The Winlink 2000
Radio e-Mail Network

E-mail with or without the Internet

Developed by
The Winlink Development Team

Defense Secretary Leon Panetta warns of “Cyber Pearl Harbor”.
What is Winlink 2000

- Worldwide system for sending e-mail via radio
- Provides e-mail from almost anywhere in the world.
- Provides vital support for 10,000+ sailors
- Adopted for contingency communication by many government agencies
- Used by infrastructure-critical NGOs such as International & American Red Cross, Southern Baptist Disaster Relief, DHS Tiered AT&T Disaster Response & Recovery, FedEx, Bridgestone Emergency Response Team, etc.
Emergency Communication

• “... we got nothing when we tried calling out on HF. We tried calling the Maritime Mobile Net, but nothing was out there. As a last-ditch effort, we used Winlink to e-mail the Coast Guard for help. Within an hour, we heard a C-130 plane, and later, a helicopter overhead.”

• *Doug Faunt, N6TQS*

• (Bounty survivor)

• 14 of 16 Crew rescued
Winlink Operating Modes

For efficiency, reliability and flexibility, the Winlink system provides three modes for transferring messages:

- Conventional system that stores messages on CMS “backbone” servers.
- Hybrid MESH network that transfers messages over long distances using automatic HF forwarding.
- Peer-to-Peer direct connections between two client stations without any use of Internet or Infrastructure.
Winlink 2000 Architecture (Conventional Mode)

- CMS
- RMS (gateway)
- Client (you)
Winlink 2000 System Architecture

Hierarchal levels of the Winlink 2000 system:

1. **Client system** – Radio, computer with Winlink software, TNC (or sound card) and you, the end-user!

2. **Radio Message Server (RMS)** – Radio gateway between the client (end-user) and the Winlink system backbone.

   - 5 CMS locations.
   - Redundant, fault-tolerant.
   - Located on 3 continents.
   - One CMS is sufficient for normal system operation.
Winlink Connection Modes

- **HF Pactor 1, 2, 3 and 4** – Fast and reliable but requires an expensive modem ($1500+).
- **HF WINMOR** – “Poor man’s Pactor”. Not as good as Pactor, but operates with inexpensive sound card device ($100). Speed between Pactor 2 and 3.
- **VHF/UHF Packet**
  - **9600 baud** – Fast, reliable, range limited and requires $400 modem (Kantronics or SCS Tracker).
  - **1200 baud** – Slower, but can use inexpensive Byonics TinyTrak-4 modem.
- **Telnet** – Non-radio connection through the Internet. Good for training and use if radio is down or network is busy.
Pactor Speeds (typical k bits per second)
SignaLink External Soundcard for Winmor

- External SignaLink soundcard costs about $100 and works well for Winmor and all other digital modes.
- Connect to computer via USB and radio data port.
What Winlink 2000 Offers for EmComm

- **Flexibility:**
  - Internet-only (Telnet) direct connections to Winlink.
  - Radio link bridge to Internet e-mail
  - Radio-only store and forward messaging
  - Peer-to-peer connections between radio end-users
  - Various levels of security including message encryption

- **Interoperability:** Connect different types of systems
  - Bridge different radio capabilities (VHF/UHF/HF)
  - Bridge protocols: Pactor, Winmor, Packet, Robust Packet
  - Seamless integration with Internet e-mail

- **Geographical dispersion and redundancy for reliability**
What Winlink Offers for EmComm (more)

- Standard e-mail format with many features
  - Binary file attachments (pictures, pdf, spreadsheets)
  - Automatic message compression/decompression
  - Encryption capabilities available to Agencies on non-ham channels
- Time independence
- Ability to collect messages while unattended
- Good operation at most power levels
- Not limited by station-to-station propagation
- Message logging, and ICS report generation
- Wide adoption by EmComm related agencies
Levels of Message Validation & Correction

- **No validation or correction** – RTTY, BPSK-31.

- **Forward Error Correction (FEC)** – Redundant information transmitted so minor errors can be corrected: MT63, Olivia, QPSK-31.

- **Automatic Repeat Request (ARQ)** – Positive or negative packet acknowledgements from receiving station: Pactor, Winmor, Packet, TCP/IP.

- Pactor and Winmor use both FEC and ARQ.

- Only ARQ provides 100% accurate message delivery.

- Accuracy is essential for EmComm.
Disaster Assessment Picture Sent Via Winlink 2000

Public safety systems do fail.

Kentucky ice storm pix from TEMA recon vehicle.

Amateur Radio Safety Foundation, Inc.
RMS Express E-mail Client Program

- Multiple call signs
- Personal message folders
- Contacts address book
- Multiple modes
Composing a Message in RMS Express

Click to start a message

Scott,

This is a test message from Phil.

