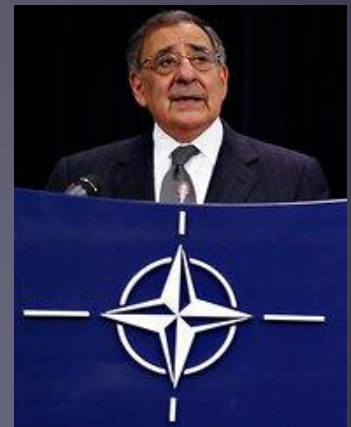




The Winlink 2000 Hybrid “Radio-Only” Network

E-mail with or without the Internet

Developed by
The Winlink Development Team



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

Review of Winlink 2000 System

- 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)



Winlink Advantages for EmComm

- 100% accurate message transmission.
- Accessible at a reasonable cost to both agencies and amateur radio operators.
- Able to provide local and long-haul communication.
- Able to transmit encrypted messages and files.
- Seamless bridge between VHF/UHF/HF/Telnet.
- Multiple protocols including Pactor, Winmor and Packet.
- Time independence due to store-and-forward.
- Not limited by station-to-station propagation.
- Reliable operation and low power levels.
- Excellent portability.

Kentucky Ice Storm of 2009

Cell phones, Internet and public service radio out



Picture sent from mobile Winlink station

The Need for a Radio-Only Winlink System

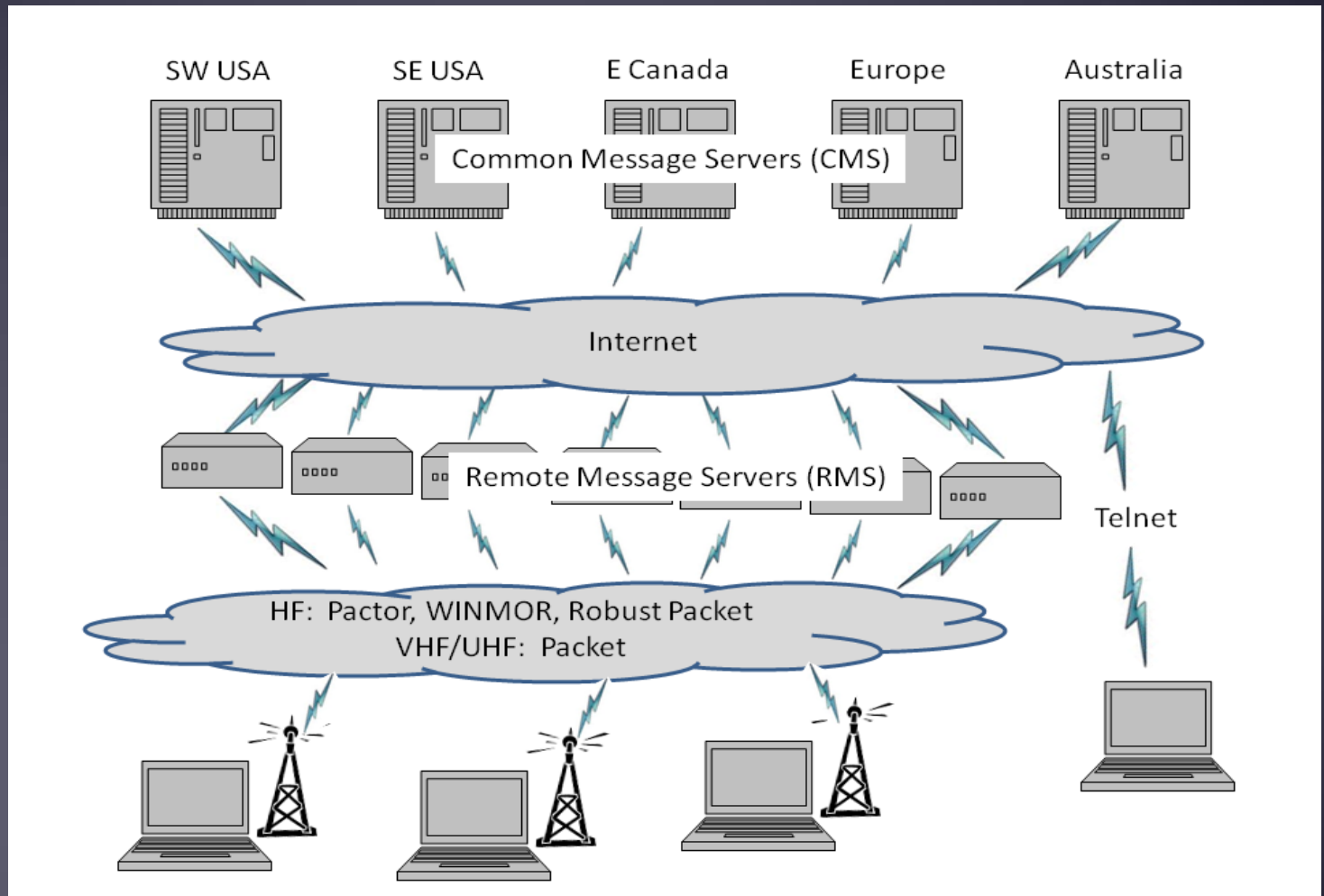
- There is increasing concern about the vulnerability of the Internet. Secretary of Defense Leon Panetta warned of the risk of a “Cyber Pearl Harbor”.
- DoDI mandates MARS to communicate without depending on the Internet.
- The Winlink Development Team addressed this concern by developing the Hybrid Winlink Network.
- The Hybrid network uses the efficiency of the Internet when it's available, but resorts to radio-only message forwarding if the Internet is not available.

