The Winlink Radio e-Mail Network

E-mail with or without the Internet

Phil Sherrod, W4PHS

Developed by
The Winlink Development Team

Defense Secretary Leon Panetta warns of “Cyber Pearl Harbor”.

What is Winlink

- Worldwide system for sending/receiving e-mail via radio
- Provides e-mail from almost anywhere in the world.
- Mature, well-tested and full featured system.
- Adopted for contingency communication by many federal, state and county government agencies
- Used by the National Guard (14 units in Tennessee)
- 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.

Primary Winlink Networks

- **Amateur ("ham") radio**. Over 10,000 amateur users are registered. Winlink is used by most off-shore sailors. Operates within the international amateur radio frequency space.
- **SHARES** – Federal system providing HF radio contingency communication for federal agencies. SHARES operates on NTIS, federal frequencies that are not part of the amateur radio frequency space.
- **MARS** – Military Auxiliary Radio Service. Provides contingency communication for U.S. military. Operates in NTIS MARS radio frequency space.

Southeastern SHARES Winlink Users

- TEMA: RMS Gateway at State EOC, 4 mobile, Command bus.
- Williamson County sponsored RMS Gateway
- Madison County RMS (TEMA West) RMS Gateway
- Knox County RMS (TEMA East pending) RMS Gateway.
- Cumberland County RMS Gateway.
- National Guard has 14 locations using NCC SHARES Winlink.
- 65 EMA counties, 48 EMS counties, 24 Hospitals including Vanderbilt University Life Flight.
- NGO: FedEx, Bridgestone Emergency Response Team and AT&T Disaster response team units.
- Central United States Earthquake Consortium (CUSEC): IL, IN, MO, KY, AR, TN, AL, MS.
- Tennessee Department of Transportation
- Tennessee Department of Health (next slide).

Winlink Has Been Used in Many Incidents

Disaster Assessment Picture – Kentucky Ice Storm

Kentucky Ice Storm 2009

Cell, Land-line or Fax? NO!

- Air Card? NO!

-Public Safety, Mutual Aid? NO!

- Satellite/Microwave? NO!

-Winlink Radio E-Mail?
Yes! Mobile from a TEMA vehicle.

This picture was one of several sent by TEMA mobile through the Winlink radio email system.

What Winlink Offers for EmComm

- Reliability, Accuracy and Flexibility:
  - High reliability (99.99% availability for 15 years)
  - 100% accurate message transmissions.
  - Radio connection bridge to Internet e-mail
  - Radio-only store and forward without Internet
  - 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.
- 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
  - Encrypted attachments using the encryption program you choose. No need to convert to letter groups.
- Time independence and frequency agility
- Stores messages for pickup at a later time.
- Good operation at most power levels
- Not limited by station-to-station propagation
- Automatic message logging, and ICS report generation
- Wide adoption by EmComm related agencies

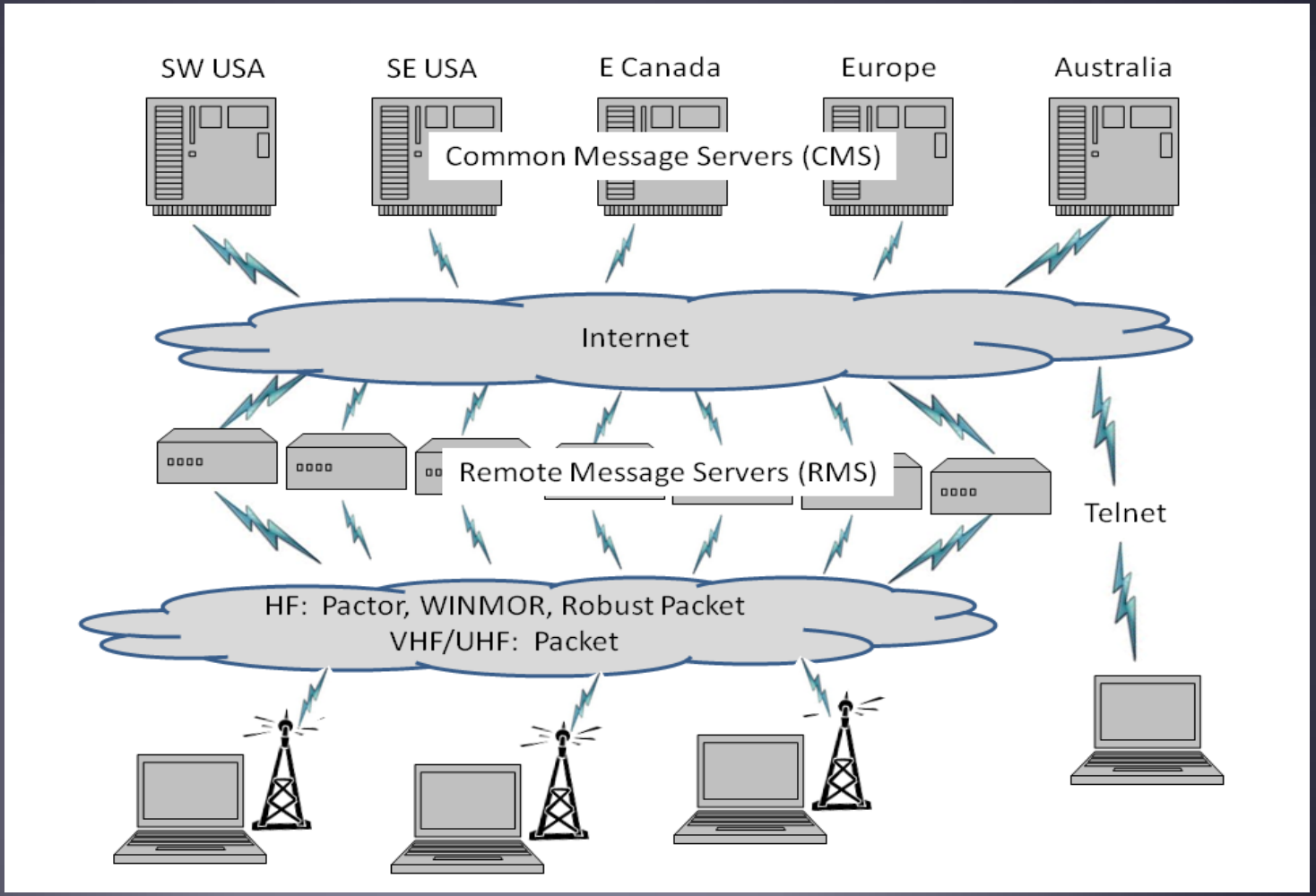
Winlink System Components

Hierarchal levels of the Winlink 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 Architecture (Conventional Mode)

- CMS
- RMS (gateway)
- Client (you)



Winlink Connection Modes

- **HF Pactor** – Fast but expensive - $1,500.
- **HF WINMOR** – "Poor man's Pactor". $100 or $0.
- **VHF/UHF Packet – 9600 baud, $400. 1200, $100.**
- **Telnet** – Non-radio connection through the Internet. Good for training or if no radio.
- **Iridium GO!** – Satellite phone connection.
- **MESH network** to Winlink "Post Office" (RMS Relay).
- **Telnet peer-to-peer** between to Express users.

