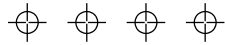


Using Winlink 2000



Configurations for Basic, Field and Emergency Communications use

With drawings

N5TIM

2017 V2.0 RELEASE

With the continued upgrade and enhancements of the Winlink suite of programs the content of this document is subject to change. Please review the Winlink.org site for information regarding changes and updates. The Google Winlink groups also announce changes and discuss issues related to operating with the Winlink programs.

Several of the Winlink equipment configurations shown are identified in the Communications Resource Function (CRF) documentation located elsewhere. (www.tinyurl.com/AR-EmComResources)

Thanks to members of our response group and N5TW for their input and review.

Winlink Basic and EmComm Hardware/Software Configurations

N5TIM-8.4.14/12.17

Winlink is ...

Winlink is a digital radio communications system that allows amateur radio operators to send and receive electronic mail (e-mail) and attachments without having a direct connection to the Internet. Winlink is a store and forward messaging system. Being able to send and receive e-mail without an internet connection is especially valuable during times of commercial communication outages. Visit www.winlink.org for additional information.

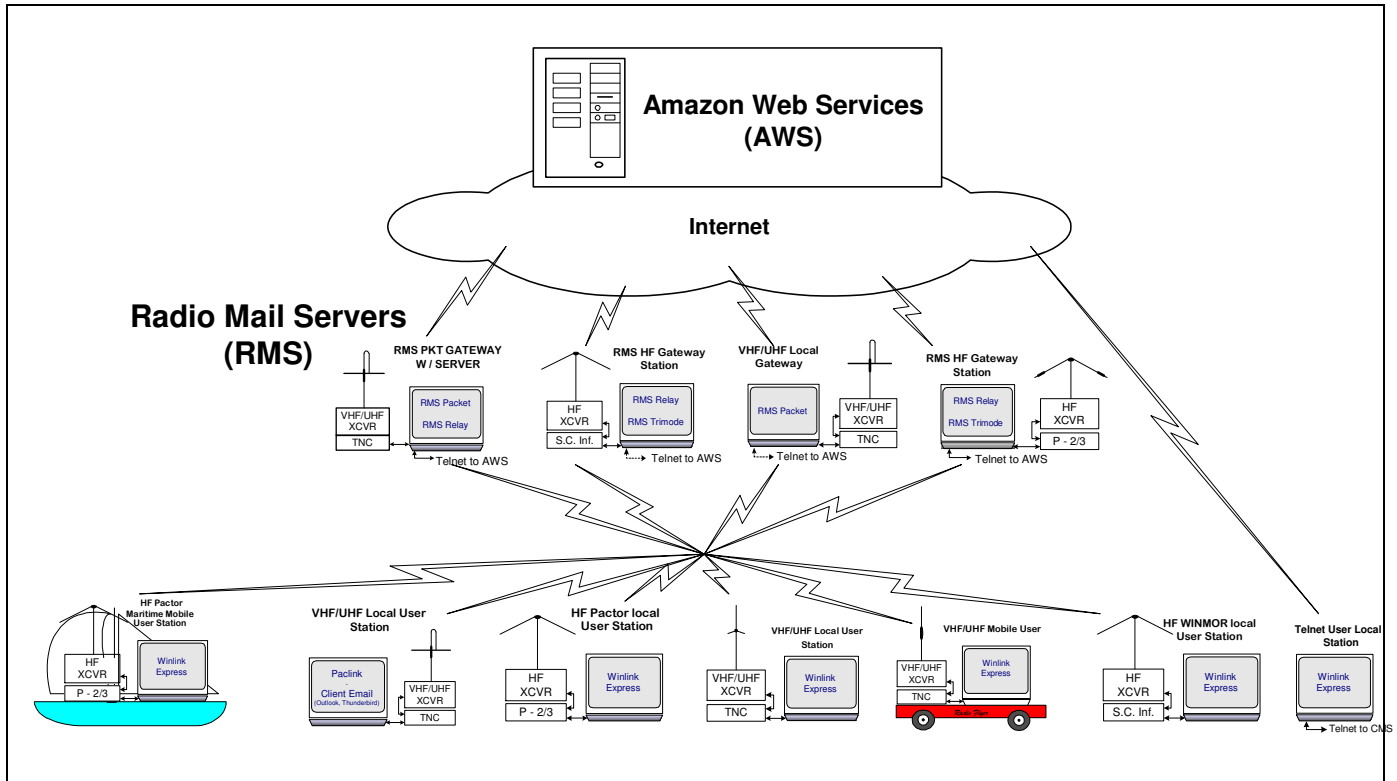


Figure 1- A global view of the Winlink system. In times of Radio Only operation the message traffic never goes to the internet but is handled at the RMS level.

- Winlink 2000 (WL2K) is a worldwide system of volunteer resources supporting e-mail by radio, with non-commercial links to internet e-mail
- These volunteer resources come from Amateur Radio, the Military Affiliate Radio System (MARS), and other non-commercial organizations. The system provides a valuable service to emergency communicators
- This network provides truly inter-operable messaging to all agencies in the same format. Winlink mixes Internet technology and appropriate amateur radio, military, marine RF and commercial technologies
- Multiple digital modes are accommodated, and the system provides radio interconnection services including: email with attachments, position reporting, graphic and text weather bulletins, emergency / disaster relief communications, and message relay
- This network provides truly inter-operable messaging to all agencies in the same format

Winlink Express

Winlink Express is the basic work horse software used by most EMCOMM minded amateurs. It is designed to be most easily used software for single users with a single call sign. It may also be used to access one or two preset tactical addresses or alternate call signs. Winlink Express supports a wide selection of TNCs and multimode controllers, the new sound card mode WINMOR, as well as support for HF Pactor, SCS Robust Packet, VHF/UHF packet and direct telnet to WL2K AWS servers or to amateur radio High Speed Multimedia [HSMM], D-Star DD mode, or internet connected stations. This software is used in nearly every type of Station configurations.

Winlink Express with built in email client supports attachments, multiple addresses and tactical addresses. With the WINMOR mode Winlink Express may be used peer-to-peer (connecting directly via HF to other Winlink Express clients).

