



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

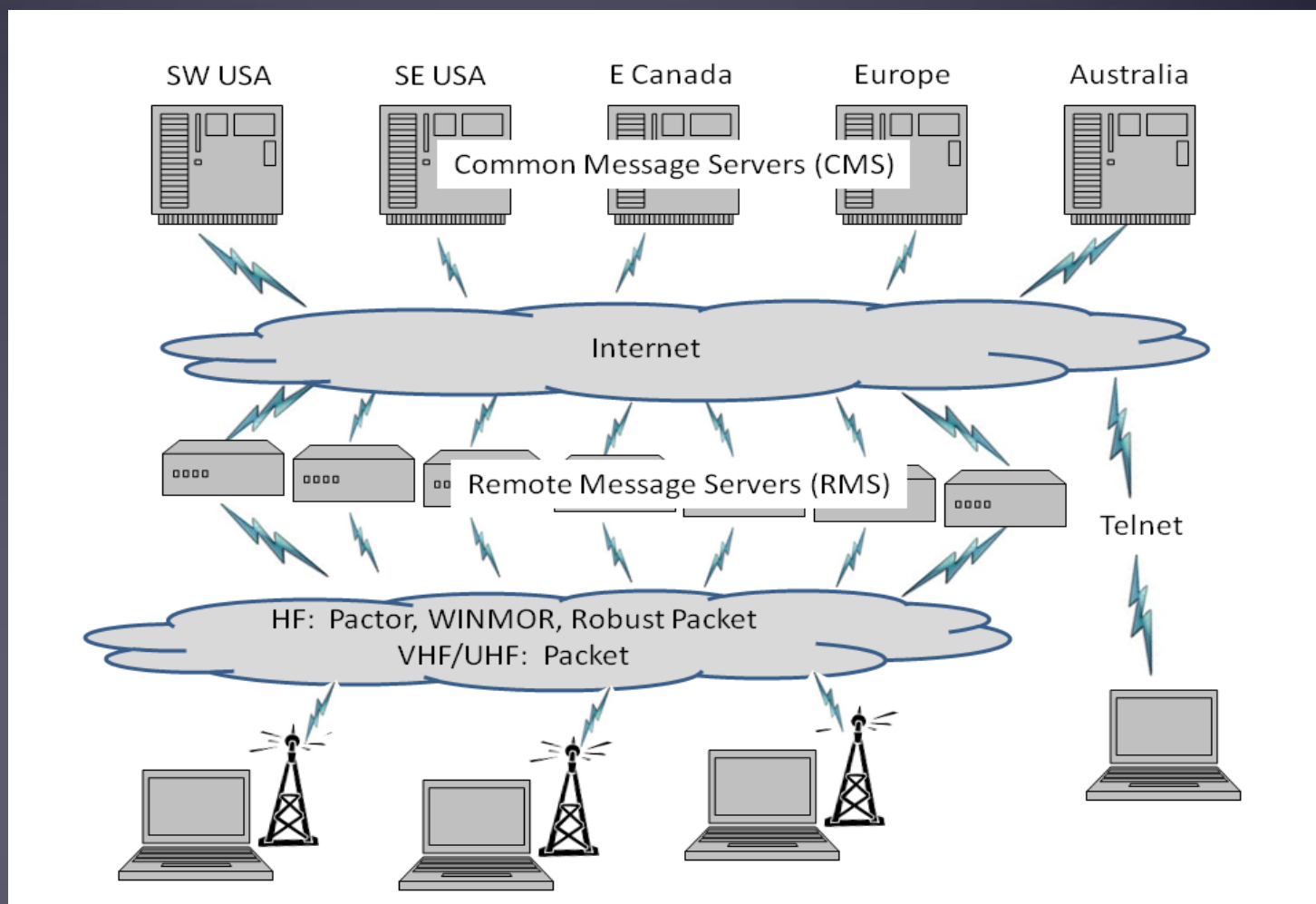


Winlink Operating Modes

- 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

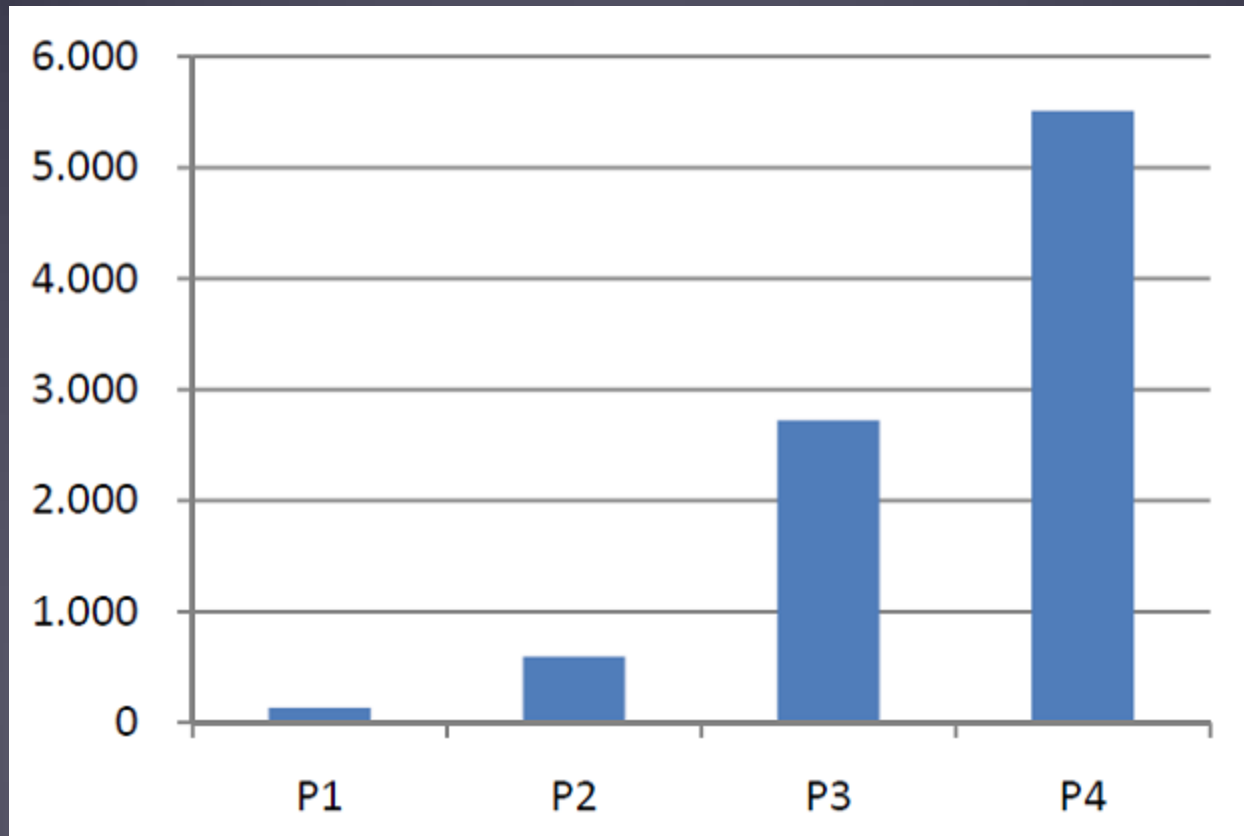
Hierarchical levels of the Winlink 2000 system:

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.
3. ***Common Message Servers (CMS)*** – Winlink 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.