Key Points About the Hybrid Network

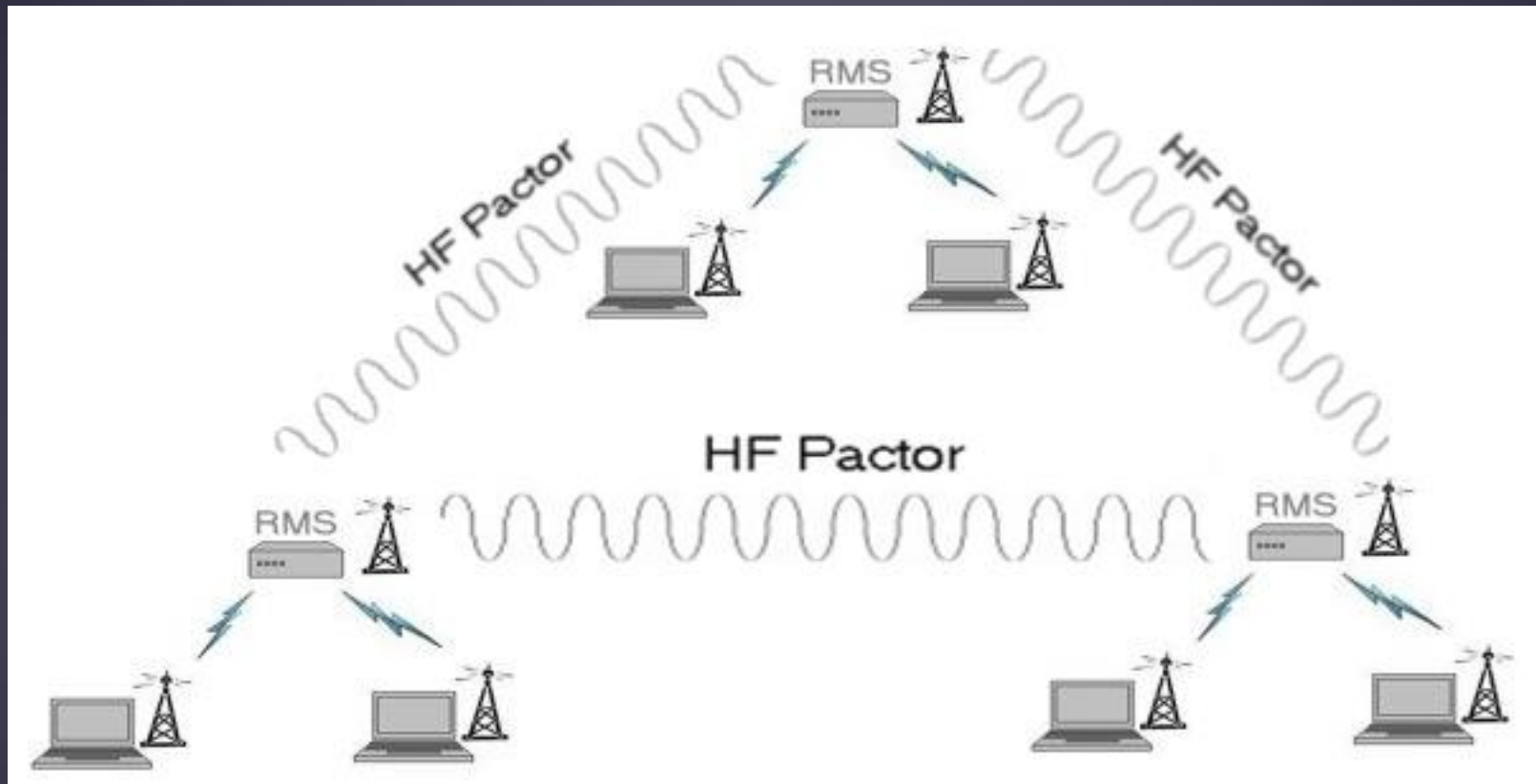
- Currently providing nation-wide e-mail support for MARS and its civil agency clients should the Internet not be available. In use at ham RMS inside and outside the USA.
- Satisfies DoDI requirement for radio-only operation.
- Uses standard Winlink client e-mail programs.
- Supports standard e-mail 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.