Winlink Express is available at <ftp://autoupdate.winlink.org/User%20Programs/>

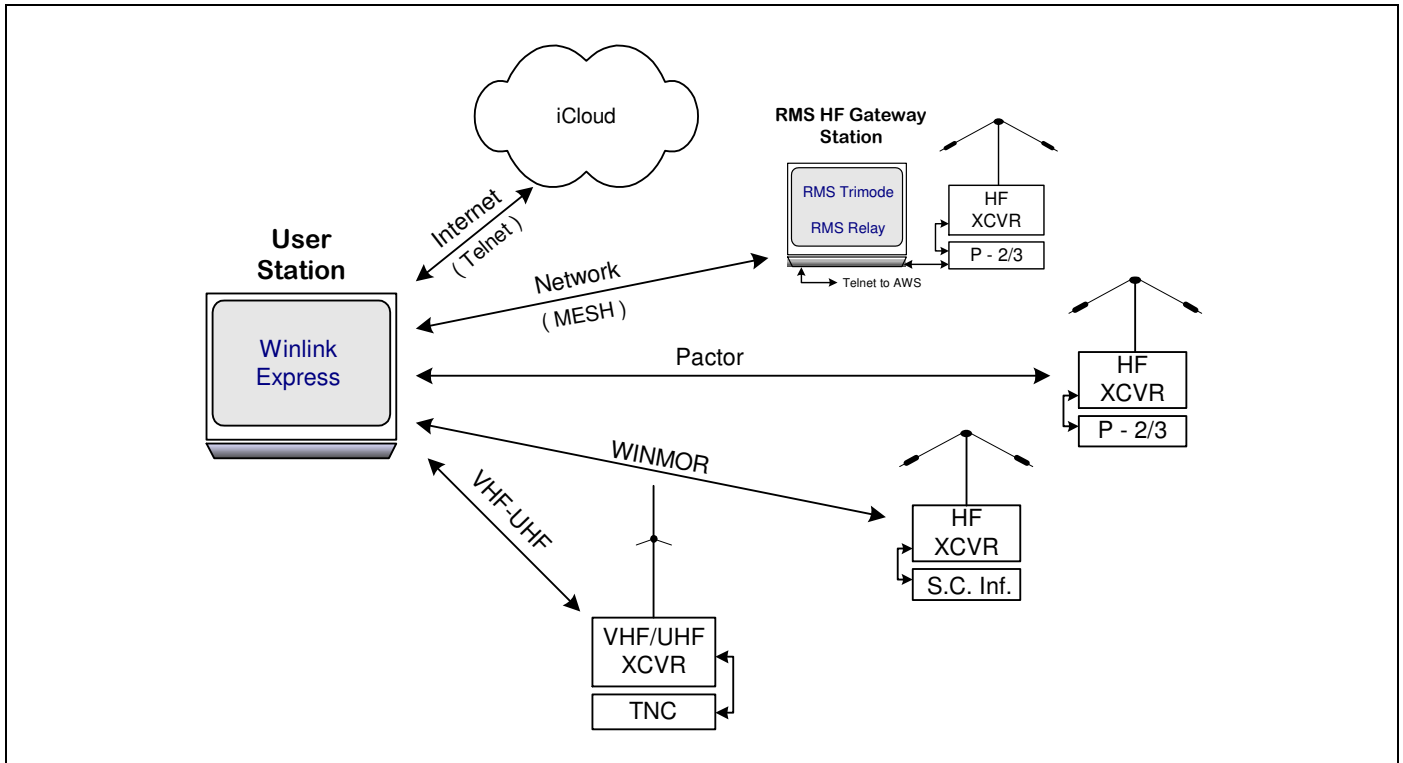


Figure 2 – The many ways Winlink Express can be interfaced to get the message through. Winlink Express is becoming the “Swiss Army Knife” for Winlink.

Basic Station Configurations

Home or Field Telnet Station

This station is a minimalist hardware and software setup for sending and receiving messages via Telnet (the Internet) with the Winlink system. A computer with an internet connection (LAN or WiFi) is required. This could be considered a Winlink Express user training setup. (Hardware = computer | Software = RMS* Express).

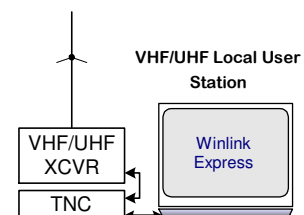
* Radio Message Server (RMS)

Local Telnet User Station



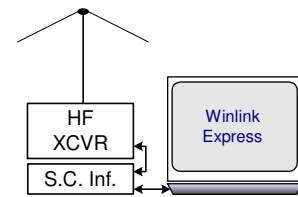
Home or Field VHF/UHF Station

The VHF/UHF station is one of three basic hardware and software setups for sending and receiving messages via RF with the Winlink system. This configuration could also be used mobile and for other packet systems. (Hardware = computer, TNC, VHF/UHF transceiver | Software = Winlink Express)



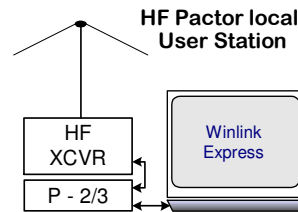
Home or Field HF Station (WINMOR)

The HF WINMOR Station is the second of three basic hardware and software setups for sending and receiving messages via HF with the Winlink system. This configuration uses Winlink Express with a sound card interface. (Hardware = computer, sound card interface, HF transceiver | Software = Winlink Express)



Home or Field HF Station (Pactor)

The HF Pactor Station is the third of three basic hardware and software setups for sending and receiving messages via RF with the Winlink system. This configuration uses Winlink Express along with a Pactor modem. Due to the cost of Pactor modems this type of station is usually found in permanent installations such as EOC's. (Hardware = computer, Pactor modem, HF transceiver | Software = Winlink Express)



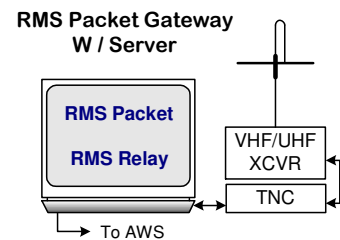
Advanced/Sysop Radio Mail System (RMS) Station Configurations

(Operators of Gateway stations require registration with and approval of the WL2K development team.)

RMS Packet Gateway

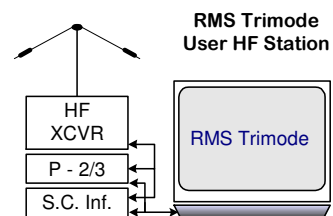
The RMS Packet Gateway Station is the radio link between a client VHF/UHF/WiFi/DD stations and a telnet/internet connection to a Common Message Server (AWS) or an RMS Relay module. The Gateway may be co-located at a client station or a separate secured site.

Gateways operate 24/7/365 and require SysOp authorization. In the absence of the internet the Gateway becomes a server for local users if RMS Relay is used. RMS Packet also works with AGWPE (multiple TNC driver utility) to provide multiple radio channel connections. RMS Packet may be used without RMS Relay if the intent is to only provide AWS access with the Internet. These stations usually use a SSID of -10. (Hardware = computer, VHF/UHF transceiver, TNC | Software = RMS* Packet and RMS Relay)



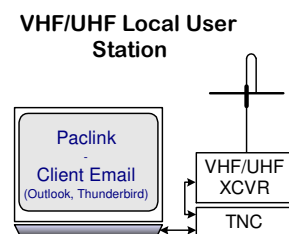
RMS Trimode HF Station

This is the latest in the Winlink evolution of user software/hardware for sending and receiving HF radio email. This station has the capability of running three types of configurations. WINMOR, Pactor and Robust Packet. It can be programmed to step through the different modes using a single HF radio and computer. This type of station is usually located at a fixed location and provides AWS access 24/7. (Hardware = computer, HF transceiver, Pactor modem and/or sound card interface | Software = RMS Trimode)



Paclink (for reference only – program is minimally supported)

Paclink is a radio e-mail client with a built-in POP/SMTP server. It is a single or multi user client. Paclink supports telnet, VHF/UHF packet radio, and HF Pactor radio connections to WL2K servers. The user interface is with many common e-mail client programs (Microsoft Live Mail, Outlook Express and Mozilla Thunderbird). Paclink supports attachments, multiple addresses and tactical addresses. Paclink also supports use of a sound card interface via

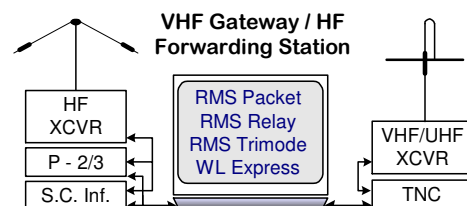


AGWPE. Paclink does not support the WINMOR sound card mode.

Unique Configurations (Radio Only or EMCOMM focused)

VHF Gateway / HF Forwarding Station

A portable station running RMS Packet, RMS Relay and RMS Trimode that can provide local server capability, send and receive email messages via VHF/UHF radio. Using RMS Trimode, the station HF radio can be used to forward messages outside the local area via Pactor or WINMOR. This function may be referred to as a Store and Forward station. By adding Winlink Express a local message capability is enabled. This setup is typically used by the Rapid Response Task Force Amateur Radio attachment, the Rapid Deploy Communications Assistance Group, a North Texas Section ARES Team (RRTF/RDCAG) and mutual assistance teams. (Hardware = computer, HF transceiver, Pactor modem or sound card interface, VHF/UHF transceiver, TNC | Software = RMS Packet, RMS Relay and RMS Trimode - optionally Winlink Express)



Designated Station

At times, generally during EMCOMM situations a station may be tagged with the term "Designated." This indicates that the station has been identified as a hubbing station for a local area, a specialty station serving a specific task or a station with unique capabilities. Designated stations are typically listed in the Action plan and the ICS-205A documentation. The use of designated stations is also a means to manage the bandwidth of a band typically used for EMCOMM communications.