Winlink Express E-mail Client Program

-

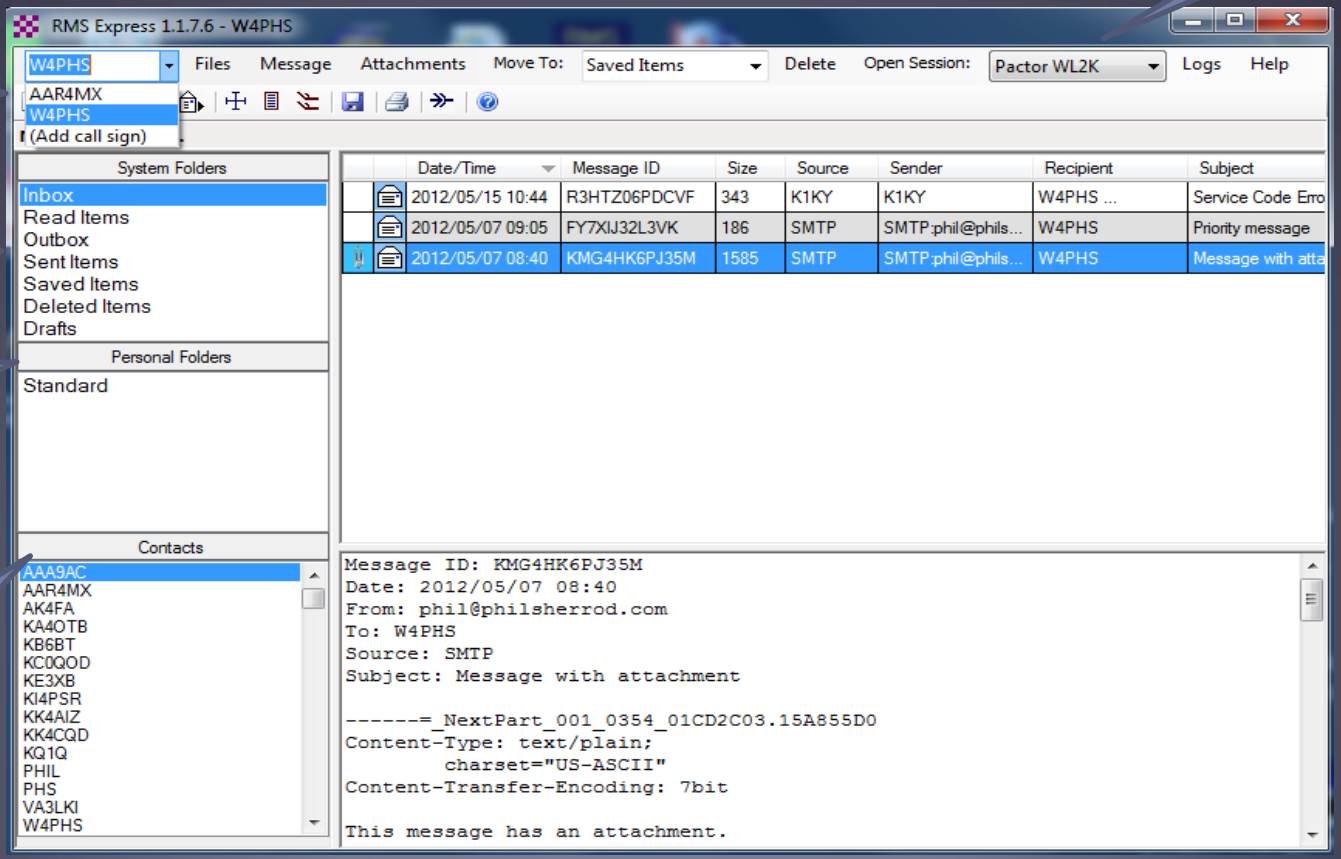
Multiple call signs

In-box, Out-box, etc.