Normal Winlink Operation With Internet

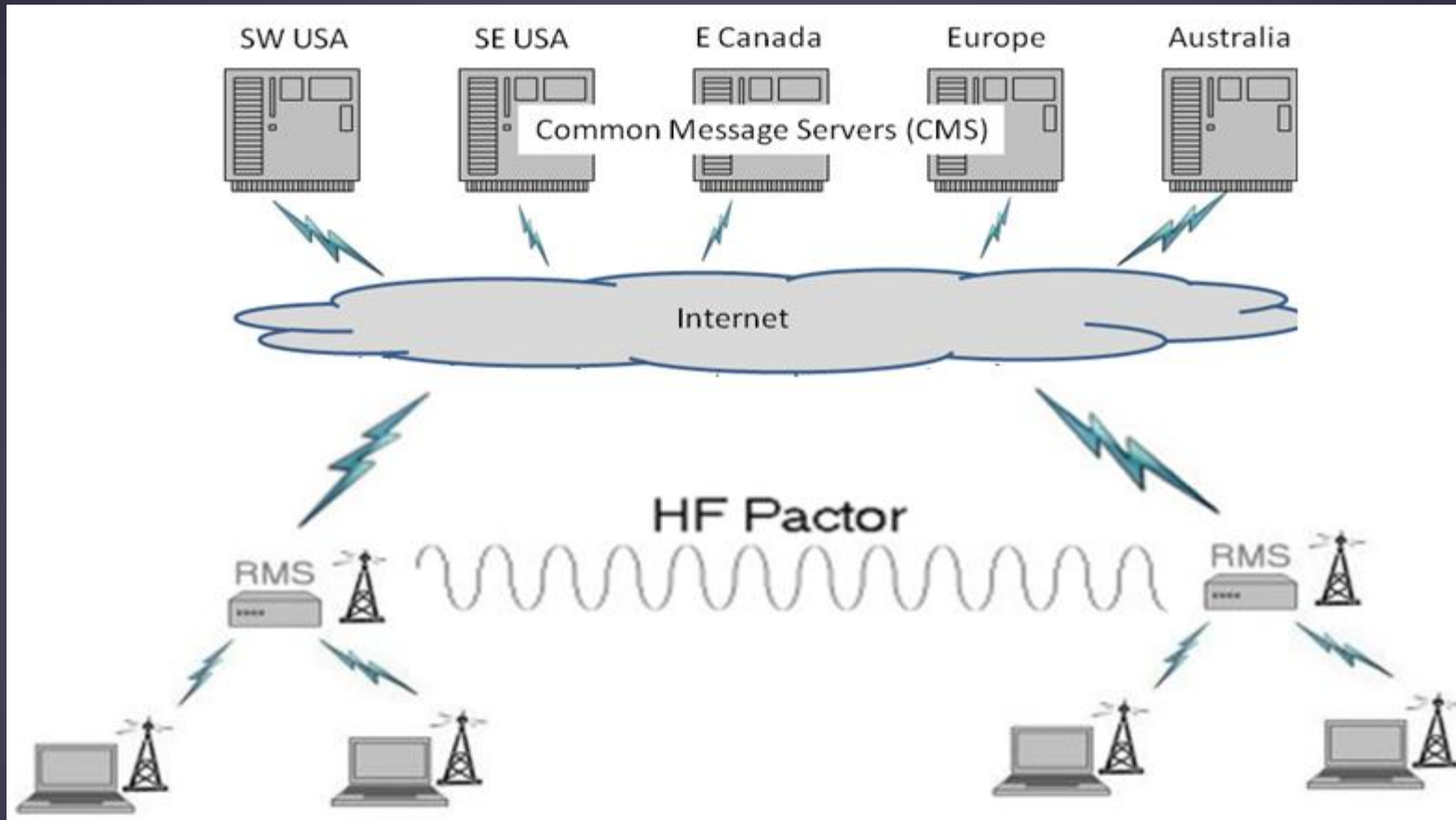
- CMS
- RMS
(gateway)
- Client
(you)