Radio-Only or the Winlink Hybrid Network

Winlink also can be operated in a radio-only mode of operation called the "Hybrid Winlink Network" where messages are stored on RMS themselves without being transferred to an AWS. The radio-only system is designed primarily for use by agencies during an Internet outage, but it could be used at other times. Additional detail can be found in the help section of Winlink Express.

All the Winlink programs have extensive help files. Use them as some set ups are quite unique.

Radio Mail Server (RMS) Software

RMS-Packet (Winlink system administrator's approval is required for this software)

RMS Packet software is intended for WL2K sysops. This software supports a VHF/UHF packet radio gateway station to the WL2K system. RMS Packet stations are part of the network of participating stations, and they provide full automated messaging capability to the wireless amateur user using AX.25 packet radio in combination with the WL2K Common Message Servers. **One or several RMS Packet stations may serve an area or group.**

RMS Packet is simple to install and run, and requires a minimum of computer and radio equipment. It runs on virtually any WinXP and later computer with .NET extensions that has a permanent connection to the internet. It supports the most popular TNCs directly, and almost all others through the AGW Packet Engine or Packet Engine Pro software.

RMS Packet is ideal to provide a temporary emergency portal for radio e-mail users, or for fixed installation at unattended remote locations where it can provide wireless e-mail communications to the "last mile".

RMS-Relay (Winlink system administrator's approval is required for this software)

RMS Relay software provides temporary storage of messages and local routing in the event internet access to the AWS sites is lost. It will normally only be used with co-located RMS Packet and Trimode programs. (Co-located means on the same computer, LAN, or short distance Ethernet links.) The relay program becomes a local server when links are lost to AWS sites.

Operating Modes

- *Only accept connections if Internet is available* -- If an Internet connection is available, RMS Relay acts as a conduit from the RMS program to the Internet and the AWS. If the Internet connection is down, RMS Relay refuses connections from the RMS program, so the program rejects connections with the message "No AWS available". This would be essentially how the RMS Packet or RMS Trimode would operate if not using RMS Relay. This mode must not be selected if you wish to participate in the Winlink Hybrid Network.
- *If Internet is not available, accept only radio-only forwarding connections and deny CMS connections* -- If an Internet connection is available, RMS Relay accepts both radio-only forwarding connections and normal connections wishing to be passed to the AWS. If the Internet is not available, then RMS Relay continues to accept radio-only forwarding connections, but any connection attempting to reach a CMS is rejected with an error message saying that there is no Internet connection to the AWS. This is a good choice for RMS that are serving both EmComm and maritime users, because it prevents important messages from the maritime users from being delayed within the RMS if the Internet connection is down. This operating mode is strongly recommended for ham RMS operating as hybrid stations that are using manual message forwarding, since the time that a message may be held before it is forwarded could be very long.
- *Radio-only, local message hub* -- When this mode is selected, RMS Relay does not forward messages through the Internet to a WL2K AWS even if it is available. All messages are stored in a local database or forwarded via radio through the Hybrid Network. The primary use of this option is for RMS that are operating at sites that do not have Internet connections.
- *Hold for Internet access* -- If an Internet connection is available, RMS Relay passes the message through the Internet to the AWS. If the Internet connection goes down, the RMS Relay stores messages in a local database until the Internet connection is restored at which time I sends them to the AWS. If the station is participating in the Hybrid Network, messages will be forwarded via radio to another RMS. Buffering by RMS Relay can cause unexpected delays that might be unacceptable for emergency messages. This is the recommended mode of operation.
- *Stand-alone Network "Post Office"* -- If this mode is selected, RMS Relay operates as a simple message repository post office. It does not upload messages to the AWS, and it does not forward them via radio. Trimode and VOACAP do not need to be installed, and there is no need for a radio. The computer also does not need to be connected to the Internet. This operating mode is intended for use in MESH and LAN networks, but it can be used in any context.

RMS Trimode (Winlink system administrator's approval is required for this software)

RMS (Radio Mail Server) Trimode is software intended for WL2K sysops who operate High-Frequency gateway stations. These RMS stations are part of the controlled global network of WL2K participating stations. RMS Trimode is the only Winlink program that does not use a SSID.

RMS Trimode is a flexible HF Radio server for the Pactor (P1-P3), WINMOR (500Hz & 1600Hz bandwidths) and the Robust Packet HF protocols. RMS Trimode can be used for any one, two or all three of the above protocols simultaneously and can scan multiple frequencies adjusted by time of day. A single instance can support Amateur, MARS and EMCOMM applications.

The objective of RMS Trimode is to allow sysops to use one program that supports multiple user protocols using the same radio, antenna, and computer resources. This gives users more connectivity options and makes better use of limited spectrum. It is intended to replace RMS Pactor and RMS WINMOR.

Once a connection in one protocol is established RMS Trimode will block other connections on the remaining protocols until the session is completed. If desired a single instance and radio can support multiple call signs and service codes. RMS Trimode may optionally use the program RMS Relay with a local message database or to temporarily buffer messages if internet connectivity is lost. Sysop approval is required for this software.

Winlink Express, RMS Packet, RMS Trimode and RMS Relay programs internal communications path

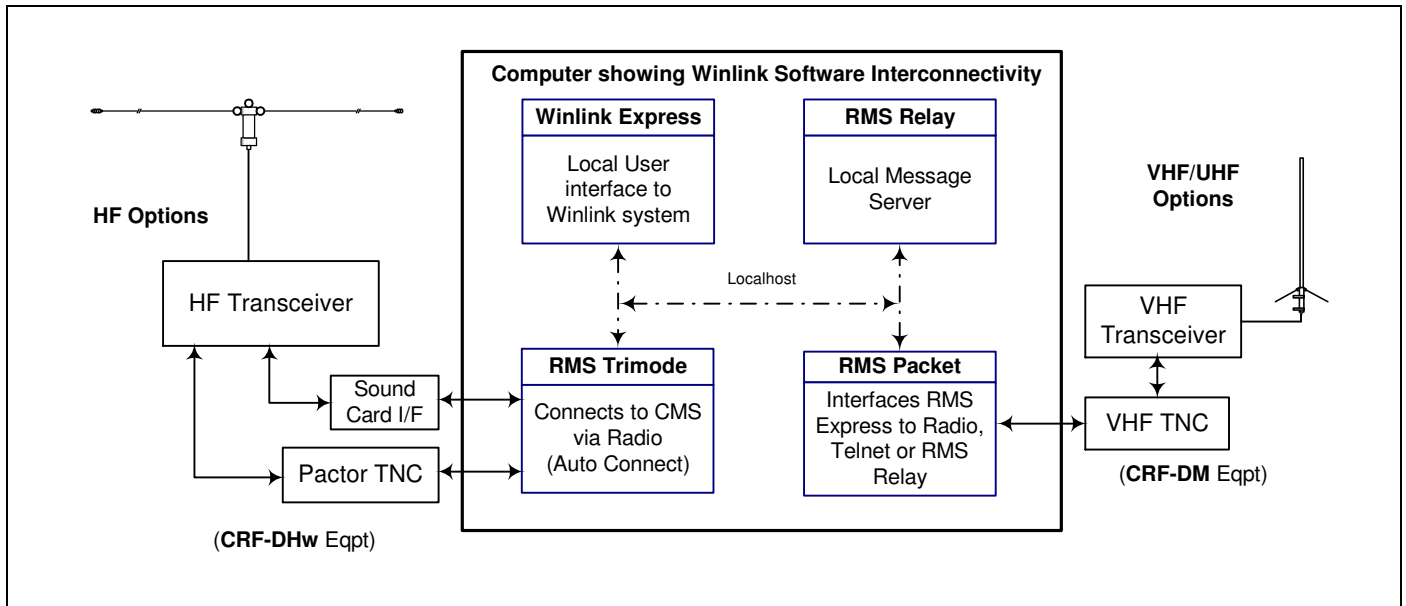


Figure 3 – Internal communications path between each of the software packages

Paclink (Reference)

Paclink is a radio e-mail client with a built-in POP/SMTP server. It is a single or multi user client. Paclink supports telnet, VHF/UHF packet radio, and HF Pactor radio connections to WL2K servers. The user interface is with many common e-mail client programs (Microsoft Live Mail, Outlook Express and Mozilla Thunderbird). Paclink supports attachments, multiple addresses and tactical addresses. Paclink also supports use of a sound card interface via AGWPE. Paclink does not support the WINMOR sound card mode.