Personal message folders

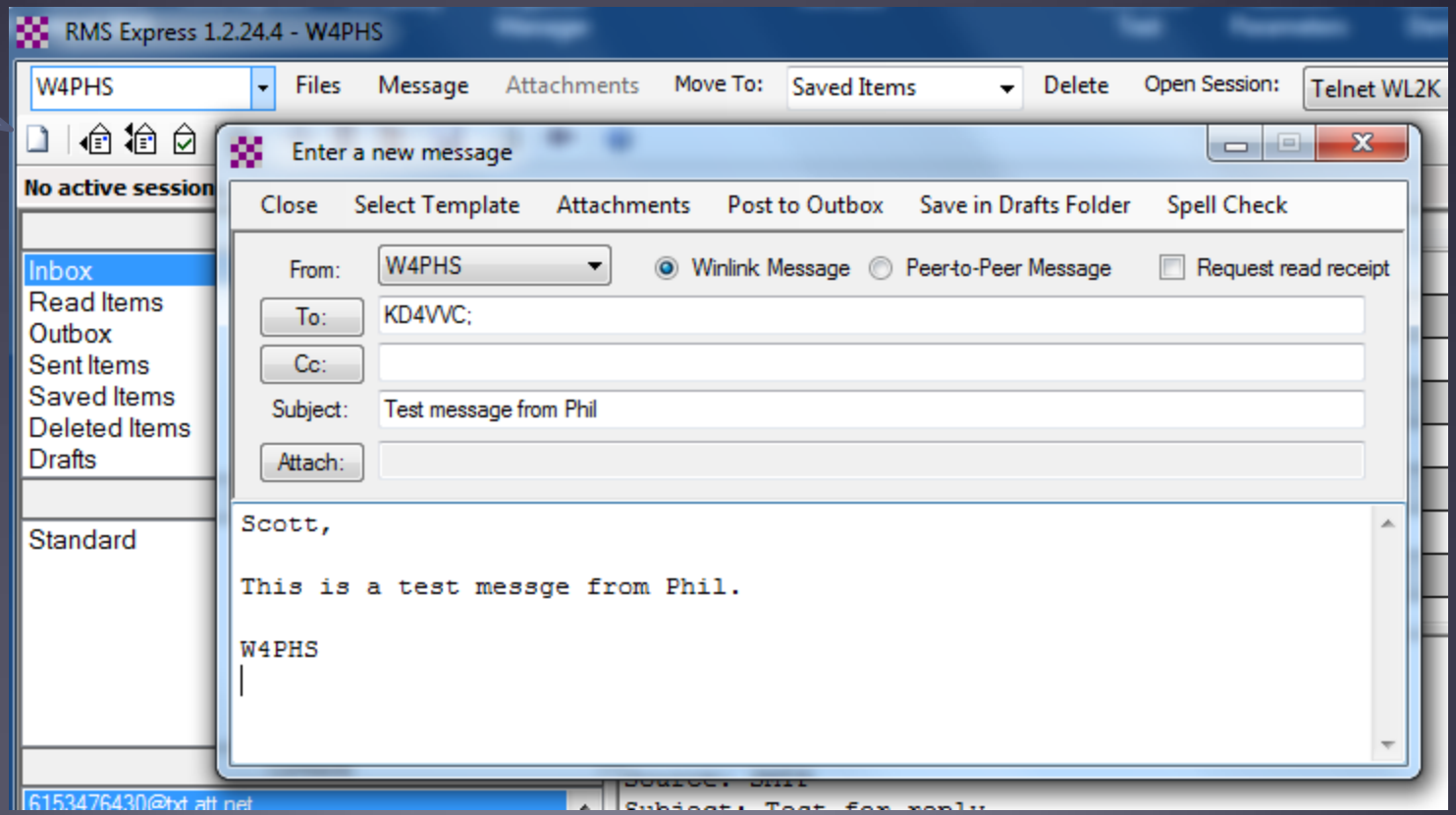
Contacts address book

Multiple modes



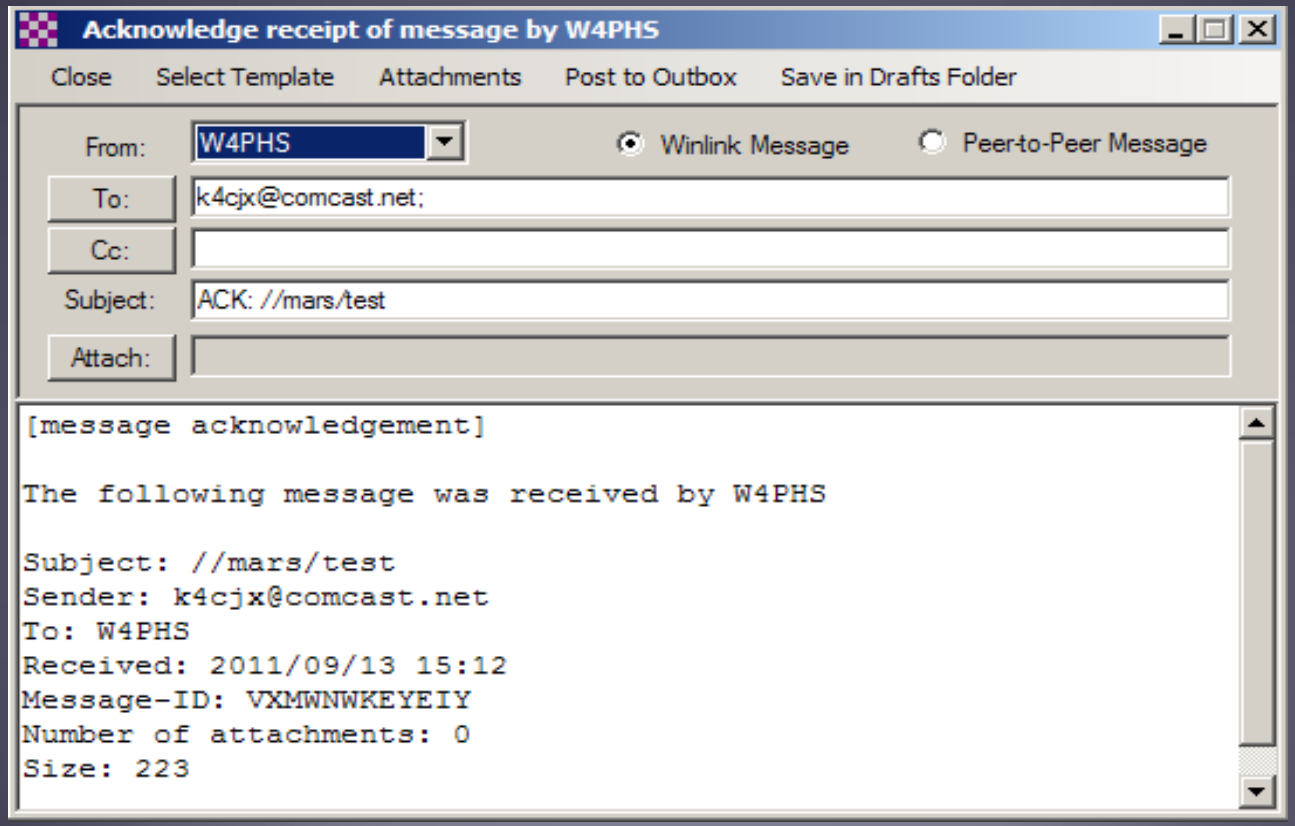
Composing a Message in Winlink Express

Click to start a message

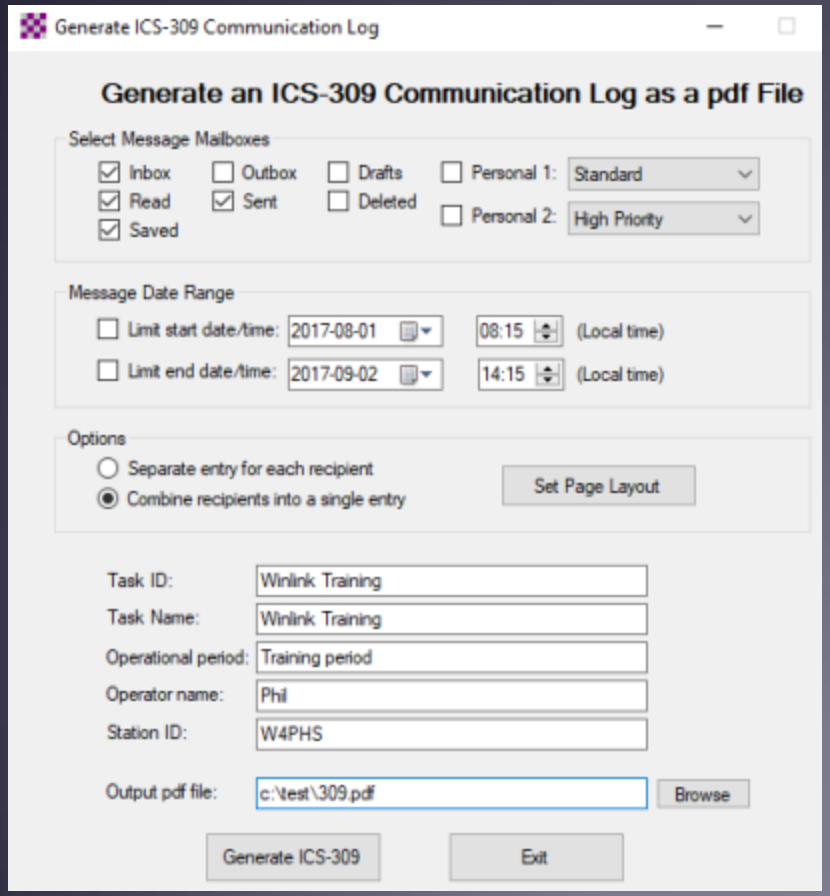


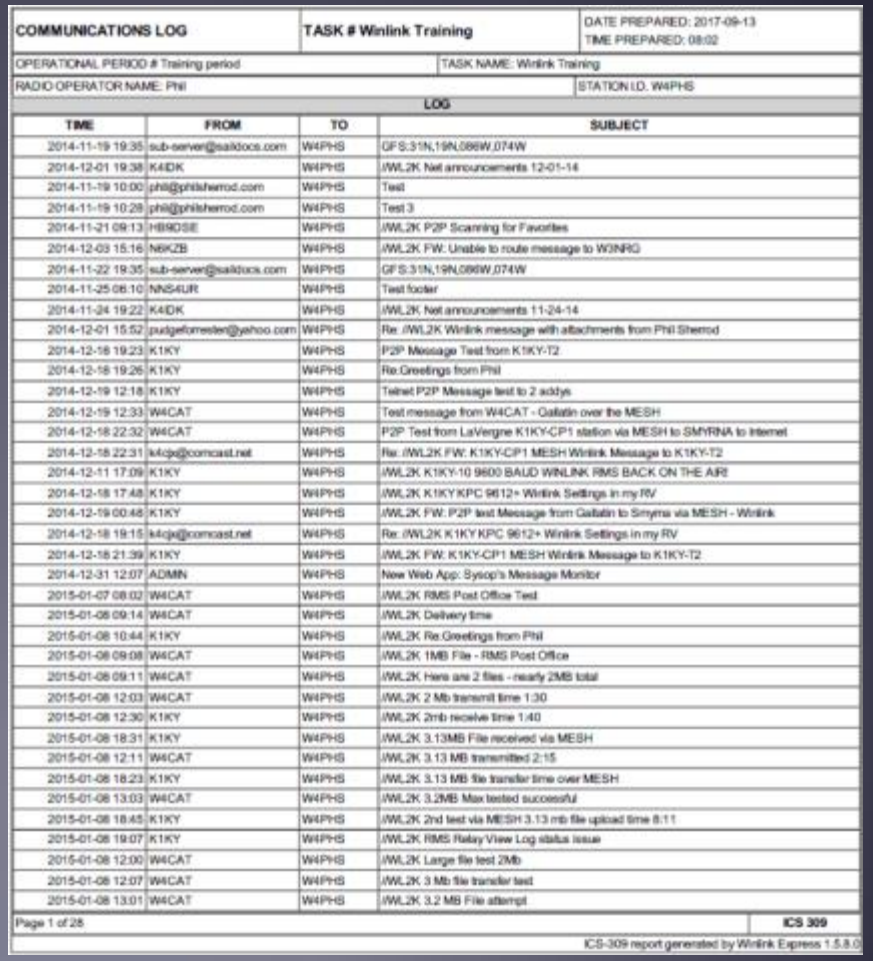
Message Receipt Acknowledgements

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



Built-in ICS-309 pdf Message Log Generator





COMMUNICATIONS LOG	TASK # Winlink Training	DATE PREPARED: 2017-09-13 TIME PREPARED: 08:02
OPERATIONAL PERIOD # Training period	TASK NAME: Winlink Training	
RADIO OPERATOR NAME: Phil		STATION I.D. W4PHS