Radio-Only Winlink Network (no Internet)



Hybrid Radio-Only/Internet System



Combined Radio and Internet Operation

- The hybrid network seamlessly integrates Internet operation with radio message forwarding.
- Automatic switch-over from normal Internet-connected stations to radio-only operation.
- If an RMS is connected to the Internet, traffic from a connecting client is passed through the Internet.
- If an RMS is *not* connected to the Internet, message traffic is forwarded via HF radio to its destination.
- If a message being forwarded by radio passes through an RMS connected to the Internet, the message is uploaded through the Internet to a CMS *and* the RMS also forwards it via radio.

Support for non-Internet RMS

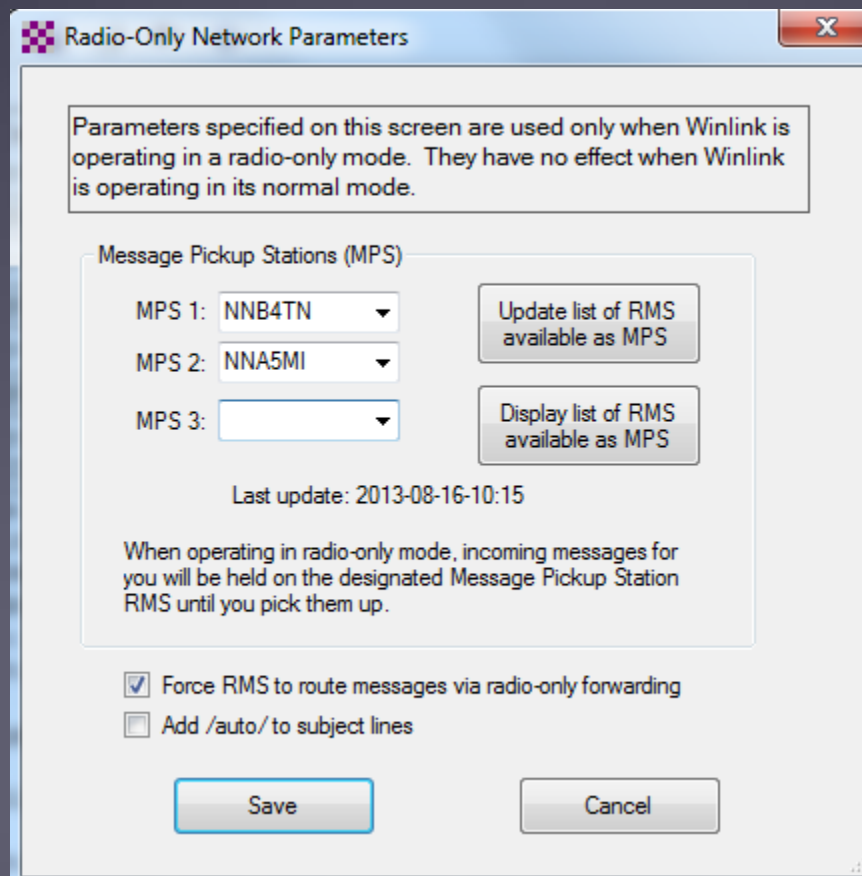
- Due to policy or physical location, some RMS permanently operate without Internet access.
- The Winlink Hybrid Network supports non-Internet RMS operating in radio-only mode.
- Reports about the status of the station, channels being scanned, etc. are sent via radio to another hybrid RMS that reports this information to the central server.
- Updates about the status of the hybrid network (RMS in the network, channels, MPS, etc.) are sent to the non-Internet RMS via radio e-mail attachments.

