

• Specific state(s) or section(s) defined as targets for message routing and delivery to served agencies.

• Network Management Coordinator assigned to collect data identifying participating stations, their capabilities, connectivity to specific agencies/NGOs and their operational status.

• Message content can be defined for specific functions.
ACCOUNTABILITY AND NETWORK MANAGEMENT

• Who is responsible for the content of the message and what is his authority?
• When was the content of the message drafted and presented for origination?
• Has the content of the message been superseded by subsequent message traffic?
• What operator/station and network has access to the signatory?
• How important is the message to the originator?

In many cases, it is not sufficient to simply “talk” a message into a microphone.
RADIOGRAM FORMAT

• Defines network topology.
• Assigns accountability.
• Defines temporal context (sequence of message traffic).
• Identifies messages in a large file to facilitate service messages and ease of reference in replies.
• Ensures message remains intact through last mile (message integrity).
• Facilitates automation within automated digital networks.
ORIGINS OF RADIOGRAM FORMAT

• Origins in commercial telegraph practice.
• Analogues in message formats used by Western Union, Postal Telegraph, Radiomarine Corporation (RCA), MacKay Radio, military methods, etc.
• Network management data is similar to the modern e-mail.
• NOT created by the ARRL, but rather, imported from other services.
ICS213 VS. RADIOGRAM

• The ICS213 is designed only for accountability ONLY – “Interoffice Memo.”
• The ICS213 is suitable only for local functions.
• Radiogram incorporates additional network management data to ensure message integrity during transfer between multiple networks/services.
• Radiogram facilitates service messages reporting errors.
• Radiogram defines network topology to ensure that reply messages can be directed to the operator/station who has access to the proper official.
• ICS213 can be conveyed in a radiogram wrapper.

*The Federal Emergency Management Agency has accepted operational message traffic in radiogram format during major national exercises.*
RADIOGRAM COMPONENTS

The *Preamble* includes service data and address.

**Message No.** – Serial number assigned by originating station. Allows one to quickly locate a message in a large file during emergency operations within an EOC or similar facility. The serial number should be kept small to facilitate interoperability between modes.

…REFERENCE MESSAGE 213 CAPT JOHNSON APPROVES ESTABLISHMENT OF TEMPORARY MORGUE AT CLEVELAND INTERMEDIATE SCHOOL….\[redacted\]
**RADIOGRAM**

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<tr>
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**TO:** LT FRANK J NAVIN  
MICHIGAN STATE POLICE EMD  
5512 CANAL ST  
LANSONG MI 48234  
517 555 2323

**MESSAGE:**  
TEMPORARY MORGUE ESTABLISHED AT CLEVELAND  
INTERMEDIATE SCHOOL 13322 CONANT STREET  
HAMTRAMCK 48212

**FROM (SIGNATURE):** DR MILLARD BASS  
DETROIT MEDICAL EXAMINER

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**RADIOGRAM COMPONENTS (CONT.)**

**Precedence:** Defines the importance of the message to the individual or agency whose signature is associated with the message.

- **Routine:** Message of general interest.
- **Welfare:** Message pertaining to the wellbeing of an individual in a disaster area.
- **Priority:** Message that is time-sensitive in nature, including official agency traffic.
- **EMERGENCY:** Life critical (vital) message related to the immediate safety or life of individual(s).
- “Test” (“T”) placed before the precedence in exercise messages.
RADIOGRAM

TO: LT FRANK J NAVIN
MICHIGAN STATE POLICE EMD
5512 CANAL ST
LANSONG MI 48234
517 555 2323

MESSAGE:
TEMPORARY MORGUE ESTABLISHED AT CLEVELAND
INTERMEDIATE SCHOOL 13322 CONANT STREET
HAMTRAMCK 48212

FROM (SIGNATURE): DR MILLARD BASS
DETROIT MEDICAL EXAMINER

WS8EOC 0107Z JUN 16
Handling Instructions (HX) – Optional

- Specifies actions to be taken by either the delivering operator or those handling the message within the network.
- “HXA through HXG”
- See RRI Operating Manual for more details.

Example: HXC: Report time and date of delivery to originating station.
TO: LT FRANK J. NAVIN  
MICHIGAN STATE POLICE EMD  
5512 CANAL ST  
LANSONG MI 48234  
517 555 2323

MESSAGE:  
TEMPORARY MORGUE ESTABLISHED AT CLEVELAND  
INTERMEDIATE SCHOOL 13322 CONANT STREET  
HAMTRAMCK 48212

FROM (SIGNATURE):  
DR MILLARD BASS  
DETROIT MEDICAL EXAMINER

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RADIOGRAM COMPONENTS (CONT.)

Station of Origin:

- Identifies operator/station having access to official/agency whose signature is associated with the radiogram, thereby facilitating the routing of replies.
- Essential network management data.
- The first station of to inject the message into the network.

