SCCo ARES/RACES Data Network
The Next Phase

Santa Clara County ARES®/RACES
Michael E Fox, N6MEF
Revised: 08-Dec-2017
Overview

- The Santa Clara County RACES data network provides emergency communications responders with a reliable, efficient and effective digital network environment that meets the needs of our served agencies.
  - Emergency communications responders: usually amateur radio operators, but could also include CERT personnel and others
  - Primary need (so far): message traffic
  - Reliability: No service outage in over 7 years!
- Until recently, the network provided one service: packet
  - Accessed using VHF amateur radio for maximum county-wide coverage
  - Provides plain text “e-mail” messages plus bulletins, HTML versions of county EOC and hospital forms, 2-way Internet e-mail gateway
- Recent enhancements to the network allow more services
  - The result is poised to be a major step forward in amateur radio EmComm
Service Offering Overview

Managing and moving information during emergencies
Service Strategy

• Initial services have been focused on message, status traffic
  • It’s the bulk of EOC communications needs
  • Even at packet speeds, it’s ~15 time faster than voice!
  • And it’s about to get even faster, with even better message services!

• Future services depend on needs of served agencies and/or amateur radio operator responders
  • Potential next step: intranet, image and file transfer/sharing
  • Other services as the need arises

• Cities can use the network to develop their own services
  • Example: city-wide damage assessment forms with roll-up display in EOC
Packet BBS Service

- E-mail-like service with automated workflow and documentation
- Capabilities:
  - Simple, e-mail-like client
  - Plain text e-mail-like messages
  - Optimized HTML EOC forms
  - Multi-user notices/bulletins
  - Message numbering & tracking
  - Automatic acknowledgement
  - ICS-309 Comm Log generation
  - Internet e-mail Log generation
    - But Internet is not required
- Optimized for low bandwidth
- VHF/UHF radio access
- Availability:
  - RF throughout county
  - Also useful at higher speeds
  - TCP/IP access
New for 2018
Plain Text Conversion Service for Packet
Let’s Packet Users Read Encoded Messages
Reminder (2016):
E-mail to Packet: Conversion to Plain Text

• Most E-mail uses MIME (Multipurpose Internet Mail Extensions) format
  • Packet BBS doesn’t understand MIME

• Most E-mail text is sent as HTML; packet is plain text
  • Most e-mail senders don’t know they need to set plain text mode
  • Even if they do, they may not know how to do it, or they may forget

• Some service providers automatically encode; no choice!
  • Example: Mobile phone text message > HTML > Base64 (ugh!)

• Investigate MIME conversion to plain text in mail gateway
It Turns Out ... It’s REALLY Complicated

Partial List of Text Message Formats

<table>
<thead>
<tr>
<th>Carrier</th>
<th>Text Message</th>
<th>Resulting E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprint</td>
<td>Test</td>
<td>Text &gt; HTML &gt; Base64-encoded</td>
</tr>
<tr>
<td>Verizon</td>
<td>Test</td>
<td>Plain text (subject and body)</td>
</tr>
<tr>
<td></td>
<td>Test (S)(S)(S)</td>
<td>Quoted-printable (subject and body)</td>
</tr>
<tr>
<td></td>
<td>Test (S)(S)(S)(S)</td>
<td>Base64-encoded (subject and body)</td>
</tr>
<tr>
<td></td>
<td>Blah blah blah ... blah Test (S)(S)(S)(S)</td>
<td>Blank (subject and body); file attachment</td>
</tr>
</tbody>
</table>

(S) = Smiley face emoji

- Each client/app is different; any of the above could change at any time
- So, we must handle just about every possible combination
What Should We Do With These Messages?