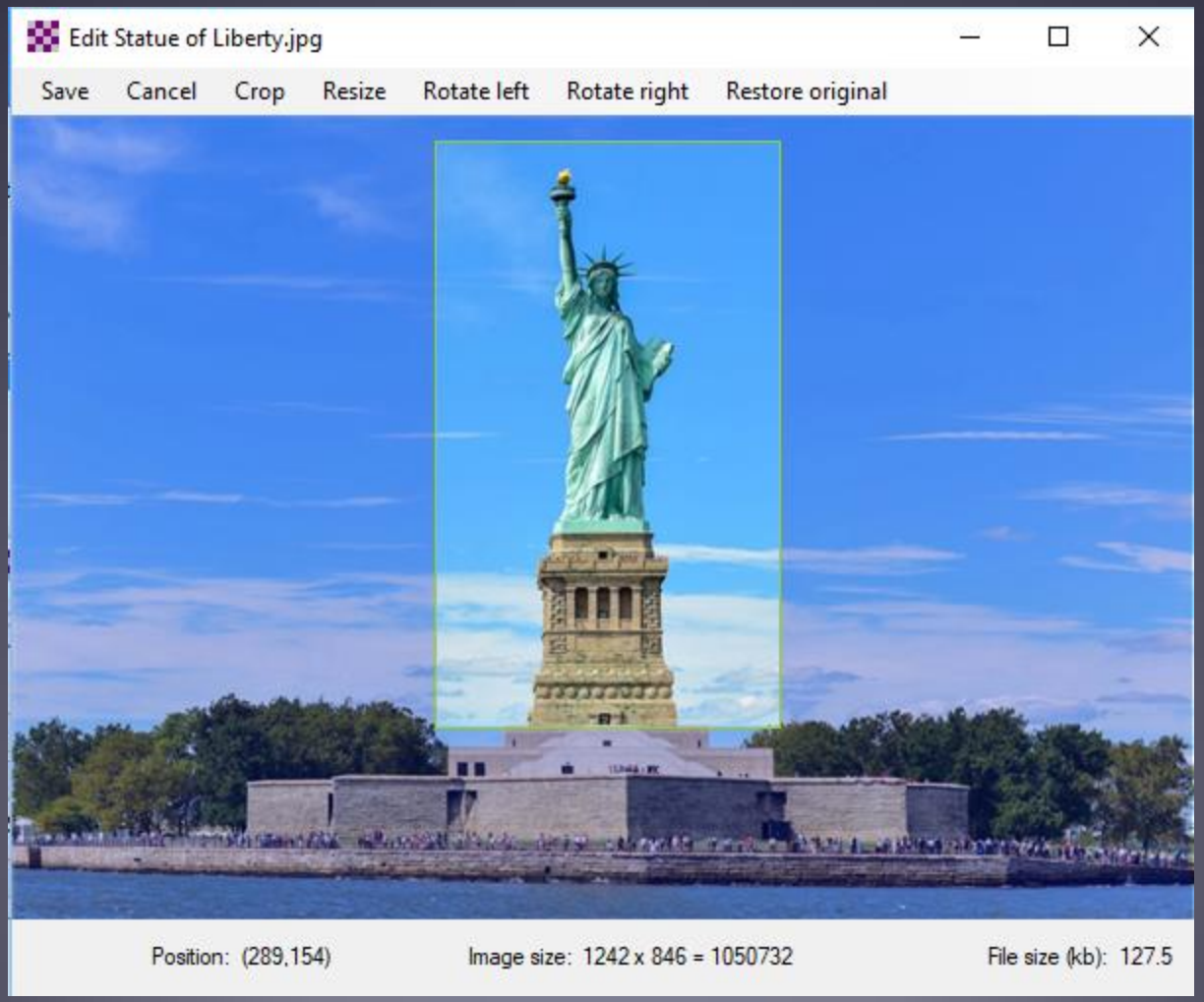
LOG

TIME	FROM	TO	SUBJECT
2014-11-19 19:35	sub-server@saildocs.com	W4PHS	GFS:31N,19N,086W,074W
2014-12-01 19:38	K4IDK	W4PHS	/WL2K Net announcements 12-01-14
2014-11-19 10:00	phil@philsherrod.com	W4PHS	Test
2014-11-19 10:28	phil@philsherrod.com	W4PHS	Test 3
2014-11-21 09:13	HB9DSE	W4PHS	/WL2K P2P Scanning for Favorites
2014-12-03 15:16	N6KZB	W4PHS	/WL2K FW: Unable to route message to W3NRG
2014-11-22 19:35	sub-server@saildocs.com	W4PHS	GFS:31N,19N,086W,074W
2014-11-25 06:10	NNS4UR	W4PHS	Test footer
2014-11-24 19:22	K4IDK	W4PHS	/WL2K Net announcements 11-24-14
2014-12-01 15:52	pudgeforrester@yahoo.com	W4PHS	Re: /WL2K Winlink message with attachments from Phil Sherrod
2014-12-18 19:23	K1KY	W4PHS	P2P Message Test from K1KY-T2
2014-12-18 19:26	K1KY	W4PHS	Re:Greetings from Phil
2014-12-19 12:18	K1KY	W4PHS	Telnet P2P Message test to 2 addys
2014-12-19 12:33	W4CAT	W4PHS	Test message from W4CAT - Gallatin over the MESH
2014-12-18 22:32	W4CAT	W4PHS	P2P Test from LaVergne K1KY-CP1 station via MESH to SMYRNA to Internet
2014-12-18 22:31	k4cjx@comcast.net	W4PHS	Re: /WL2K FW: K1KY-CP1 MESH Winlink Message to K1KY-T2
2014-12-11 17:09	K1KY	W4PHS	/WL2K K1KY-10 9600 BAUD WINLINK RMS BACK ON THE AIR
2014-12-18 17:48	K1KY	W4PHS	/WL2K K1KY KPC 9612+ Winlink Settings in my RV
2014-12-19 00:48	K1KY	W4PHS	/WL2K FW: P2P test Message from Gallatin to Smyrna via MESH - Winlink
2014-12-18 19:15	k4cjx@comcast.net	W4PHS	Re: /WL2K K1KY KPC 9612+ Winlink Settings in my RV
2014-12-18 21:39	K1KY	W4PHS	/WL2K FW: K1KY-CP1 MESH Winlink Message to K1KY-T2
2014-12-31 12:07	ADMIN	W4PHS	New Web App: Sysop's Message Monitor
2015-01-07 08:02	W4CAT	W4PHS	/WL2K RMS Post Office Test
2015-01-08 09:14	W4CAT	W4PHS	/WL2K Delivery time
2015-01-08 10:44	K1KY	W4PHS	/WL2K Re:Greetings from Phil
2015-01-08 09:08	W4CAT	W4PHS	/WL2K 1MB File - RMS Post Office
2015-01-08 09:11	W4CAT	W4PHS	/WL2K Here are 2 files - nearly 2MB total
2015-01-08 12:03	W4CAT	W4PHS	/WL2K 2 Mb transmit time 1:30
2015-01-08 12:30	K1KY	W4PHS	/WL2K 2mb receive time 1:40
2015-01-08 18:31	K1KY	W4PHS	/WL2K 3.13MB File received via MESH
2015-01-08 12:11	W4CAT	W4PHS	/WL2K 3.13 MB transmitted 2:15
2015-01-08 18:23	K1KY	W4PHS	/WL2K 3.13 MB file transfer time over MESH
2015-01-08 13:03	W4CAT	W4PHS	/WL2K 3.2MB Max tested successful
2015-01-08 18:45	K1KY	W4PHS	/WL2K 2nd test via MESH 3.13 mb file upload time 8:11
2015-01-08 19:07	K1KY	W4PHS	/WL2K RMS Relay View Log status issue
2015-01-08 12:00	W4CAT	W4PHS	/WL2K Large file test 2Mb
2015-01-08 12:07	W4CAT	W4PHS	/WL2K 3 Mb file transfer test
2015-01-08 13:01	W4CAT	W4PHS	/WL2K 3.2 MB File attempt