If W8ABC calls W8XYZ on the phone and asks him to send a message on his behalf, the station of origin is W8XYZ, NOT W8ABC.
**RADIOGRAM**

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RADIOGRAM COMPONENTS (CONT.)

Check (Group Count):

• Number of words or groups in text.

• Preamble, address and signature are NOT counted.

• Mixed groups and number groups, such as a zip code counted as one group.
  Example: 62959: One Group
  Example: 313 878 7100: Three Groups
  Example: MCRD RTBN: Two Groups

• “ARL” precedes the check when an ARL numbered radiogram text is present in
  the message (example: “ARL12”). See RRI Operating Manual for more details.”
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RADIOGRAM COMPONENTS (CONT.)

Place of Origin:

• The location of the person whose signature is associated with the message.
• **NOT** the location of the radio operator who injects it into the network.
• Typically city and state.
• If message was transferred from a non-RRI network, one should append “via” and the organization or network on which it originated.

*Example: “PARIS ISLAND SC VIA MARS”*
RADIOGRAM

MSG. NO. 213  PRECEDENCE P  HX C  STATION OF ORIGIN K8QMN  CHECK 12  PLACE OF ORIGIN DETROIT MI  TIME (UTC) 0103Z  DATE JUN 16

TO: LT FRANK J NAVIN  
MICHIGAN STATE POLICE EMD  
5512 CANAL ST  
LANSing MI 48234  
517 555 2323

MESSAGE:
TEMPORARY MORGUE ESTABLISHED AT CLEVELAND INTERMEDIATE SCHOOL 13322 CONANT STREET  
HAMTRAMCK 48212

FROM (SIGNATURE):  DR MILLARD BASS  
DETROIT MEDICAL EXAMINER

RECEIVED FROM (CALL)  TRANSMITTED TO (CALL)  
TIME DATE  TIME DATE
WS8EOC 0107Z JUN 16
RADIOGRAM COMPONENTS (CONT.)

Time of Origin (Optional):

• Not necessary for routine messages.

• Required for served agency messages.

• Four digit UTC (GMT) preferred.

• Use of UTC eliminates time confusion when messages pass between time zones.

• If local time is used, the time zone must clearly identified and the date adjusted accordingly – see RRI Operating Manual.

Example: “0103Z DEC 2” = “2003 EST DEC 1”
RADIOGRAM

MSG. NO. 213  PRECEDENCE P  HX C  STATION OF ORIGIN K8QMN
CHECK 12  PLACE OF ORIGIN DETROIT MI
TIME (UTC) 0103Z  DATE JUN 16

TO:  LT FRANK J NAVIN
      MICHIGAN STATE POLICE EMD
      5512 CANAL ST
      LANSING MI 48234
      517 555 2323

MESSAGE:
TEMPORARY MORGUE ESTABLISHED AT CLEVELAND
INTERMEDIATE SCHOOL 13322 CONANT STREET
HAMTRAMCK 48212

FROM (SIGNATURE):  DR MILLARD BASS
                    DETROIT MEDICAL EXAMINER

RECIIVED FROM (CALL)  TIME  DATE  TRANSMITTED TO (CALL)  TIME  DATE
WSBEOC  0107Z  JUN 16
RADIOGRAM COMPONENTS (CONT.)

Date of Origin:

- Three letter month and day
- Date based on UTC (radio day), NOT local time.
- New radio day starts at 0001Z.

Example: 0100Z JUN 6 in the Central Time Zone would be the equivalent of 8-PM CDT JUN 5 local time.
TO:  LT FRANK J NAVIN
      MICHIGAN STATE POLICE EMD
      5512 CANAL ST
      LANSING MI 48234
      517 555 2323

MESSAGE:
TEMPORARY MORGUE ESTABLISHED AT CLEVELAND
INTERMEDIATE SCHOOL 13322 CONANT STREET
HAMTRAMCK 48212

FROM (SIGNATURE):  DR MILLARD BASS
                   DETROIT MEDICAL EXAMINER

RECIVED FROM (CALL)  TIME  DATE

TRANSMITTED TO (CALL)  TIME  DATE
WS8EOC  0107Z  JUN 16
Address:

- Address should be as complete as possible.
- Served agency traffic should include title and agency.
- Zip code/postal code **required** on all messages (regardless of mode) for automatic routing via DTN.
- Up-to-date telephone number is extremely helpful for delivery
- Some abbreviation appropriate when direct liaison to a served agency or addressee is available.

*Receipt of traffic initially delivered via e-mail or FAX is often best confirmed with served agency via telephone call (when possible).*
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RADIOGRAM COMPONENTS (CONT.)

Text (Body of Message):

• Routine messages should be limited to 25 words or less when possible.
• Served agency messages have no limit. However, brevity is encouraged to facilitate full interoperability.
• Avoid case-sensitive contents. All-caps default for all messages when possible.
• Use only “X” for period and “QUERY” for “question mark.”