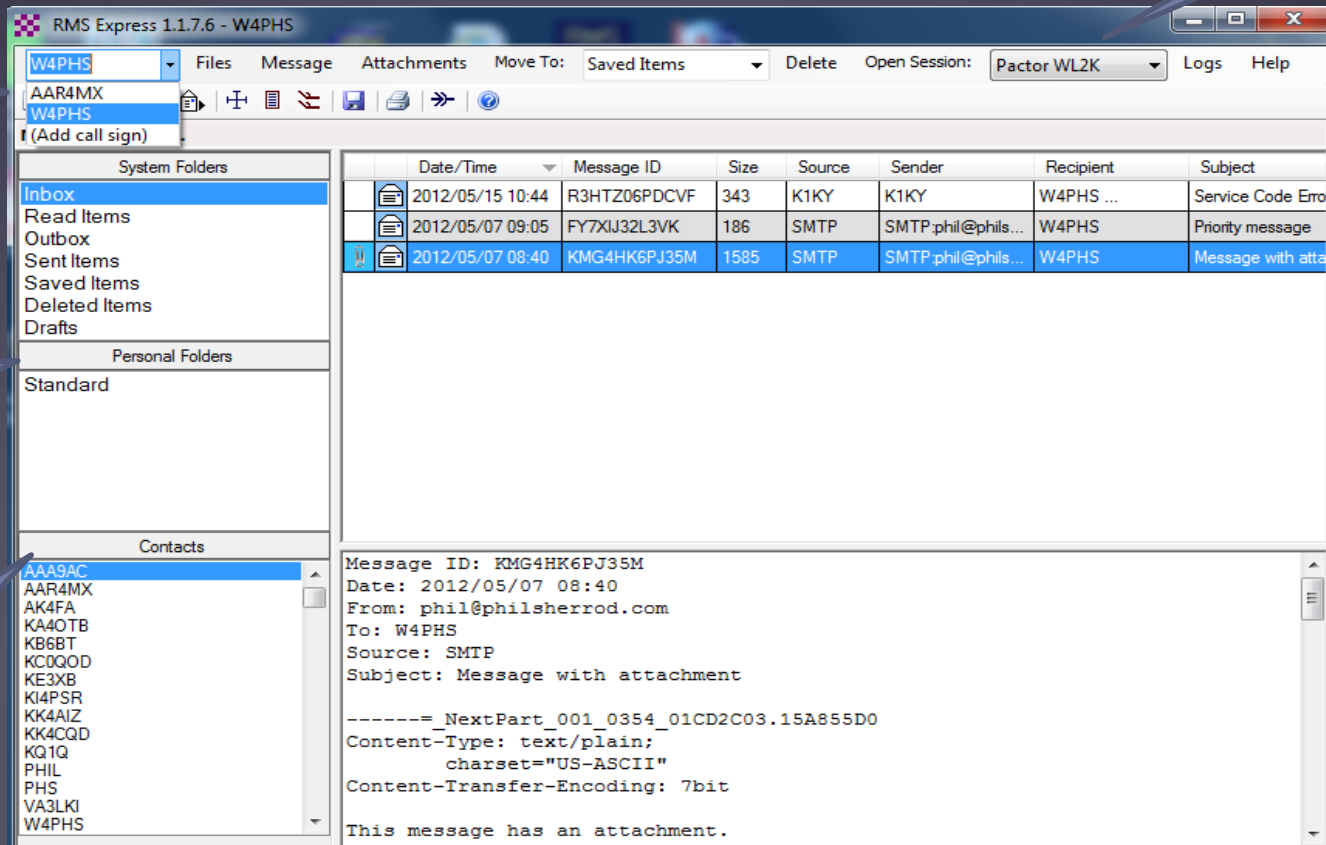
RMS Express E-mail Client Program

Multiple modes

Multiple call signs

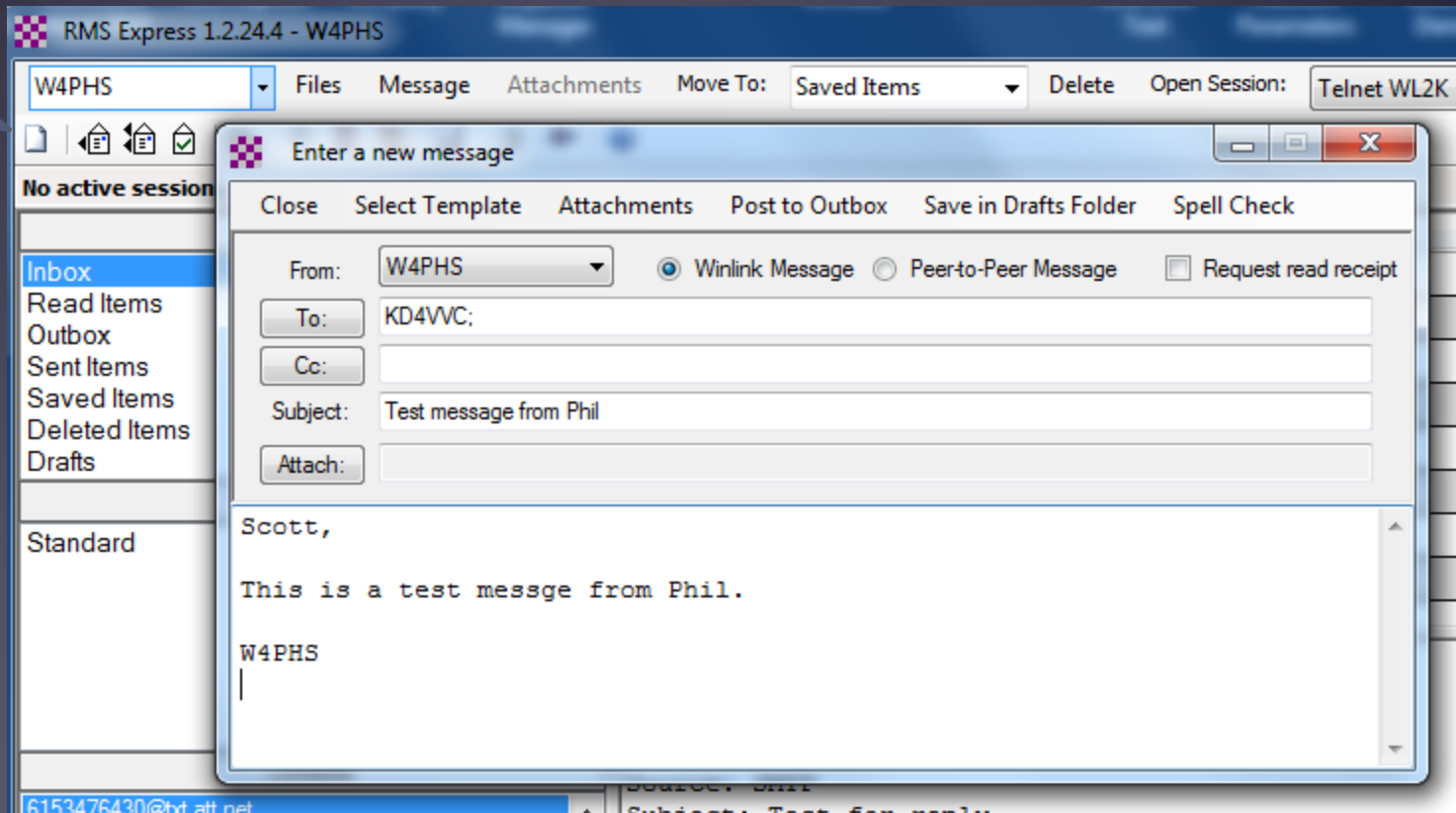
Personal message folders

Contacts address book



Composing a Message in RMS Express

Click to
start a
message



RMS Express Channel List

HF Channel Selector

Exit	Filter	Select	Update Table	Update Table Via Radio	SSN			
Factor channels available at 1200Z, Up to 20000 Kilometers, Q >= 12								
Callsign	Frequency (kHz)	Mode	Grid Square	Hours	Group	Distance (Kilometers)	Bearing (Degrees)	Path Quality Estimate
N0IA	7063.900	P1, P2, P3	EL98JV	00-23	PUBLIC	952	145	48
HP2XBA	21102.900	P1, P2, P3	EJ88RK	00-23	PUBLIC	3095	171	48
AE5R	10141.200	P1, P2, P3	EL16DE	00-23	EMCOMM	1499	226	48
KN6KB	7083.000	P1, P2	EL98PF	00-23	PUBLIC	1041	144	48
W5SEG	7098.500	P1, P2, P3	EL19AN	00-23	EMCOMM	1258	238	47