Paclink is available at <ftp://autoupdate.winlink.org/User%20Programs/>

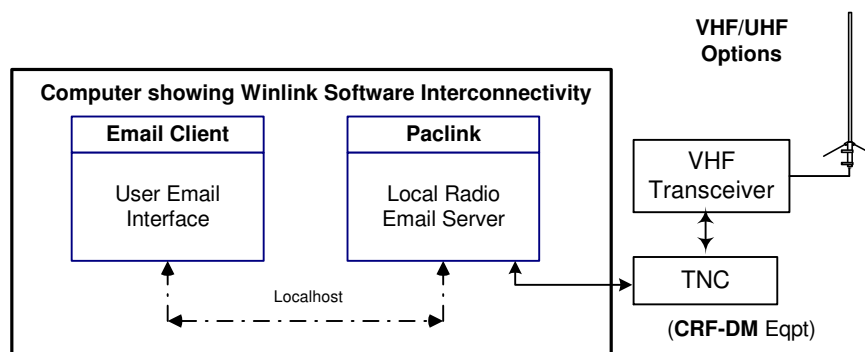


Figure 4 – Internal communications paths between Paclink and Email Client

General Notes -

With the Winlink suite of software constantly changing there are bound to be inaccuracies in this document. The document's intent is to give an overview of operating configurations using Winlink software.

- Winlink Express can be downloaded at this URL; <<http://www.winlink.org/ClientSoftware>>
- RMS Packet, RMS Relay and RMS Trimode are available at <ftp://autoupdate.winlink.org/Sysop%20Programs/>
- Setting up a user Winlink address account is automatically done when you connect to the Winlink 2000 system via radio or via a telnet session using a valid call sign with Winlink Express.
- Each RMS software program has an extensive help section to help getting started and setting up configurations and options. Searching the internet or asking a user are alternate ways of getting help with Winlink. Visit <www.winlink.org> for more info. A very good Winlink frequently asked questions document is located at;

<https://winlink.org/content/winlink_faq_11_15_17_frequently_asked_questions_answers>

- Sysop software requires a 24/7/365 commitment and Winlink team approval to activate.
- The Winlink system requires the use of password and secure login for ALL users. This is being done to enhance the privacy and protection of the Winlink community.
- Details of CRFs can be found at <<http://n5tim.info/CRF%20Info/CRF%20resource%20data.html> >
- Most new PCs and laptops do not have a serial port (9 pin) but have several USB ports. For a number of devices still requiring the serial interface a serial to USB dongle is required. Choose your dongle carefully as there have been a number of reports of clone dongles that will not work with the Winlink suite of programs. Select one that is FTDI listed and buy from a reputable dealer.
- Additional Winlink Program information and EmComm use can be found at the following urls;
<<https://groups.google.com/forum/#!forum/winlink-programs-group>>
<https://groups.google.com/forum/#!forum/winlink_for_emcomm>

HTML Forms

Winlink Express now contains the capability to send HTML version of a number of user and standard forms. HTML form template files are used to send formatted documents and messages between users. These small .xml data file(s) (form content) that is sent, can be opened and rendered as a received HTML form with Winlink Express. Once displayed in HTML, they can be copied, saved, printed, or sent as fully-rendered documents to served agency recipients. Message content is also sent as plain text within the body of the message for use by non HTML renderers. The forms library is now updated automatically with a telnet connection. Most ICS forms are available as well as numerous state and other unique forms.

Sound Card Programs and Interfaces

Winlink users more and more are beginning to use the available "soft TNC" or sound modem programs rather than a hardware TNC. There are pro's and con's regarding the use of these programs regarding their reliability and decoding capability vs the hardware TNC. Most have "hooks" that make it easy to interface to the Winlink programs. If choosing to use this method on interfacing, the hardware between the computer and radio still has to be considered. The use of interfaces that provide the PTT capability are usually the best choice. Others do not provide this function and rely on VOX to key the radio. An additional item to consider is to choose an interface with the sound conversion function rather than relying on the computer to provide this function. It just increases the burden of work for the computer. (see Figure 16 for a typical sound card interface)

RFI

RFI is a serious concern and can render your station inoperable. Some suggestions to minimize the problem;

- Place your external tuner, if used, as near to the antenna as possible
- Consider using shielded cables for all data and control interfaces
- Install snap-on ferrite beads on each end of all data and control cables
- Ensure your set up is well grounded

Digital Frequencies

VHF/UHF Packet Frequencies:

- **2 meters** (VHF): Baud rate is 1200. The most common frequencies are 144.910, 144.930, 144.950, 144.970, 144.990, 145.010, 145.030, 145.050, 145.070, 145.090 and 145.530. Others may be selected anywhere between 144.900 to 145.100 and 145.500 to 145.800.
- **70 cm** (UHF): The packet allocation for the band (mixed mode segment) is 432.10-432.30 and 432.40-433.00. Packet should not be used below 432.00. By local option, packet could also be used from 442.000 to 445.950 and 446.100 to 448.000. 441.000/025/050/075, 440.975 and 446.150 are possible selections. Baud rate may be 9600 or 1200.

HF Digital Frequencies:

HF Digital Frequencies Band plan (In kHz)			
BAND	Allowable Frequency Range for Data (Winlink courtesy)	Frequency range for Pactor 1 & 2, WINMOR or ARDOP Narrow mode (500 Hz)*	Frequency range for Pactor 3 & 4, WINMOR or ARDOP Wide mode (1600Hz)**
160M	1800.000 – 2000.000	1800.000 – 1810.000	---
80M	3525.000 – 3600.000	3570.000 – 3600.000	3585.000 - 3600.000
40M	7025.000 – 7125.000	7080.000 – 7125.000	7100.000 – 7105.000
30M	10100.000 – 10150.000	10130.000 – 10140.000	10140.000 - 10150.000
20M	14025.000 – 14150.000	14070.000 - 14095.000	14095.000 - 14099.500 14100.500 – 14112.000
17M	18068.000 – 18110.000	18100.000 - 18105.000	18105.000 – 18110.000
15M	21025.000 – 21200.000	21070.000 – 21110.000	21090.000 - 21100.000
12M	24890.000 – 24930.000	24920.000 - 24925.000	24925.000 – 24930.000
10M	28000.000 – 28300.000	28070.000 – 28120.000	28120.000 - 28189.000

*Operating frequency must be outside the automatic data portions of the band and within normal data portions of the bands

**Operating frequency must be within the automatic data portions of the selected band

Table 2 - HF Digital Frequencies Band plan

BAND	Channel Frequencies (5 MHz each)	Notes
60M*	5330.500, 5346.500, 5357.000, 5371.500, 5403.500	USB limited to 2.8KHz Bandwidth

*CW & Digital emissions must be centered 1.5 KHz above channel frequency, MRP 100W PEP and only one signal at a time is permitted

Table 3 – 60M Band Channels

Operational (Typical) and EMCOMM Configurations

The following figures and diagrams are a few representations of various ways basic stations can be put together to create systems for both normal and emergency digital communications.