• We could pass them through “as is” (like we do now)
  • “Test” becomes “VGVzdA==” in Base64 (unreadable)
  • Increasingly, many 3rd party e-mail/text messages will need translation
  • Every packet operator would need local tools (no Internet) and training
  • Recreate or rewrite message before passing on; VERY time consuming
  • Result: no communication or greatly reduced throughput

• We could reject them
  • Sender may not receive or understand a rejection notification
  • Sender may understand, but not have control over the format
  • Sender may have control, but not know how or may forget
  • Result: deadlock; no communication

• Or, we could do something else …
New
Decode / Notify Conversion Filter

• Try (very hard) to get a usable message through
  • Decode to plain text where possible
    • “VGVzdA==” in Base64 becomes “Test” (readable!)
  • Non-text content left encoded for possible manual decoding
    • Recipient sees that “something” is there; can manually decode if needed
  • Notify recipient of other necessary changes
    • Attachments removed
    • Redundant HTML removed

• Only reject messages that we can’t handle at all
  • Currently, only MIME-type message/partial (rarely, if ever, used)

• Result: most likely, a usable message
  • If necessary, recipient can perform further decoding or ask sender for additional clarification
Example: HTML E-mail w/attachments to Packet

Original E-Mail

Packet: Old Behavior

Packet: New Behavior

Before: VERY long and mostly unreadable message
After: Text portion is readable, printable; recipient can decide on rest
Example: Text Message w/ Emojis to Packet

Original Text Message

Packet: Old Behavior

Packet: New Behavior

Before: A completely unreadable message

After: Text portion is readable, printable; recipient can decide on rest
And, in case you were wondering ...
Yes, you can recover the graphics!

Outpost Message

Decoder

Encode/Decode Quoted Printable

This message was modified for compatibility with narrowband radio:
Translated Subject from UTF-8 to quoted-printable
Translated message body from Base64 to quoted-printable
New

Status: Plain Text Conversion Service

• Basic functionality working on development server
• Need to add
  • Error-handling
  • Case of blank body w/ text attachment
• Lots more testing needed; move to test server
• Expect production deployment: Spring 2018
• Result: packet remains compatible with current (and future) encoding methods
New for 2018
Standard Internet E-mail
... no Internet required!
New
E-mail Service

• Standard e-mail service
• Capabilities:
  • Standard server software
  • Standard e-mail client software
    • Recommended: Thunderbird
  • Standard features
    • Rich text formatting, attachments
  • Standard e-mail protocols
    • POP3, SMTP, TLS, SPF, DKIM, ...
• Anti-X measures
• Internet gateway
  • But Internet is not required
E-mail and Packet Servers are Co-Located

- Multiple servers, just like with packet
- Numbered 1-5, just like with packet
- Each city has primary and secondary, just like with packet
- Failure of one doesn’t affect the others, just like with packet

<table>
<thead>
<tr>
<th>E-mail Domain</th>
<th>Location</th>
<th>Co-located Packet BBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>email1.scc-ares-races.org</td>
<td>San Jose (Santa Clara Co office bldg)</td>
<td>W1XSC</td>
</tr>
<tr>
<td>email2.scc-ares-races.org</td>
<td>Crystal Peak (South County)</td>
<td>W2XSC</td>
</tr>
<tr>
<td>email3.scc-ares-races.org</td>
<td>Palo Alto</td>
<td>W3XSC</td>
</tr>
<tr>
<td>email4.scc-ares-races.org</td>
<td>Frazier Peak (above Milpitas)</td>
<td>W4XSC</td>
</tr>
<tr>
<td>email5.scc-ares-races.org</td>
<td>varies (drills, events, incidents)</td>
<td>W5XSC</td>
</tr>
</tbody>
</table>

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2017 High-speed Redundant Backbone Status

Key: WHD = 70 W Hedding; CPK = Crystal Peak; CHH = Channing House (Palo Alto); FPK = Frazier Peak; CAR = Carol Drive; WYG = 55 W Younger

Legend:
- 100+ Mbps
- 10+ Mbps
- 1+ Mbps
- 10+ kbps

When completed, no single site or link outage can interrupt the network
# Account Details