HP2XBA	18119.000	P1, P2, P3	EJ88RK	00-23	PUBLIC	3095	171	47
W0MAC	7101.200	P3	EM20GB	00-23	EMCOMM	1037	233	47
W0MAC	7066.900	P1, P2	EM20GB	00-23	EMCOMM	1037	233	47
KB5HCD	7096.000	P1, P2	EL29FU	00-23	PUBLIC	1058	232	47
W5SEG	7067.500	P1, P2, P3	EL19AN	00-23	EMCOMM	1258	238	47
KK5AN	7103.400	P3	EM11CC	00-23	PUBLIC	1147	245	47
KJ6VW	21122.500	P1, P2, P3	FK87ML	00-23	PUBLIC	3125	125	47
VE1YZ	14114.000	P1, P2, P3, P4	FN04BQ	00-23	PUBLIC	2102	030	47
VA3LKI	7092.000	P1, P2, P3, P4	FN04CR	00-23	PUBLIC	1137	030	47
KB5HCD	7065.300	P1, P2	EL29FU	00-23	PUBLIC	1058	232	47
KF5JJK	7105.900	P3	EM02DK	00-23	EMCOMM	1243	255	46
WB0TAX	10143.700	P3	EM32GI	00-23	PUBLIC	729	238	46
K6IXA	14063.900	P1, P2	CM97QI	00-23	PUBLIC	2994	283	46
K6CYC	14108.500	P3	DM03SX	00-23	PUBLIC	2870	275	46
K6IXA	14102.700	P3	CM97QI	00-23	PUBLIC	2994	283	46