Remember that a message may be originated using an advanced digital mode but it may be transferred to a VHF voice or CW circuit for “last mile” connectivity.
TEMPORARY MORGUE ESTABLISHED AT CLEVELAND INTERMEDIATE SCHOOL 13322 CONANT STREET HAMTRAMCK 48212
RADIOGRAM COMPONENTS (CONT.)

Signature:

• *Routine Messages*: A basic signature is adequate, but additional contact information such as a phone number or e-mail can facilitate replies.

• *Served agency messages*: Require *name, title and agency* to define authority/responsibility for message content.

• One may add additional contact information to served agency messages to facilitate replies and alternative routings:
  • Telephone
  • E-mail
  • Communications network default

*The use of name, title and agency in served agency messages establishes authority for important message content.*
TO: LT FRANK J NAVIN
MICHIGAN STATE POLICE EMD
5512 CANAL ST
LANSing MI 48234
517 555 2323

MESSAGE:
TEMPORARY MORGUE ESTABLISHED AT CLEVELAND
INTERMEDIATE SCHOOL 13322 CONANT STREET
HAMTRAMCK 48212

FROM (SIGNATURE): DR MILLARD BASS
DETROIT MEDICAL EXAMINER
RADIOGRAM COMPONENTS (CONT.)

Administrative Service Data:

• Record station from which message was received and/or to which message was transmitted.

• Record time (UTC) at which message was sent and/or received.

• Record date (UTC) on which message was sent and/or received.

• Optional: Record net/frequency associated with message receipt or transfer (relay).
RADIOGRAM

MSG. NO. 213
PRECEDENCE P
HX C
STATION OF ORIGIN K8QMN
CHECK 12
PLACE OF ORIGIN DETROIT MI
TIME (UTC) 0103Z
DATE JUN 16

TO: LT FRANK J NAVIN
MICHIGAN STATE POLICE EMD
5512 CANAL ST
LANSing MI 48234
517 555 2323

MESSAGE:
TEMPORARY MORQUE ESTABLISHED AT CLEVELAND
INTERMEDIATE SCHOOL 13322 CONANT STREET
HAMTRAMACK 48212

FROM (SIGNATURE): DR MILLARD BASS
DETROIT MEDICAL EXAMINER

RECEIVED FROM (CALL) TIME DATE

TRANSMITTED TO (CALL) TIME DATE

WS8EOC 0107Z JUN 16
EMERGENCY SUPPORT

RRI Supports three types of emergency response:

- **Organizational Response**: Infrastructure for local and state EMCOMM organizations, Federal agencies and relief organizations.
- **Individual Response**: Infrastructure for individual radio amateurs providing basic communications for their neighborhood, CERT organization, SAR team, etc.

*RRI and related traffic nets provide an excellent “ready-made” infrastructure for small EMCOMM groups and individual radio amateurs.*
HOW TO GET INVOLVED:

• The best way: Listen to nets, follow procedures.
• Read the RRI Operating Manual.
• Register with RRI (Radio Operator Registration Form 1601).
• Read back issues of QNI-The Traffic Newsletter.
• Integrate routine traffic handling into weekly, local EMCOMM nets.
• Originate routine messages to family, friends, fellow radio amateurs.
AVOID “DISUSE ATROPHY”

• Radio amateurs can “play” and experiment because they also provide a public service.

• Use Amateur Radio Service facilities instead of commercial facilities for administrative activities, “radiogram QSLs,” to arrange schedules, etc.

• Excessive use of commercial systems to handle basic Amateur Radio Service business undermines our own capabilities and leads to “disuse atrophy.”
MYTHS REGARDING TRAFFIC NETWORKS:

- **Myth**: “Emergency Traffic (welfare, priority or emergency) must be forced through the entire network.” **Truth**: Special procedures facilitate rapid routing or delivery.

- **Myth**: “Delays of routine message traffic is a network design fault.” **Truth**: Routine traffic delivery delays are typically the result of a volunteer deficiency (no outlet).

- **Myth**: “Traffic networks are slow.” **Truth**: Traffic flows quickly through infrastructure.

Most delivery delays within traffic networks are due to a lack of volunteers in the destination area. Under emergency conditions, traffic can be placed on special circuits or taken off of the system at the first available delivery point.
WHY EXERCISE THE ENTIRE SYSTEM?

Routine message traffic is moved through the entire system from point of origin to point of delivery for the following reasons:

• Provides maximum training benefit across the system.
• Keeps nets at all levels active and “well-oiled.”
• Ensures operational readiness.
• Social dynamic – camaraderie, fun, sense of purpose.
WHY HANDLE TRAFFIC?

• The simple answer: It’s fun and beneficial.

• If one can accurately handle routine messages, he is better equipped to handle important served agency messages in time of emergency.

• Traffic work and emergency communications operations requires that one have the ability to communicate at a given time, on specific frequencies and over specific coverage areas. This is far more demanding than contesting or casual operating in which one simply communicates with points that existing RF propagation favors.