<table>
<thead>
<tr>
<th>Maximum Message Size</th>
<th>10 MB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mailbox quota</td>
<td>50 MB</td>
</tr>
<tr>
<td>• Warnings at 75% and 90%</td>
<td></td>
</tr>
<tr>
<td>Old message expiry and removal</td>
<td>92 days</td>
</tr>
<tr>
<td>• Warnings at 7 days</td>
<td></td>
</tr>
</tbody>
</table>
Example: Mailbox Quota Warning

From postmaster@
Subject Quota Warning
X-Account-Key account16
X-UIDL 1512540327.M672899P10036.
X-Mozilla-Status 0001

Warning: Your mailbox is over 75% full.

For more information, visit:
http://www.scc-ares-races.org/email/email-quota.html
Example: Old Mail Expiry Notice

On our test server only

--- DELETED ---
The following messages were older than the maximum age of 4 days.
They have been deleted.

Date From Subject Mailbox
05-Oct-2017 [redacted] Re: testing for spam INBOX

To prevent expiry (and warnings):
-- Check your mailbox on a regular basis
-- Make sure your e-mail client is NOT set to leave messages on the server

For more information, visit:
http://www.scc-ares-races.org/email/email-service.html

End of report
### E-mail vs. Packet - Summary

<table>
<thead>
<tr>
<th></th>
<th>E-mail</th>
<th>Packet</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUI Interface</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Supports rich text</td>
<td>✓</td>
<td>Plain text</td>
</tr>
<tr>
<td>Supports attachments</td>
<td>✓</td>
<td>No attachments</td>
</tr>
<tr>
<td>Requires higher bandwidth</td>
<td></td>
<td>Requires minimal bandwidth</td>
</tr>
<tr>
<td>Reduced RF coverage</td>
<td></td>
<td>County-wide coverage</td>
</tr>
<tr>
<td>No workflow</td>
<td></td>
<td>Rich EmComm workflow (message numbering, delivery receipts, logging, ...)</td>
</tr>
</tbody>
</table>

- Packet – still best for EmComm
  - Best RF coverage; best EmComm workflow
- E-mail – can help with some 3rd party communications
  - Complex encoding, attachments; but requires more BW; less coverage
Accessing the E-mail Service

• E-mail needs MUCH more bandwidth than packet
  • Larger packets, chattier protocols, attachments, rich text formatting
• To get more bandwidth, we have to use higher frequencies
• Higher frequencies mean less RF coverage
• Access options for our network:
  • TCP/IP at n* Mbps via WiFi: from locations with line of sight to hub
  • TCP/IP at 56+ Kbps via UHF: soon, from most of the county
New

Intra/Internet Service
New
Intra/Internet Service

• Standard TCP/IP connectivity
  • To internal servers (as they are developed)
  • To external, Internet sites

• Capabilities
  • Standard, general TCP/IP service
  • Connect isolated radio room PCs
    • Connect to internal servers or Internet
  • Emergency backup Internet access
  • NOT a replacement for commercial ISP
  • Considering other services
    • Internal DNS, VPN, etc.
Accessing Intranet/Internet

• General web browsing, file sharing, and other services require even more bandwidth than E-mail
• These services are not possible at VHF/UHF; need WiFi
• Access options for our network:
  • TCP/IP at n* Mbps via WiFi: from locations with line of sight to hub
Network Infrastructure Overview

Options for accessing the services
High Level Network Architecture

External Networks: Internet, Amateur Radio Nets, ...