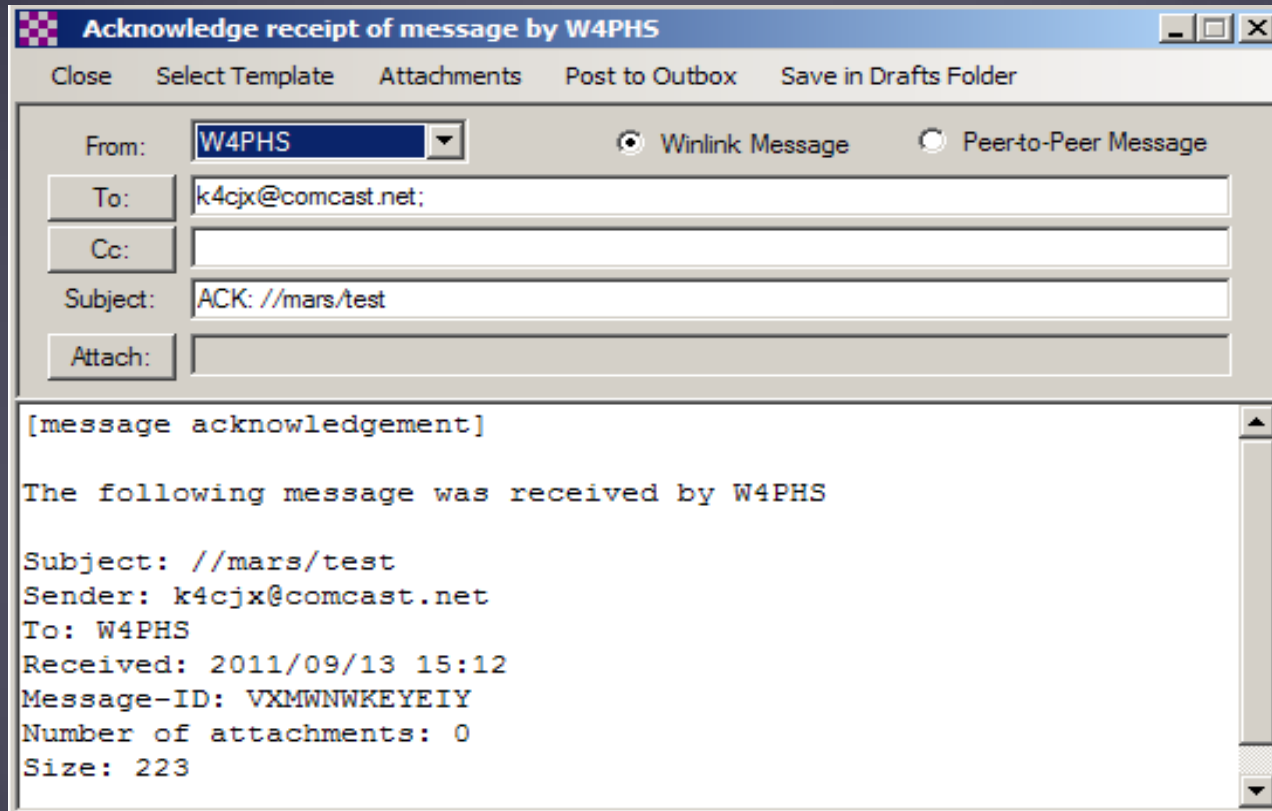
Estimate of
Signal Path
Quality

Service Code
Group

Pactor Modes

Message Receipt Acknowledgements

- Positive acknowledgment that message was received
- Information about message filled in automatically



The screenshot shows a window titled "Acknowledge receipt of message by W4PHS". It has a menu bar with "Close", "Select Template", "Attachments", "Post to Outbox", and "Save in Drafts Folder". Below the menu bar, there are fields for "From:" (set to "W4PHS"), "To:" (set to "k4cjsx@comcast.net;"), "Cc:" (empty), "Subject:" (set to "ACK: //mars/test"), and "Attach:" (empty). There are two radio buttons: "Winlink Message" (selected) and "Peerto-Peer Message". Below these fields is a large text area containing the following text:

```
[message acknowledgement]

The following message was received by W4PHS

Subject: //mars/test
Sender: k4cjsx@comcast.net
To: W4PHS
Received: 2011/09/13 15:12
Message-ID: VXMWNWKEYEIIY
Number of attachments: 0
Size: 223
```

RMSMessageLog ICS-309 Generator

RMS Express Message Log Report Generator by W4PHS

RMS Express Message Log

Call sign of station: WC4EOC-2

Log	Time	From	To	Subject
Sent	5-Nov-2011 02:31	WC4EOC-2	KA40TB	//WL2K Test message from exchange 28
Read	5-Nov-2011 02:31	KA40TB	WC4EOC-1;C4EOC-2;K...	CP-3 Message5
Read	5-Nov-2011 02:31	KA40TB	AK4GD-5;I4PSR;C4EO...	CP-2
Read	5-Nov-2011 02:31	KA40TB	WC4EOC-1;C4EOC-2;K...	CP-1
Sent	5-Nov-2011 02:44	WC4EOC-2	KI4PSR	//WL2K Hi from exchange 28
Read	5-Nov-2011 02:46	KA40TB	WC4EOC-2	Re: Test message from exchange 28
Sent	5-Nov-2011 03:06	WC4EOC-2	jon@aristoworks.com	//WL2K Test
Read	5-Nov-2011 03:19	jon@aristoworks.com	WC4EOC-2	Re: Test
Sent	5-Nov-2011 03:54	WC4EOC-2	WC4EOC-3	//WL2K Orion

Refresh message list

Logs to include

☒ Inbox ☒ Read Items ☒ Outbox ☒ Sent Items ☐ Saved items ☐ Drafts ☐ Deleted items

Date-time range for log entries

☒ Limit start date/time: 5-Nov-2011 00:00 Set start date ☐ Limit end date/time: Set end date

Generate message log reports

Generate ICS-309 report Generate CSV file

Program settings and information

Program settings Help Program information

Exit

Messages during period

Select folders

Starting & ending report period

Generate ICS-309 pdf file

Generated ICS-309 PDF Message Log Report

[illegible]

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’.”