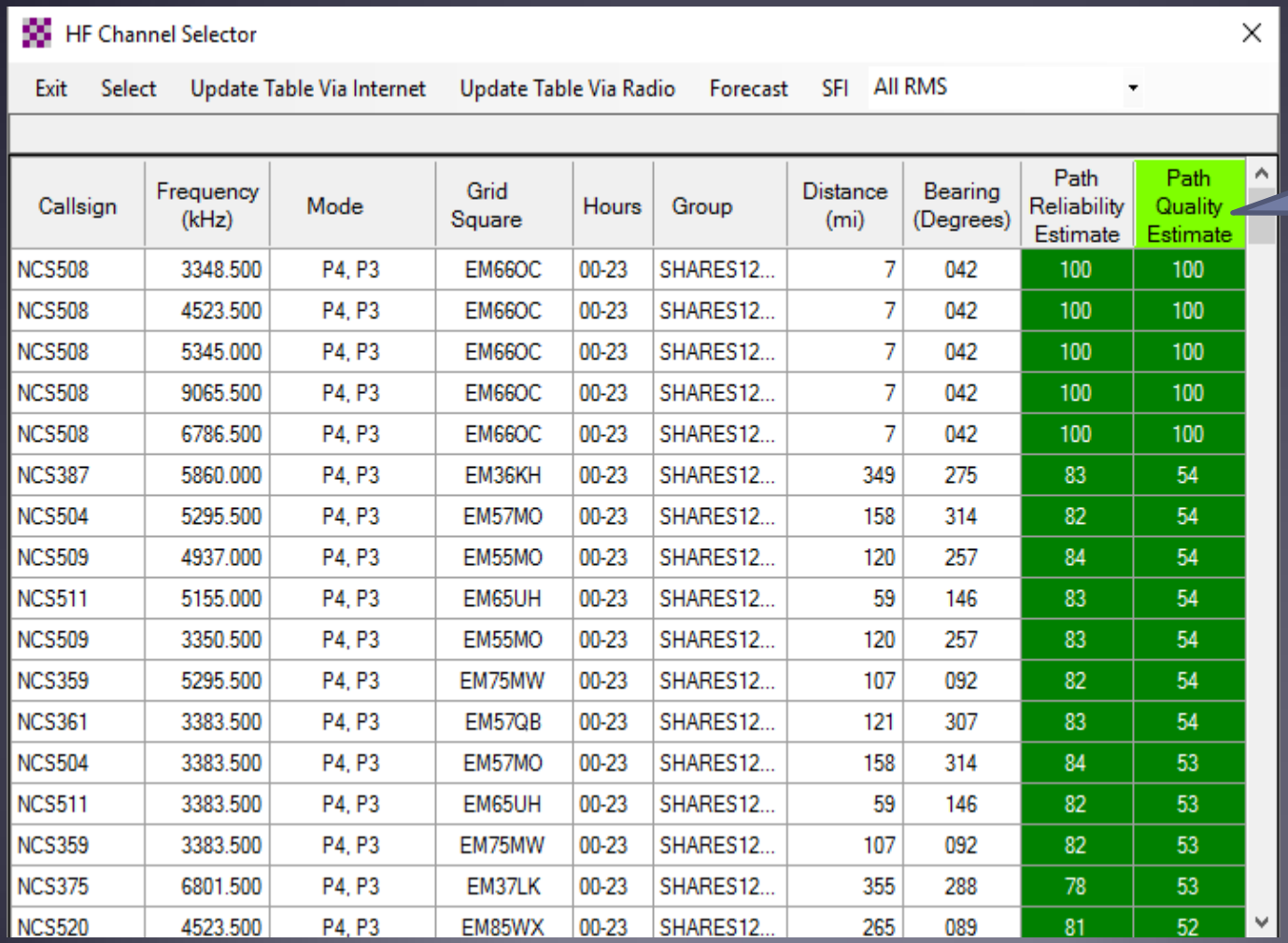
Page 1 of 28 ICS 309

ICS-309 report generated by Winlink Express 1.5.8.0

Built-in Picture Cropping/Resizing



Winlink Express RMS Channel List

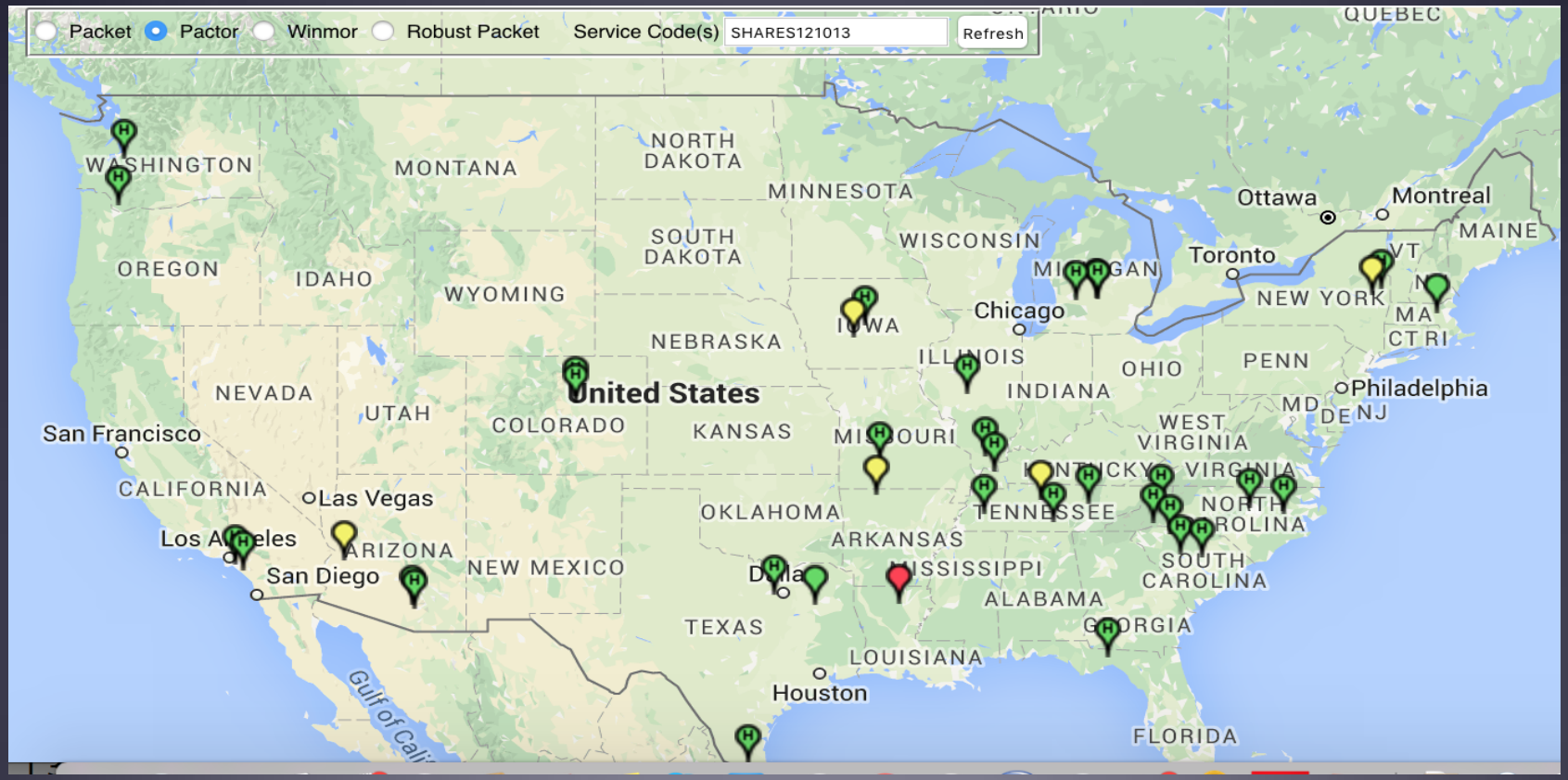


Callsign	Frequency (kHz)	Mode	Grid Square	Hours	Group	Distance (mi)	Bearing (Degrees)	Path Reliability Estimate	Path Quality Estimate
NCS508	3348.500	P4, P3	EM66OC	00-23	SHARES12...	7	042	100	100
NCS508	4523.500	P4, P3	EM66OC	00-23	SHARES12...	7	042	100	100
NCS508	5345.000	P4, P3	EM66OC	00-23	SHARES12...	7	042	100	100
NCS508	9065.500	P4, P3	EM66OC	00-23	SHARES12...	7	042	100	100
NCS508	6786.500	P4, P3	EM66OC	00-23	SHARES12...	7	042	100	100
NCS387	5860.000	P4, P3	EM36KH	00-23	SHARES12...	349	275	83	54
NCS504	5295.500	P4, P3	EM57MO	00-23	SHARES12...	158	314	82	54
NCS509	4937.000	P4, P3	EM55MO	00-23	SHARES12...	120	257	84	54
NCS511	5155.000	P4, P3	EM65UH	00-23	SHARES12...	59	146	83	54
NCS509	3350.500	P4, P3	EM55MO	00-23	SHARES12...	120	257	83	54
NCS359	5295.500	P4, P3	EM75MW	00-23	SHARES12...	107	092	82	54
NCS361	3383.500	P4, P3	EM57QB	00-23	SHARES12...	121	307	83	54
NCS504	3383.500	P4, P3	EM57MO	00-23	SHARES12...	158	314	84	53
NCS511	3383.500	P4, P3	EM65UH	00-23	SHARES12...	59	146	82	53
NCS359	3383.500	P4, P3	EM75MW	00-23	SHARES12...	107	092	82	53
NCS375	6801.500	P4, P3	EM37LK	00-23	SHARES12...	355	288	78	53
NCS520	4523.500	P4, P3	EM85WX	00-23	SHARES12...	265	089	81	52

Estimate of Signal Path Quality

Current Amateur (Ham) HF Pactor RMS Stations

Current SHARES HF Pactor RMS Stations



- All SHARES RMS can make connections to CMS and also operate radio-only without using the Internet.