VHF/UHF and HF Peer to Peer Configurations

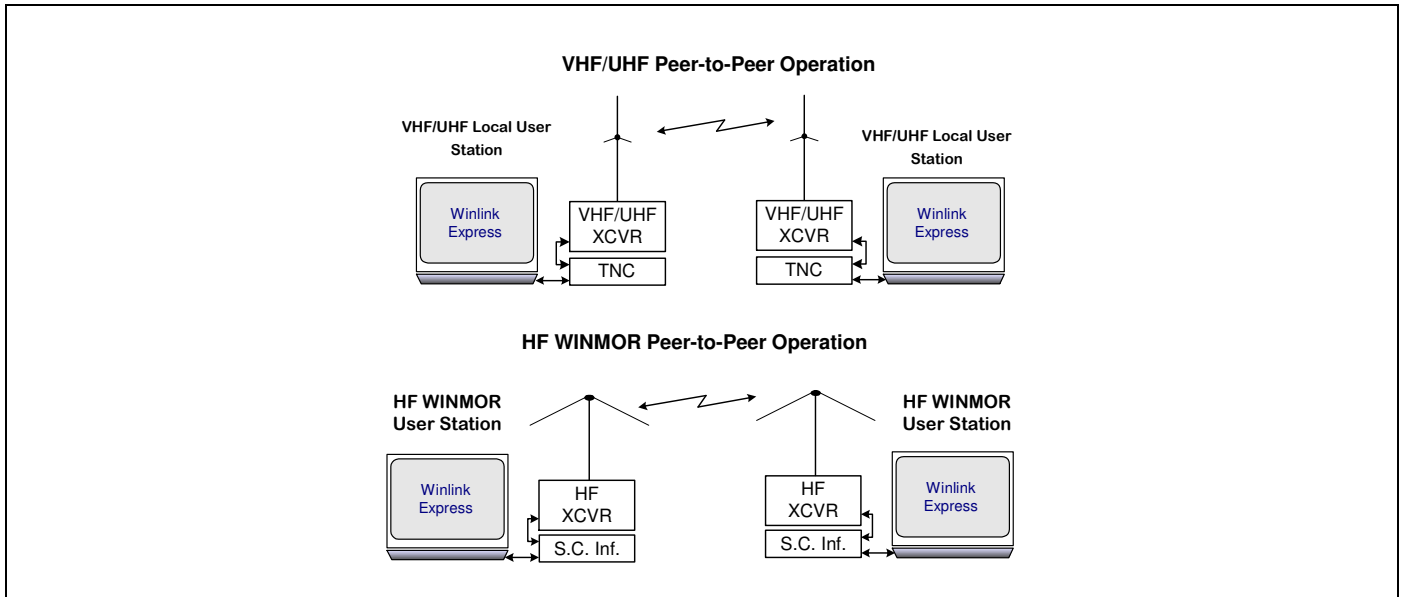


Figure 5 – The simplest configuration is the Peer-to-Peer messaging between two stations operating on the same frequency and at the same time. Timing and frequency for this type of exchange is generally planned over a voice frequency or with a standing plan. This function can be implemented between VHF/UHF, HF WINMOR or Pactor stations using a voice frequency for coordination. This is a non-preferred set up for EmComm use due to the additional use of bandwidth to set up contacts. Each station must use peer-to-peer messaging.

A local RMS VHF/UHF Gateway/Local Server Configuration

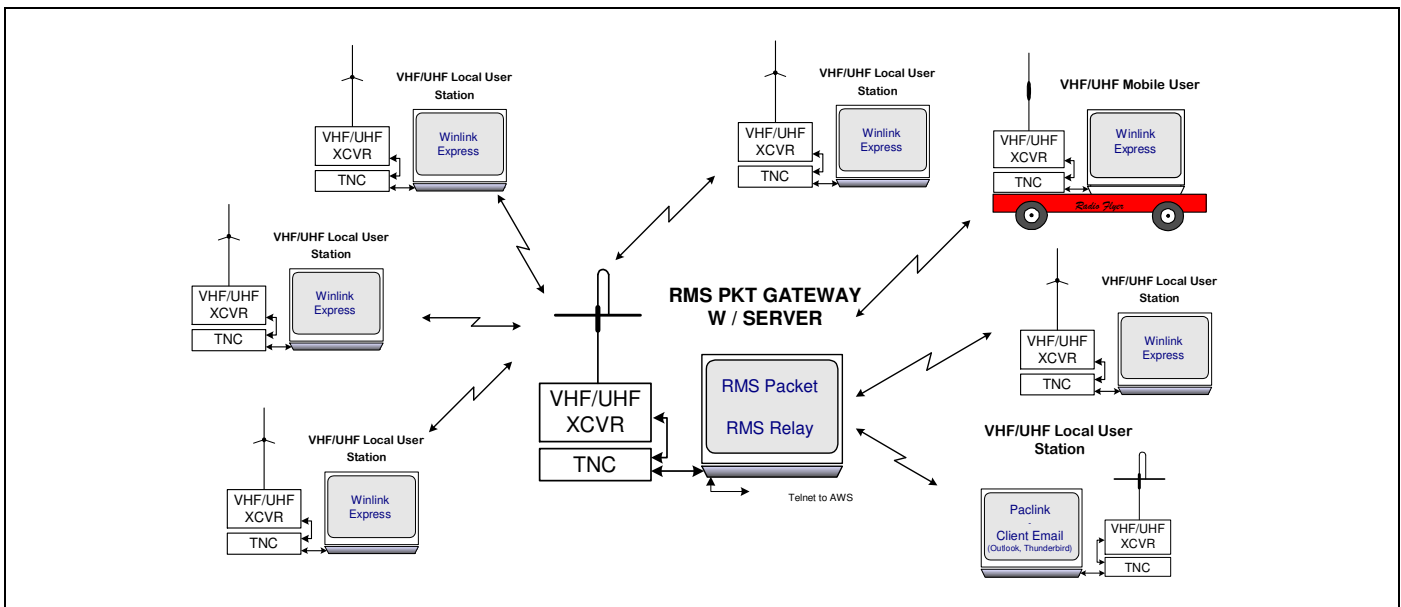


Figure 6 – A typical system configuration of a county or city level digital messaging set up used for normal routine digital operations from local user locations with only a single gateway available. In a situation where connection to the AWS (Internet) is lost, the Gateway becomes a local message hub or server using RMS Relay. This could also be viewed as a tactical digital deployment where all stations are portable in support of a local EOC or DDC.