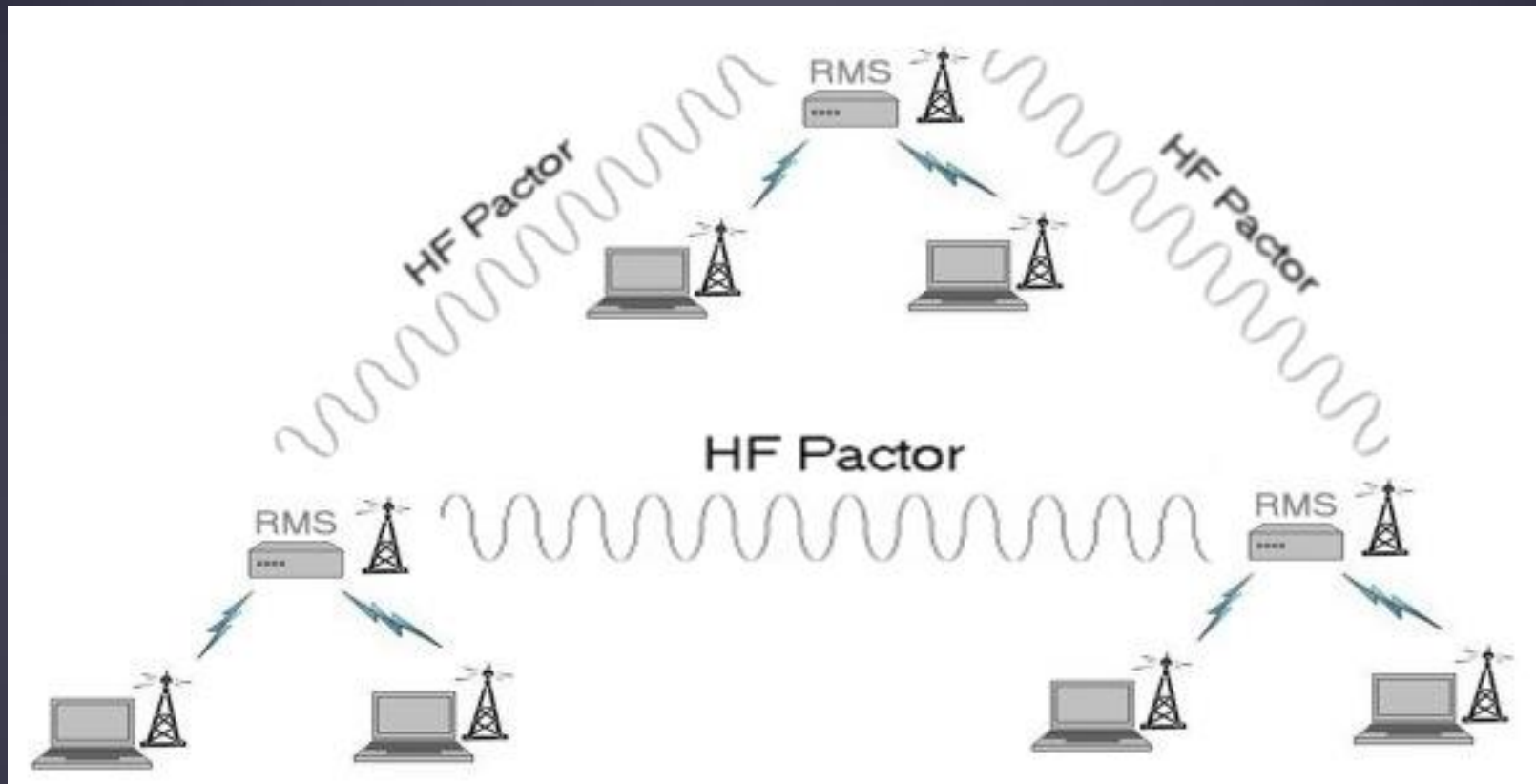
Winlink Without the Internet

- *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

The screenshot shows the 'Hybrid Network Parameters' dialog box. It contains a text box explaining that parameters control message flow. Below this is the 'Message Pickup Stations (MPS)' section with three dropdown menus for MPS 1, 2, and 3. Callouts point to these menus: 'Select first MPS' for MPS 1, 'Select second MPS' for MPS 2, and 'Register MPS via Internet' for the 'Register MPS via Internet' button. To the right of the dropdowns are three buttons: 'Update list of RMS available as MPS' (highlighted with a blue border), 'Display list of RMS available as MPS', and 'Queue radio message to register my MPS'. Callouts point to these buttons: 'Download list of available MPS via Internet' for the first, 'Display list of available MPS' for the second, and 'Queue radio message to register MPS' for the third. At the bottom of the dialog is a checkbox 'Add /auto/ to subject lines' and 'Save' and 'Cancel' buttons.