Winlink Operating Modes

- For efficiency, reliability and flexibility, the Winlink system provides four modes for transferring messages:
  - **Conventional** system that stores messages on CMS "backbone" servers. Uses Intenet from RMS to CMS.
  - **Hybrid** HF 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.
  - **MESH Network**
    - **Peer-to-peer** through MESH between two Winlink Express.
    - **Post office server** hosted by RMS Relay.

Pros and Cons of Conventional System

- **Advantages:**
  - Can send conventional (external) Internet e-mails.
  - Messages can be downloaded within one minute from any location that can access a Winlink RMS.
  - A receiving station can connect to *any* Winlink RMS.
  - 99.99% availability over 15 years of service.
  - Capable of high volume message traffic.
- **Disadvantages:**
  - Requires an Internet connection from the RMS to a CMS. (But Internet *not* required at end-user location)

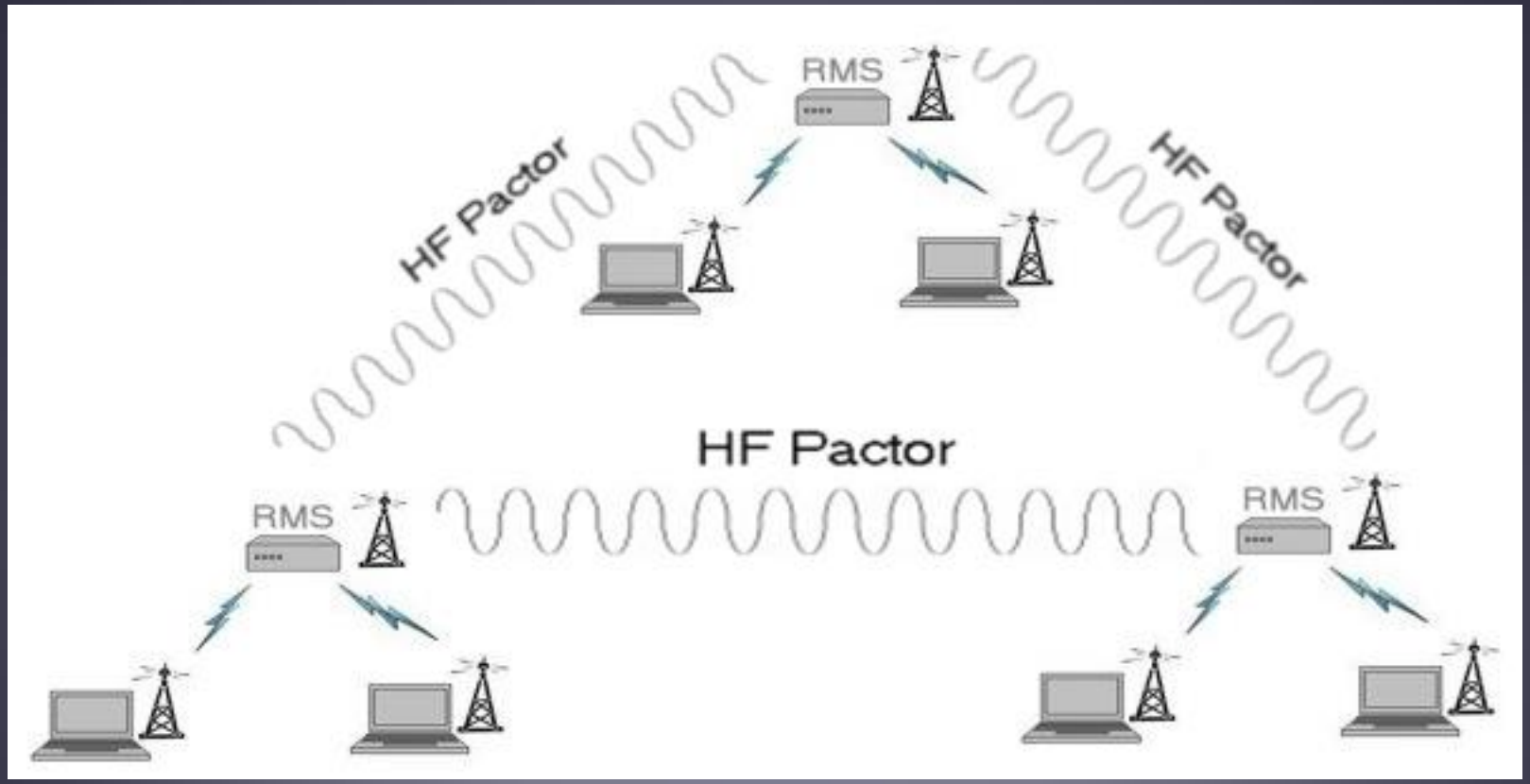
Concern About "Cyber-Pearl Harbor" Attack

- "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'."
  The New York Times, October 11, 2012

Growing Threat to USA Infrastructure

- "WASHINGTON — The Obama administration has warned the nation's power companies, water suppliers and transportation networks that sophisticated cyberattack techniques used to bring down part of Ukraine's power grid two months ago could easily be turned on them." New York Times, Feb. 29, 2016
- Power grid threats and vulnerabilities extensively researched in Ted Koppel's book *Lights Out*.
- Cyber-attacks can be devastating, and they are *much* easier to launch than physical attacks.