End-user Operation

- Use standard RMS Express and Paclink client programs.
- Connect via Pactor, Winmor, Packet or Robust Packet.
- Message origination may be through any hybrid RMS.
- Users register multiple “Message Pickup Stations” (MPS) where incoming mail will be held for pickup.
- A copy of each message is sent to each MPS for reliability.
- Messages are addressed using callsigns. No routing information is required by the sender.
- All standard features of e-mail are supported including file attachments, encryption and read receipts.
- Path through network shown in delivered message header

New Features in RMS Express

- Selection of Message Pickup Stations



The screenshot shows a Windows-style dialog box titled "Radio-Only Network Parameters". It contains a text box with a warning: "Parameters specified on this screen are used only when Winlink is operating in a radio-only mode. They have no effect when Winlink is operating in its normal mode." Below this is a section titled "Message Pickup Stations (MPS)" which includes three dropdown menus for "MPS 1", "MPS 2", and "MPS 3". "MPS 1" is set to "NNB4TN" and "MPS 2" is set to "NNA5MI". To the right of these are two buttons: "Update list of RMS available as MPS" and "Display list of RMS available as MPS". Below the dropdowns, it says "Last update: 2013-08-16-10:15". A paragraph explains: "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." At the bottom, there are two checkboxes: "Force RMS to route messages via radio-only forwarding" (checked) and "Add /auto/ to subject lines" (unchecked). "Save" and "Cancel" buttons are at the very bottom.

Radio-Only Network Parameters

Parameters specified on this screen are used only when Winlink is operating in a radio-only mode. They have no effect when Winlink is operating in its normal mode.

Message Pickup Stations (MPS)

MPS 1: NNB4TN

MPS 2: NNA5MI

MPS 3:

Update list of RMS available as MPS

Display list of RMS available as MPS

Last update: 2013-08-16-10:15

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.

☒ Force RMS to route messages via radio-only forwarding

☐ Add /auto/ to subject lines

Save Cancel

Adaptive Message 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.

Simulated Routes (Actual Hybrid RMS)

- N₅TW (Texas) → VE₁YZ (Nova Scotia, Canada)

N5TW → VA3LKI (Freq. = 14112.000 MHz, Quality = 38, Reliability = 56, Pactor 3, Arrival time = 00:31)
VA3LKI → VE1YZ (Freq. = 10148.200 MHz, Quality = 41, Reliability = 66, Pactor 4, Arrival time = 00:42)

- XE₂BNC (Mexico) → VE₁YZ (Nova Scotia, Canada)

XE2BNC → XE1VP (Freq. = 14092.900 MHz, Quality = 42, Reliability = 76, Pactor 4, Arrival time = 00:10)
XE1VP → VE1YZ (Freq. = 14114.000 MHz, Quality = 33, Reliability = 39, Pactor 4, Arrival time = 00:29)

- WX₄J (Florida) → SK6PS (Sweden)

WX4J → VE1YZ (Freq. = 14114.000 MHz, Quality = 37, Reliability = 56, Pactor 3, Arrival time = 00:32)
VE1YZ → HB9AW (Freq. = 14107.500 MHz, Quality = 31, Reliability = 31, Pactor 4, Arrival time = 00:57)
HB9AW → SK6PS (Freq. = 7053.500 MHz, Quality = 43, Reliability = 78, Pactor 4, Arrival time = 01:06)

System Operation

- Fully distributed system with no central server.
- RMSs operate in normal mode and switch to radio-only network mode automatically if the Internet becomes unavailable.
- Messages can be forced to go by radio-only forwarding.
- RMS network operation is completely automatic for MARS and non-US hams. US hams need control operator present.
- An enhanced version of RMS Relay does routing.
- Typical time to transfer a small message from the originating RMS through an intermediate, relay RMS to the destination RMS is about 90 seconds. (Time will vary depending on message size and traffic load.)