Parameters specified on this screen control the flow of messages when they are being sent via radio-only forwarding.

Message Pickup Stations (MPS)

MPS 1: N5TW

MPS 2: VE1YZ

MPS 3:

Register MPS via Internet

Update list of RMS available as MPS

Display list of RMS available as MPS

Queue radio message to register my MPS

Last update: 2014-04-25-11:02

When operating in radio-only mode, incoming messages for you will be held on the designated Message Pickup Station RMS until you pick them up.

☐ Add /auto/ to subject lines

Save Cancel

Select first MPS

Select second MPS

Register MPS via Internet

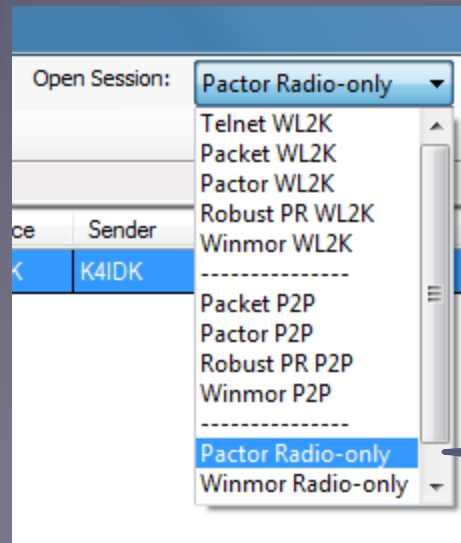
Download list of available MPS via Internet

Display list of available MPS

Queue radio message to register MPS

Sending/Receiving Radio-Only Messages

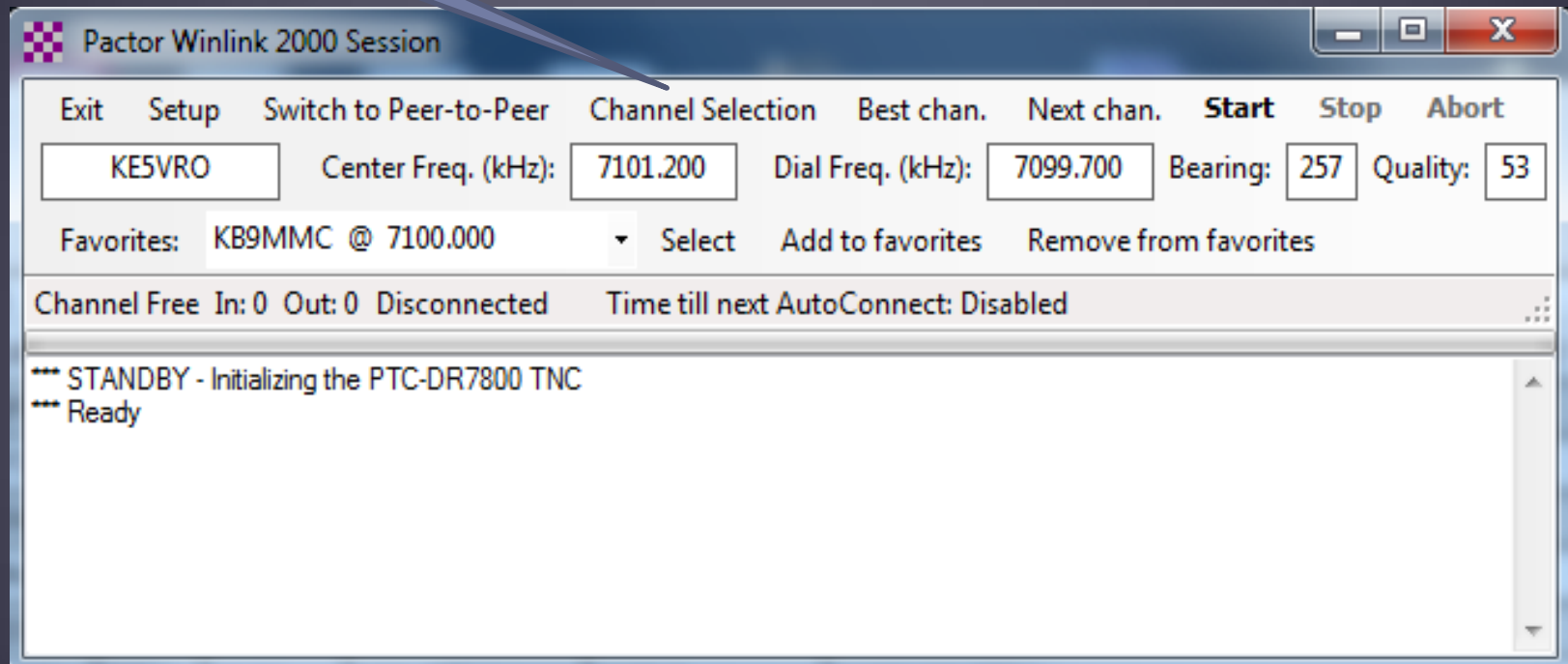
- Compose one or more messages to send
- Open a “Radio-only” Pactor or Winmor sending session
- Select the hybrid RMS
- Start sending