Local VHF/UHF to HF Forwarding Configuration

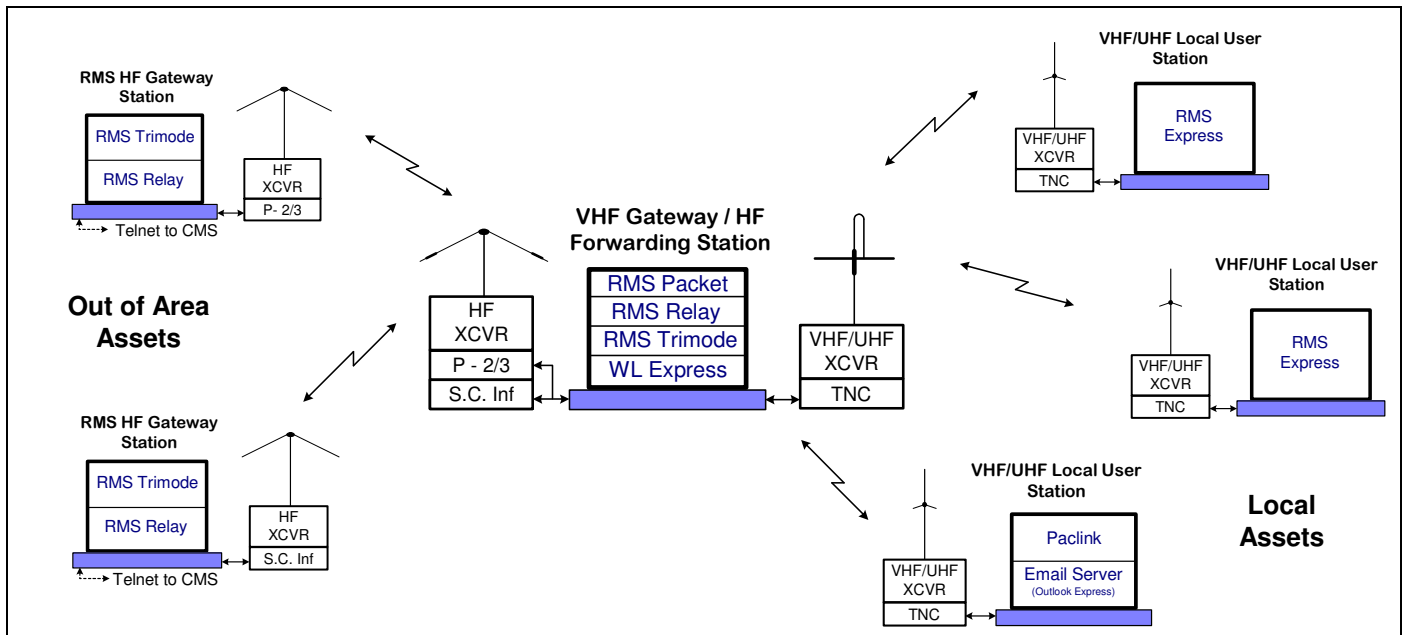


Figure 7 – System configuration showing how a forwarding station plays into the overall communications plan. This is a typical down range or forward area deployment “Store-and-Forward” feature of the Gateway and Forwarding Station. RMS Trimode is used to manually initiate HF forwarding. The store-and-forward station may also run Winlink Express for local message receipt and transmission by the gateway operator. Now with automatic forwarding.

Another configuration for message forwarding

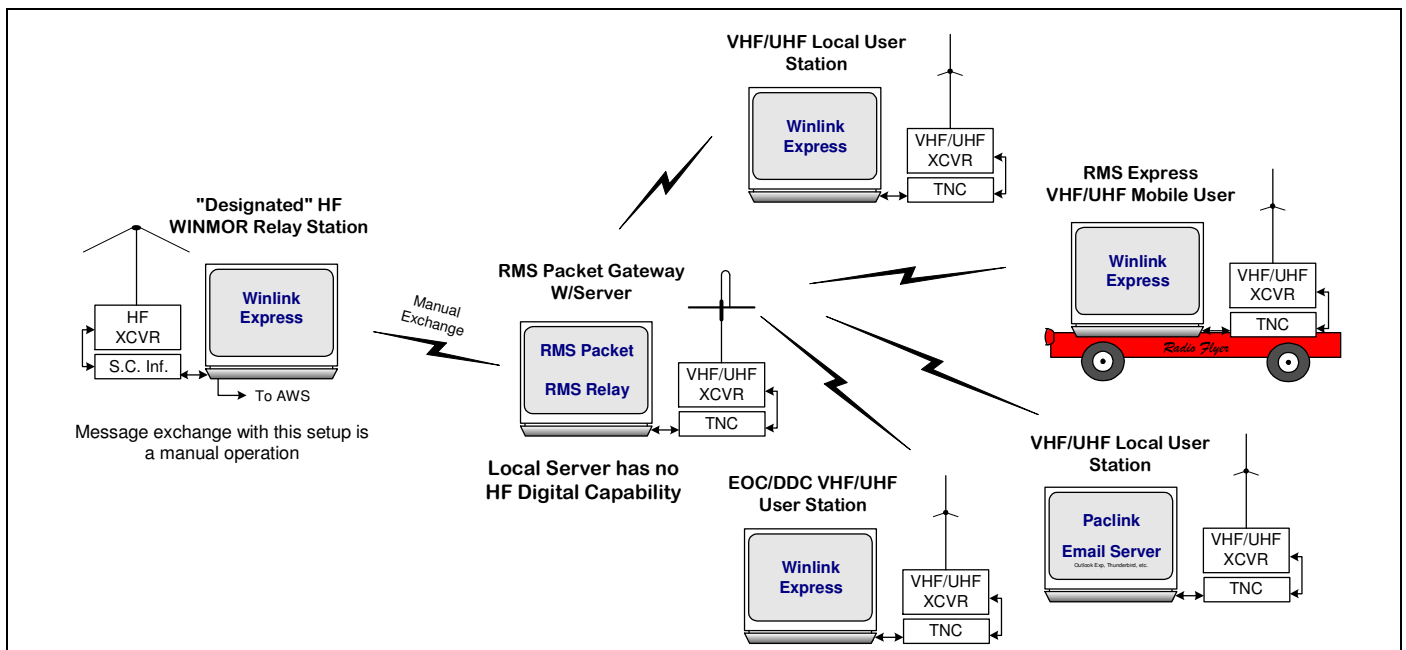


Figure 8 – Typical system configuration for a Designated HF WINMOR Relay Station. The station provides out of area connectivity for local systems that do not have HF Digital capability at the gateway server location. The connection between the gateway server and the relay station can take many forms. The station is “designated” by the local leadership and the station call is communicated on voice nets and in an ICS-217 and/or ICS-205A.