RMS Relay Operating Mode

Operating Mode

- ☐ Normal -- Only accept connections if Internet is available
- ☐ Radio-only, local message hub -- Store messages locally. Do not upload messages through Internet
- ☒ Hold for Internet access -- Store messages locally until Internet is available, then upload them

HF Message Forwarding Control

- ☐ Do not forward messages via HF
- ☐ Forward messages via HF to another RMS connected to the Internet
- ☒ Operate as a node in the Winlink radio-only HF-relay network (Trimode must run)

Minutes to delay after Internet loss before starting radio-only network operation:

Automatic Sending Control

- ☒ Enable automatic, scheduled operation
(May not be used on USA ham bands)
 - Seconds before starting:
 - Minimum seconds between sends:
 - Maximum minutes sending:
- ☒ Check for busy channel before transmitting
- ☒ Emphasize Pactor signals for busy detection
(Requires P4 modem with 1.17.8 or later firmware)
- Ignore busy after this many minutes:

Trimode Control

- ☒ Automatically start and stop Trimode
- ☐ Start Trimode minimized
- Folder where Trimode is stored:
- IP: Port:

Pactor Level for Forwarding

Minimum: Maximum:

RMS Relay Network Control

Radio Network Settings

Parameters specified on this screen control the operation of RMS Relay when it is functioning as a station in the hybrid Winlink network.

Propagation and Routing Control Files

Propagation matrix file date: 2013-08-16-10:26
Message Pickup Station file date: 2013-08-16-10:26

☒ Automatically generate files every day

Time of day (hh:mm, 24 hour, local time):

Excluded Frequency Ranges

Specify one range per line in kHz
XXXX.XXX-XXXX.XXX

3000.000-4000.000
5000-6000

Notification when forwarding pending

Forward-pending sound: ☐ Repeat

System diagnostic control

☒ Allow diagnostic information to be sent to the Winlink Development Team

Blocked RMS

Callsigns of RMS that should not be called
Specify one callsign on each line

“Ping” Messages for Network Testing

- A “ping” message can be sent via radio-only transmission to an RMS to test the radio path.
- Ping is addressed to the callsign of the RMS.
- Subject is “/ping/”
- Echo reply provides information and path trace.
- Example ping TN->CA->HI->CA->TN

```
RMS Path: NNA9HI@2013-07-25-03:38:59 AAB9CA@2013-07-25-03:46:44 NNB4TN@2013-07-25-04:57:51
Subject: Echo from NNA9HI for Y4MVSMCJ6D3X

--- Ping reply from NNA9HI for Y4MVSMCJ6D3X ---

Ping message path: NNB4TN@2013-07-25-03:21:29 AAB9CA@2013-07-25-03:24:07 NNA9HI@2013-07-25-
03:38:59

--- Information about NNA9HI ---
Status at 2013-07-25 03:38:59 UTC
Connections passed to a CMS = 0
Radio-forwarding connections = 2
Pending messages for CMS upload = 0
Pending messages for radio relay = 0
SFI = 107
Propagation matrix creation time = 2013-07-24-13:51 UTC
MPS file creation time = 2013-07-24-13:52 UTC
Uptime = 0 14:41:07
Internet connectivity = True
RMS Relay version 2.2.10.55
```

Summary and Conclusion

- The hybrid Winlink project provides a much-needed national contingency e-mail system for Internet outages.
- RMSs pass traffic through the Internet or via radio.
- Satisfies the DoDI requirement for radio-only operation.
- By using intermediate, relay RMS, the system is capable of covering CONUS, Hawaii, Europe and beyond.
- Provides 100% accurate transmission of messages & files.
- Reliability provided by routing around unavailable RMS and allowing multiple message pickup stations.
- Currently in full operation providing CONUS coverage.