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

Update channels by
Internet or radio

HF Channel Selector

Exit Select Update Table Update Table Via Radio SFI Radio-only capable RMS

Callsign	Frequency (kHz)	Mode	Grid Square	Hours	Group	Distance (mi)	Bearing (Degrees)	Path Reliability Estimate	Path Quality Estimate
KC4TVO	10139.500	P3	EM85WX	00-23	PUBLIC	265	089	80	49
N4MEH	10143.700	P4, P3, P2, P1	EM84QM	00-23	PUBLIC	261	112	80	48
WX4J	14066.900	P2, P1	EM90EB	00-23	PUBLIC	511	142	72	47
K8KHW	10134.500	P2, P1	EM99UJ	00-23	PUBLIC	388	051	71	46
KN6KB	14066.500	P2, P1	EL98PF	00-23	PUBLIC	647	144	66	44
KN6KB	14110.500	P3	EL98PF	00-23	PUBLIC	647	144	66	44
VA3LKI	14112.000	P4, P3, P2, P1	FN04CR	00-23	PUBLIC	706	030	63	44
KK5AN	14098.700	P3	EM11CC	00-23	PUBLIC	713	245	61	43
WB9AYD	14098.700	P3, P2, P1	EL87SF	00-23	PUBLIC	660	156	65	43
W5WSR	14105.600	P3, P2, P1	EL29GA	00-23	PUBLIC	694	228	62	43
KC4TVO	7103.700	P3, P2, P1	EM85WX	00-23	PUBLIC	265	089	61	43
N5TW	14110.000	P3	EM10CP	00-23	EMCOMM	729	243	60	43
N4MEH	7104.500	P4, P3, P2, P1	EM84QM	00-23	PUBLIC	261	112	61	42
WX4J	10143.400	P3	EM90EB	00-23	PUBLIC	511	142	57	42
KE5VRO	7101.200	P3, P2, P1	EM34UU	00-23	EMCOMM	315	257	52	41
VA3LKI	18108.500	P4, P3, P2, P1	FN04CR	00-23	PUBLIC	706	030	50	40
KE5VRO	7068.900	P2, P1	EM34UU	00-23	EMCOMM	315	257	52	40

Make sure list
of radio-only
RMS is
selected

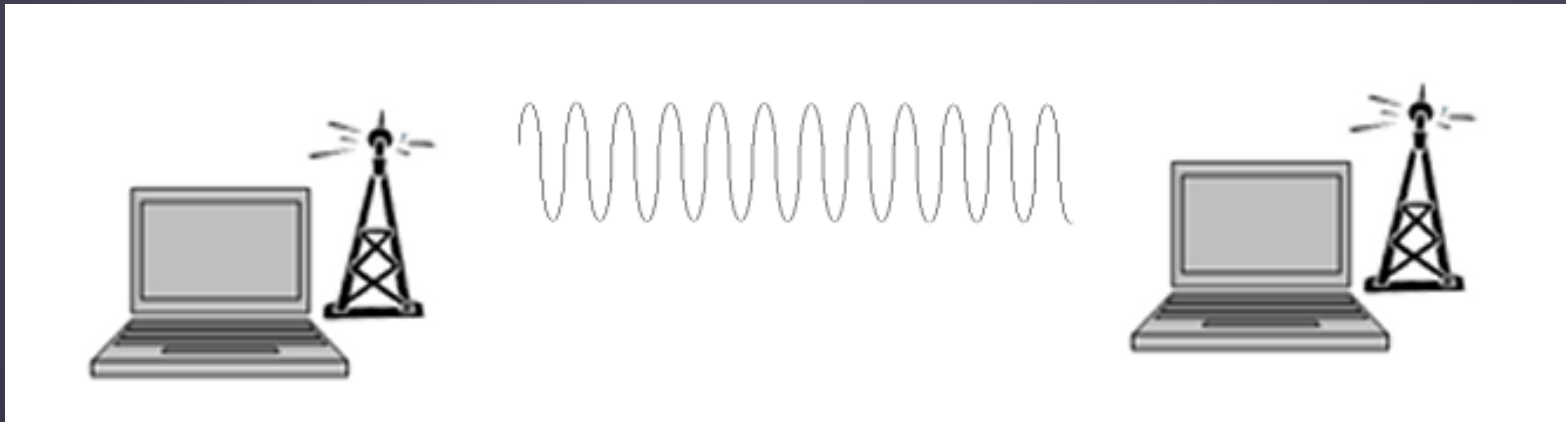
Double click
the channel
you want to
select

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