Remote user options configuration

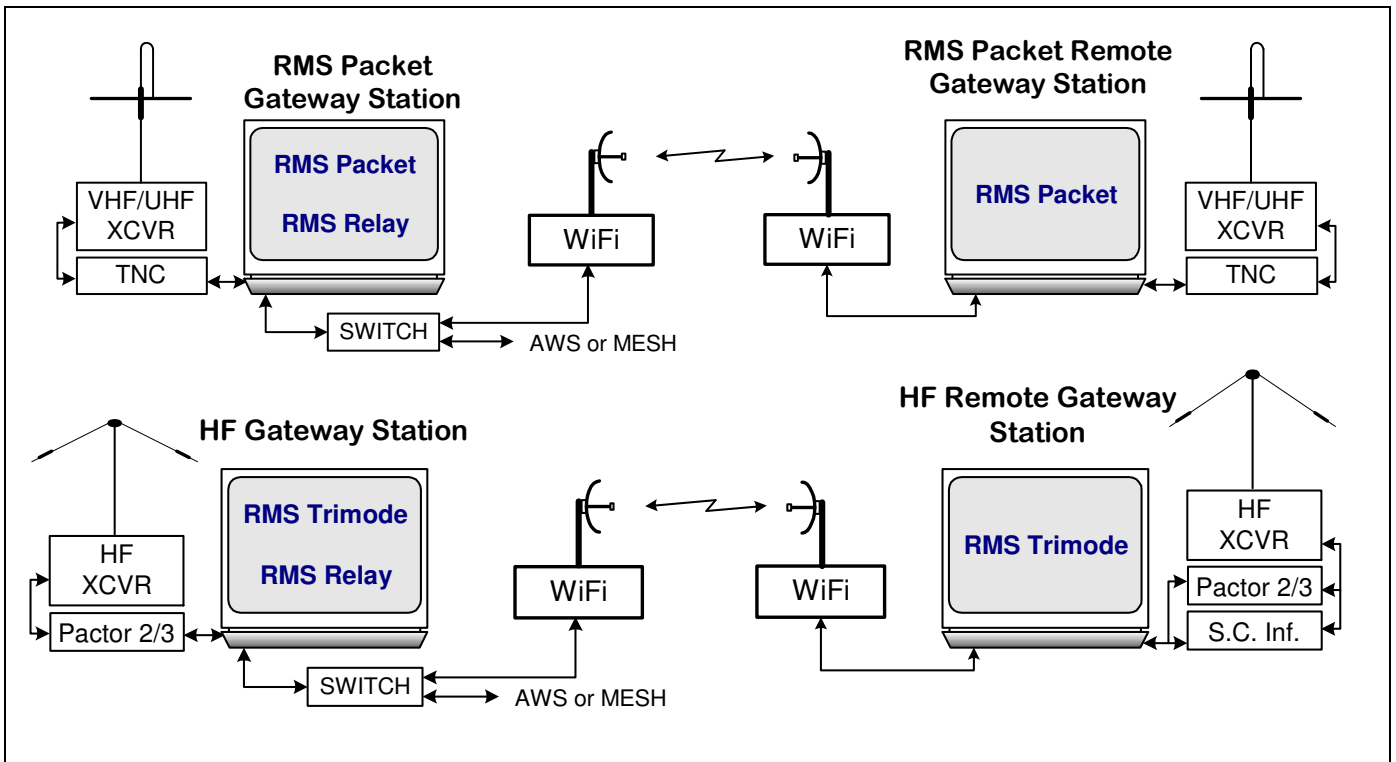


Figure 9 – Using a WiFi or MESH you can set up a remote Gateway station at a distant location without internet access that homes in on a Gateway station with internet connectivity. This function works both with VHF/UHF and HF Gateways. Additional remote Gateway stations can be added by using the appropriate equipment.

Configurations using a network or Mesh for connectivity

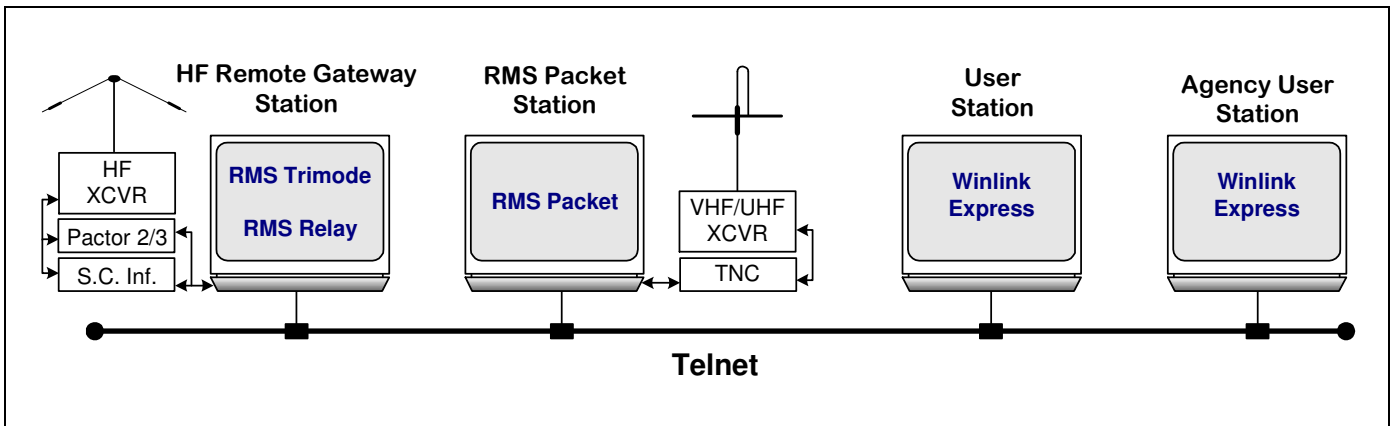


Figure 10 – Using MESH or LAN the Telnet Post Office Mode can be used to access a remote Gateway from local VHF/UHF stations or user stations at remote location without internet access that home in on a Gateway station with HF capability. This function can work with either VHF/UHF or HF Gateways. Additional remote User stations and/or RMS Packet Stations can be added by using the appropriate equipment.

Multiple instances of RMS Packet on a single computer

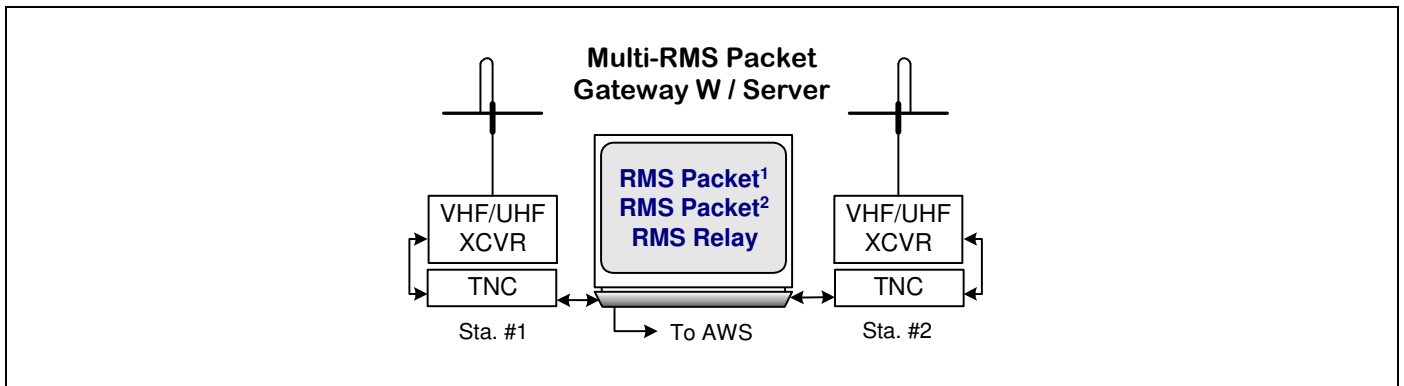


Figure 11 – Multiple radio/TNC set ups are connected to a single computer and share a common instance of RMS Relay. For each radio/TNC set up, a separate instance of RMS Packet is installed. All instances of RMS Packet home in on a single instance of RMS Relay. In setting up each instance of RMS Packet it is best to use the IP address of the local host rather than using "localhost."