Site 1
- Packet Service
- E-Mail Service
- Primary Connections
  - UHF 56+ Kbps
  - VHF 1200 bps

Site 2
- Redundant WiFi
- Backbone 10n Mbps

Site N
- Alternate Connections

Total of 4 Firewalls

Fixed Locations With Line of Sight

Most places in the county

Anywhere in the county

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Services vs. Access Methods/Speeds

To use the new services, you need one of the new high-speed connections.
General Connectivity Recommendations

• The faster your connection, the more services you can use
• EOCs, hospitals should install WiFi connections, if possible
  • Enables use of all services
  • Line of sight to hub site is required; possible at many EOCs, hospitals
• All fixed sites should install 56+ kbps UHF connections
  • Enables use of e-mail and packet services
  • Available where line of site doesn’t exist
  • Can act as fallback in case of WiFi failure
• All sites (fixed or otherwise) should have 1200 baud VHF
  • Enables packet services; broader coverage
  • Can act as fallback in case of UHF failure
New Updated Web Site

- New “Data” section coming
  - “Packet” is one part of it
- Includes
  - Service details
    - Packet BBS
    - E-mail
    - Intra/Internet
  - Access technology details
    - VHF Packet
    - UHF TCP/IP
    - WiFi TCP/IP
    - Mesh TCP/IP
- Expected: Dec 2017/Jan 2018
Getting Involved Is Easy
And there’s lots to do!
Your City/Agency Needs Your Help

• We have impressive capabilities to offer our served agencies
  • But they don’t know about them!
• Your agencies depend on you to help them understand
  • The services you/we can provide to them
  • What you need in order to provide those services to them
    • Equipment, space, procedures, etc.
• Opportunity for a team effort in each city
  • Use existing expertise and/or gain new expertise in several areas
    • RF: radios, antennas, propagation
    • Networking: TCP/IP, LANs, E-mail, PC software
    • Operations: procedures, documentation, installation, training, support
  • Room for everyone that’s interested to participate
Help Also Needed at the County Level

• Help build, maintain the county network and services
• It’s challenging. But it’s fun!
• Do you want to be a part of making it happen?
• We could use:
  • BBS sysops, Linux sysadmins
  • RF and network engineers
  • Software engineers (shell, Perl, PHP, SQL, …)
  • Installers (electrical, mechanical, tower, …)
  • Testers (services, access methods)
How To Get Connected To The New Services

A recommended approach
How To Get Connected to New Services

• Form a data networking team within your ARES/RACES group
  • Include whoever wants to participate (some lead, some learn)
  • Variety of expertise needed: some technical, some operational
  • Recruit expertise where needed (your city, other cities, county team)

• Form a plan for using the new services within your group
  • Learn more details about the services, network infrastructure
  • How can these services be used within your ARES/RACES group?
  • How can these services benefit your served agencies?

• Investigate options for high-speed connections
  • WiFi: Clear line of sight to a hub site
  • UHF: Line of site not required; but best antenna location is needed
  • Collect details: Lat/Lon, height above ground, etc.
Evaluate WiFi Line of Sight to Hub Location

• Absolute minimum = clear 60% of 1st Fresnel Zone
  • Remember: trees grow; buildings get built, rooftops are modified

• Consider antenna mounting options
  • A clear line of site may require installation on a pole or tower; consider wind load
  • Highly directional antennas must be within (climbing) reach for alignment
  • Longer distances require larger antennas; consider installation, maintenance, wind

1st Fresnel Zone
60% of 1st Fresnel Zone
How To Get Connected to New Services (2)

• Submit site info form (available 1/2018)
• County team verifies line of sight, coverage, signal levels, ...
  • Recommends radio, antenna, cabling, etc.
• Prepare a presentation of your plan for your city/agency
  • Benefits to city/agency of using new services
  • Requirements: equipment, space, access, ...
• Present the plan to your city/agency; get buy-in
  • Funding may take time (government budgets, procedures, ...)
• Keep county team informed of installation plans
  • It helps us to schedule hub site work so we’ll be ready
How To Get Connected to New Services (3)

• Coordinate installation with county team
  • Antenna alignment, signal level checks, routing/firewall updates, ...

• Train users and encourage usage
  • Local procedures, county procedures, troubleshooting, maintenance
  • Weekly check-ins, drills, public service events
For more info:
http://www.scc-ares-races.org