W4PHS
## RMS Express Channel List

<table>
<thead>
<tr>
<th>Callsign</th>
<th>Frequency (kHz)</th>
<th>Mode</th>
<th>Grid Square</th>
<th>Hours</th>
<th>Group</th>
<th>Distance (Kilometers)</th>
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</table>
Message Receipt Acknowledgements

- Positive acknowledgment that message was received
- Information about message filled in automatically
RMS MessageLog ICS-309 Generator

- Messages during period
- Select folders
- Starting & ending report period
- Generate ICS-309 pdf file

Amateur Radio Safety Foundation, Inc.
# Generated ICS-309 PDF Message Log Report

## Communications Log

<table>
<thead>
<tr>
<th>Time</th>
<th>From</th>
<th>To</th>
<th>Subject</th>
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<td>10-Sep-2011 08:21</td>
<td>KA4OGB</td>
<td>KH4FR</td>
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<td>WK4L2K Rest stop 3 shutting down</td>
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</tbody>
</table>
Concern About “Cyber-Pearl Harbor” Attack

- *The New York Times, October 11, 2012*

“The most destructive possibilities, Mr. Panetta said, involve ‘cyber-actors launching several attacks on our critical infrastructure at one time, in combination with a physical attack.’ He described the collective result as a ‘cyber-Pearl Harbor that would cause physical destruction and the loss of life, an attack that would paralyze and shock the nation and create a profound new sense of vulnerability’.”
Winlink Without the Internet

• *The New York Times, Feb. 28, 2014*

“Mobile, landline and Internet access has been cut off in parts of the Crimea region, according to a statement from Ukrtelecom, the Ukrainian National Telecommunications operator.

“The company said on Friday that ‘unknown people seized several communications hubs in Crimea’ and damaged fiber-optic cable belonging to the company. As a result, the company said it had ‘lost the technical capacity to provide connection between the peninsula and the rest of Ukraine and probably across the peninsula, too.’”
Radio-Only Winlink Network (No Internet)
Key Points About the Winlink Hybrid Network

- Wide-area, MESH network using HF forwarding.
- Currently providing nation-wide e-mail support for MARS, SHARES and civil agencies.
- Satisfies DoDI requirement for radio-only operation.
- Uses standard Winlink client e-mail programs.
- Supports standard e-mail with file attachments.
- Message routing is dynamic and fully automatic.
- Radio Message Servers (RMSs) run in normal Winlink Internet mode and switch automatically to radio-only network mode to forward radio-only messages.
- Users can connect using Pactor, Winmor or Packet.
- Pactor is used for backbone links between RMSs.
Selecting Message Pickup Stations

- During radio-only (no Internet) operation, messages sent to you will be stored in databases on the RMSs you select as your **Message Pickup Stations** (MPS).
- Each person can select up to 3 MPS, but to reduce network traffic, it is recommended that only 2 MPS be used.
- A duplicate copy of each message is delivered to each MPS, and you can pick up your messages from either MPS.
- Once a message has been downloaded from one MPS, RMS Express will not download the same message from another MPS.
- You can register MPS with RMS Express using an Internet connection or a radio message.
Updating the MPS List and Selecting MPS

Select first MPS
Select second MPS
Register MPS via Internet

Download list of available MPS via Internet
Display list of available MPS
Queue radio message to register MPS

When operating in radio-only mode, incoming messages will be held on the designated Message Pickup Station RMS until you pick them up.
Sending/Receiving Radio-Only Messages

• Compose one or more messages to send
• Open a “Radio-only” Pactor or Winmor sending session
• Select the hybrid RMS
• Start sending

Select Pactor or Winmor Radio-only session on main screen
Open a Pactor or Winmor Sending Session and Click the Button to Select Channels

Select RMS channel
Select a Hybrid RMS Channel

<table>
<thead>
<tr>
<th>Callsign</th>
<th>Frequency (kHz)</th>
<th>Mode</th>
<th>Grid Square</th>
<th>Hours</th>
<th>Group</th>
<th>Distance (mi)</th>
<th>Bearing (Degrees)</th>
<th>Path Reliability Estimate</th>
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</table>

Update channels by Internet or radio
Make sure list of radio-only RMS is selected
Double click the channel you want to select

Amateur Radio Safety Foundation, Inc.
Adaptive Message Routing Through MESH Network

- Fully automatic, wide-area MESH network routing.
- Not limited by source-to-destination propagation.
- If a direct link is not available to the destination MPS, intermediate RMS will relay the message.
- The optimum path is computed by each RMS based on HF propagation estimates, time of day, Pactor speed, message size and other factors. This is Adaptive Routing.
- Each intermediate RMS recomputes the optimum path.
- If a RMS is unavailable, the system will route around it.
- Busy RMS are tried a few times and then routed around.
- Radio messages can be relayed through RMS that are or are not connected to the Internet.
Winlink Peer-To-Peer Radio-Only Operation

- Peer-to-peer: direct radio connection between end-users
- The Internet is not used, all communication by radio.
- Only the two client stations are involved.
- 100% error-free transmission and file attachments.
Conclusion

- Winlink use continues to grow, especially for EmComm.
- The Winlink Development Team continues to enhance capabilities to adapt to changing needs.
- Winlink now has three modes of operation:
  - Conventional connections to a CMS backbone server
  - Hybrid (Radio-only) MESH network with HF relaying
  - Peer-to-Peer connections between client stations
- The new Winlink Hybrid Network allows Winlink to continue handling messages via HF forwarding if the Internet is down.
- Steady improvements are being implemented.
• Thank you!

• Questions?

• Information about Winlink can be found at www.winlink.org

• White papers about Winlink can be found at www.qrz.com/db/W4PHS