A MESH configuration supporting multiple users

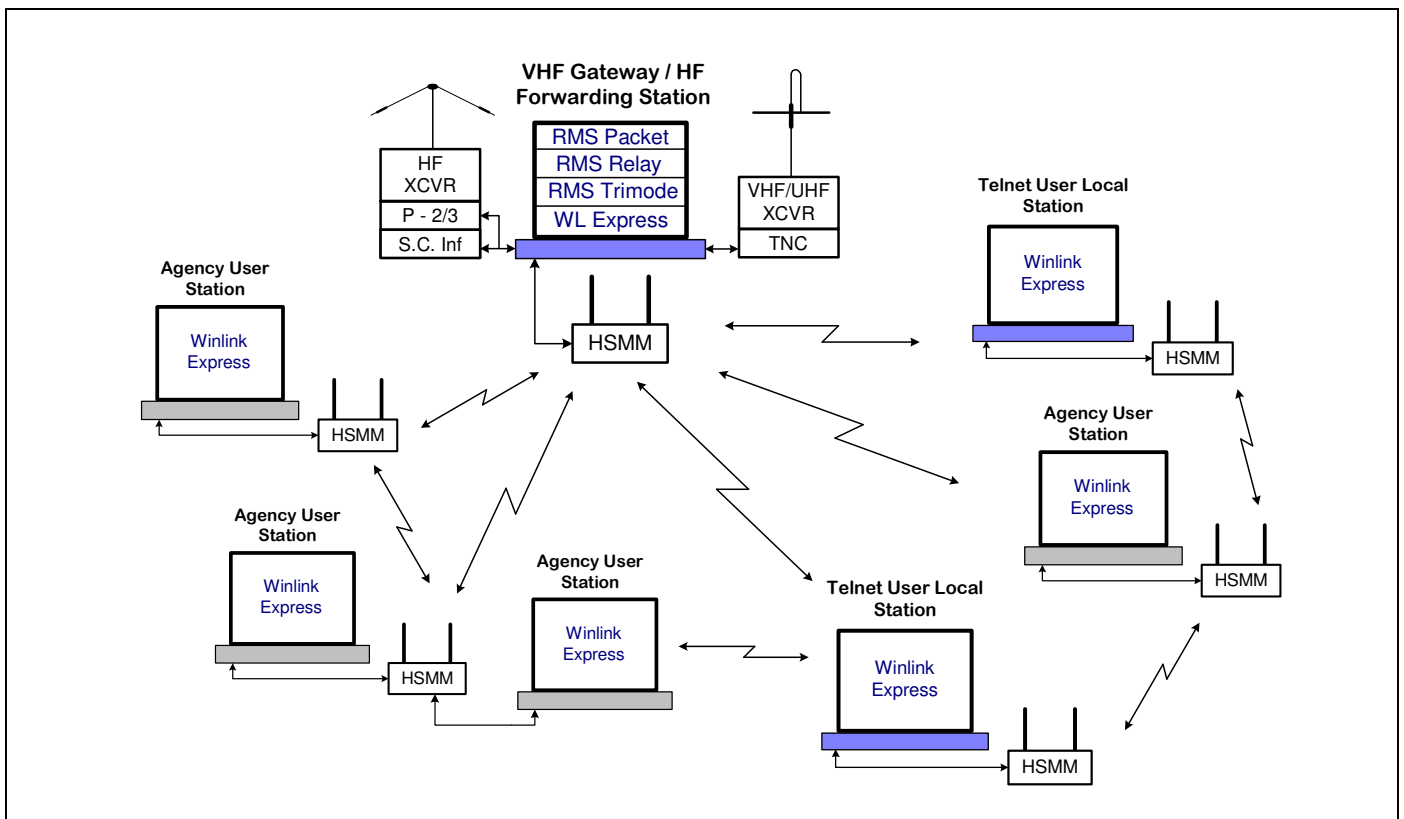


Figure 13 – Another suggested way to add non radio equipped agency and local user stations to a designated HF/VHF Forwarding station using a Broadband Multimedia MESH network. All user stations are running Winlink Express with "use RMS Relay" checked and are connected to a MESH node. A switch could be used in lieu of MESH in close in settings or an EOC to link stations.

Adding support for your local served agency

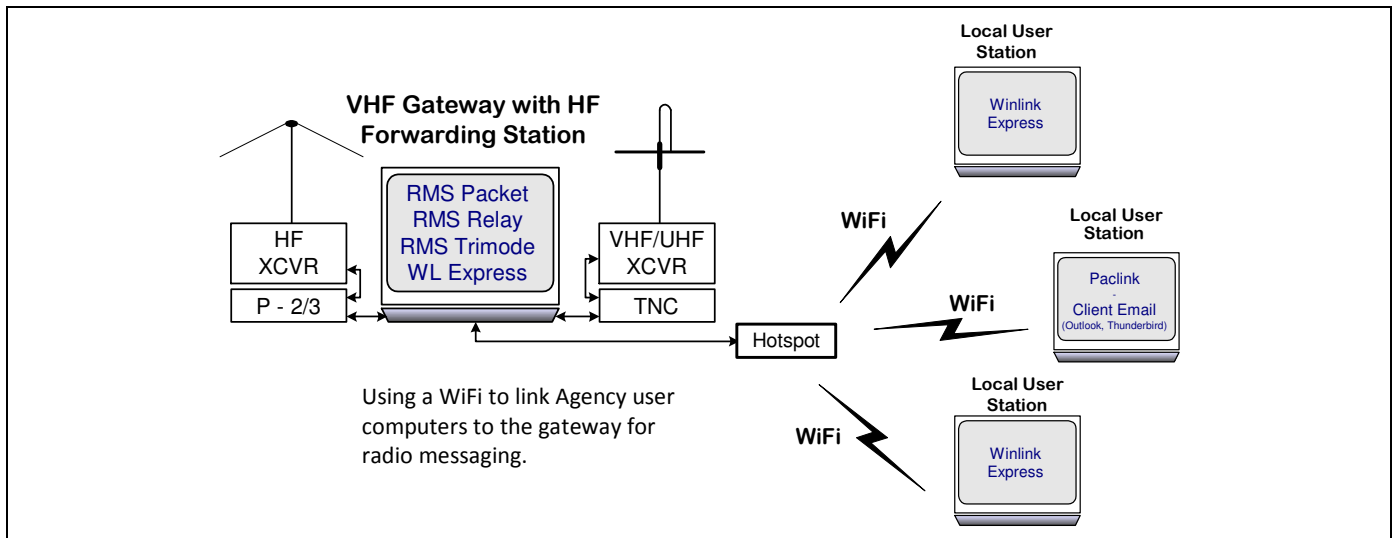


Figure 12 - A suggested way to add non radio equipped agency user stations to a designated HF Forwarding station using WiFi, using a hotspot, switch or similar networking equipment. WiFi would be best used for an open area command post location while a switch would be better for an EOC set-up. All agency user stations are running Winlink Express with “use RMS Relay checked” and are connected to the Gateway Station Access Point. In addition local VHF Winlink Express station operators can deposit and retrieve messages via the RMS Packet VHF equipment of the Forwarding Station.

RMS Packet Frequency Coordination

RMS Packet frequencies should be coordinated over an area for both physical coverage and bandwidth. Local areas should have default RMS Packet coordination plans to maximize bandwidth and coverage. For example, an RMS Packet on a frequency with wide area coverage might be reserved as a key hubbing station.

A viable solution is the Quad plan as implemented by Bruce Dingman, N5BYL of Collin County, Texas ARES. The proposal divides the county into four sections, NW, NE, SE and SW. A common RMS Packet frequency is assigned to each quad. Each County uses the same quad frequency plan. This should minimize “crashing” between RMS stations that are co-located within a multi county area. This may not work everywhere, but should help in most. The Quad frequencies are; A) 144.910, B) 144.930, C) 144.950, D) 144.970, E) 144.990, F) 145.030, G) 145.050 and H) 145.070. A, B, C and D are assigned to the four quads as shown below. A wide coverage centrally located or Hubbing RMS Packet station would use one of the remaining frequencies or one of their choosing. Adjacent Counties with wide coverage stations should coordinate the central station frequency to avoid interference.

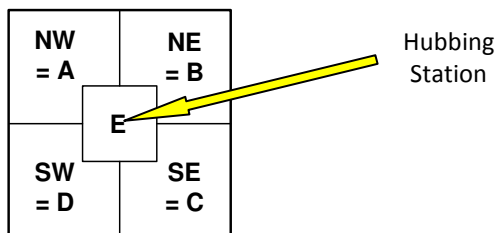


Figure 14 - Example of County sectioned per the Quad Plan. Central/Hubbing RMS optional.

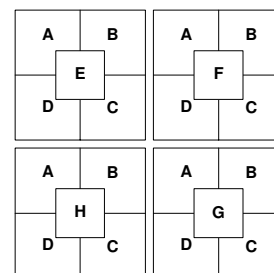


Figure 15 - Example of four adjacent Counties each using the Quad Plan.

Information used in developing this document came from many sources, Internet, other documents and field experience. Thanks go out to those who developed Winlink software, continue to support and use Winlink programs for amateur radio digital communications and those who reviewed drafts.