Radio-Only Winlink Network (No Internet)



Pros and Cons of Radio-Only Network

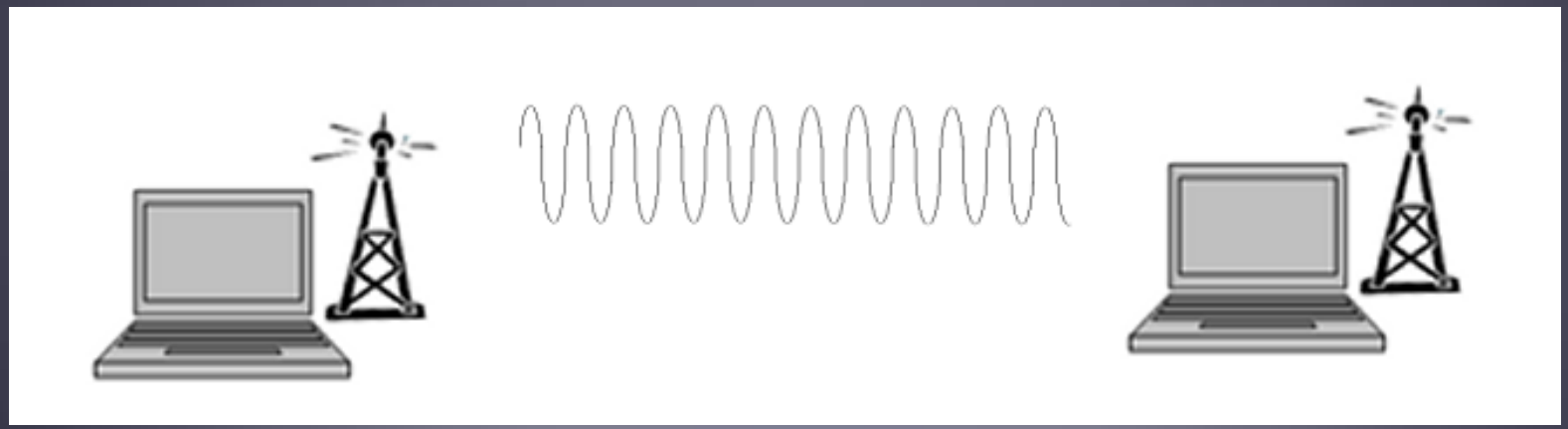
- **Advantages:**
  - Operates completely independent of the Internet.
  - Fully automatic routing and forwarding.
  - Automatic routing around unavailable RMS
- **Disadvantages:**
  - Messages must be picked up from designated Message Pickup Stations (MPS).
  - There is a delay in message delivery due to relaying.
  - Reduced message traffic capacity due to HF relaying.
  - Cannot send messages to Internet e-mail addresses.

Selecting Message Pickup Stations

- During radio-only (no Internet) operation, messages sent to you will be stored in databases on the RMS 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, Winlink Express will not download the same message from another MPS. Eventually, duplicate messages expire and are deleted.
- You can register MPS with Winlink Express using an Internet connection or a radio message.

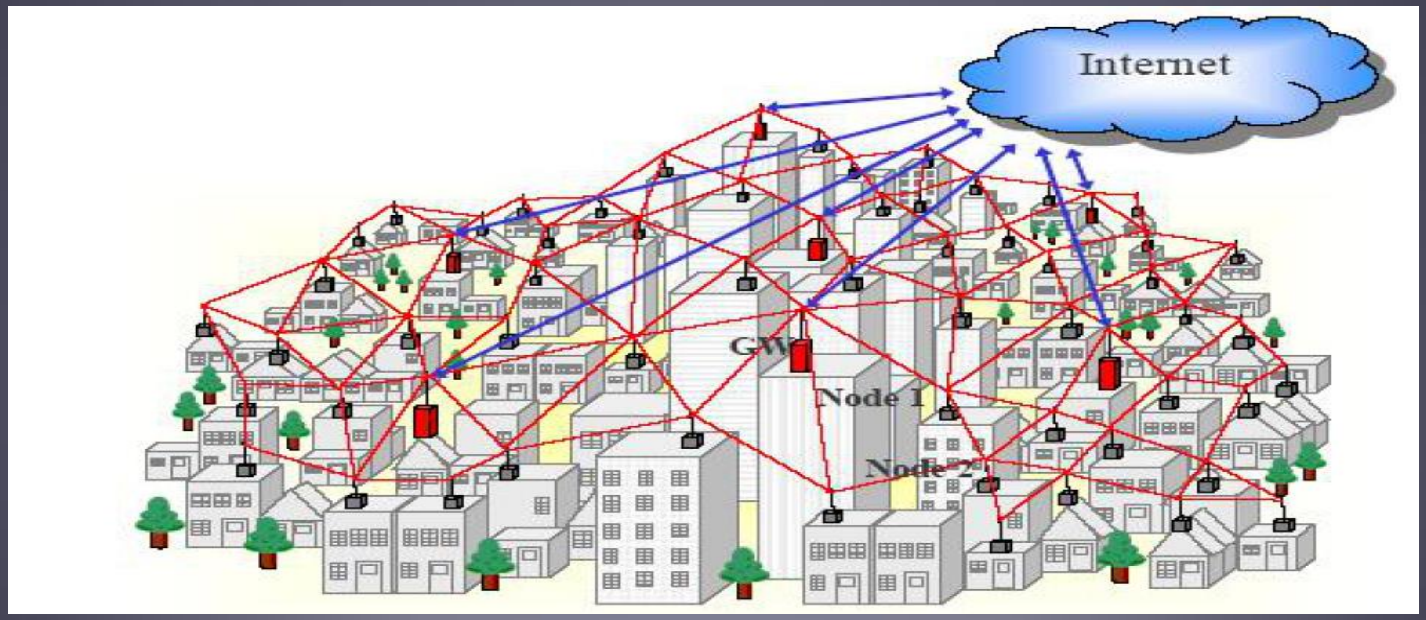
Winlink Peer-To-Peer Radio-Only Operation

- 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.



Winlink and Wi-Fi MESH Networks

- Rapidly growing among amateur operators and civil agencies. Fast: Uses inexpensive Wi-Fi equipment.
- RMS Relay can operate as a MESH “post office”. Connect from Winlink Express and POP/SMTP.



Conclusion

- Proven availability, reliability and accuracy.
- Winlink use continues to grow, especially for EmComm.
- The Winlink Development Team continues to enhance capabilities to adapt to changing needs and new technology.
- Winlink now has four 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
  - Broadband, Wi-Fi MESH networks.
- Steady improvements are being implemented.

- Thank you.
- Questions?
  - Phil Sherrod, W4PHS

- Information about Winlink can be found at www.winlink.org
- White papers about Winlink can be found at www.qrz.com/db/W4PHS