



Digital Modes for Amateur Radio

Digital communication in amateur radio refers to the use of digital modes and protocols to transmit and receive information over radio waves.

These digital modes offer several advantages over traditional analog modes, such as improved signal quality, error correction, and the ability to transmit various types of data.

AUDIO en**CODEC**ode

Encode = compress file

Decode = decompress file

Audio Codec is a device or software that encodes & decodes a digital data stream or signal.



What is Digital in Amateur Radio?

Voice Modes

DMR D-Star C4FM (Fusion) etc.
Time Division Protocols

Two conversations in same space due to compression

Analog Signal

12 kHz	

DMR
Use of Timeslots

12 kHz	
slot 1	
	slot 2
slot 1	
	slot 2
slot 1	
	slot 2
slot 1	
	slot 2
slot 1	
	slot 2
slot 1	

Data Modes

CW PSK FT4/8 RTTY JT Olivia
Original MFSK Packet Contestia Winlink
Digital Mode etc. etc. etc.

Advantages of Digital

- Data Transfer – include data with voice (location, status, call sign, etc.)
- Lower Bandwidth – CODEC compression = less space. Voice = multiple conversations in same space.
- Reserved and dedicated band space
- Weaker signal modes – overcome compromised antenna to a point.
- Less Power – increase QRP viability
- Versatility – various modes: QSO's keyboard to keyboard, text, files, etc.
- Expand capability

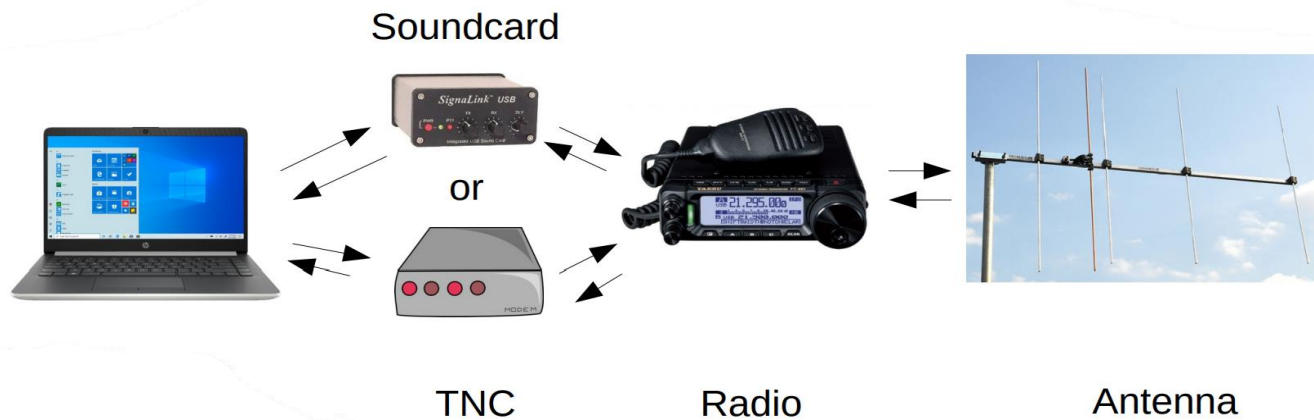


How does digital radio work?

How does it “CODEC”?

Audio Interface = Feeding your transceiver’s audio into a computer soundcard where it gets encoded/decoded by software.

Computer + Software + Soundcard/TNC + Radio & Antenna



- Audio Interface manages flow of audio data.
- Computer’s internal soundcard can manage, but difficult settings & setup.
- Recommend dedicated interface + appropriate cable.



Types of Dedicated Audio Interface (Soundcards)

SIGNALINK



PRO's

- Easy to adjust.
- Audio controls on front panel

CON's

- Fragile for portable
- Size - larger

= great desktop unit

RIGblaster



DIGIRIG



PRO's

- Size – Compact
- Durable

CON's

- Management of sound settings in computer

= great portable go kit unit

+ cable to match transceiver

Most Modern Radios



- Most modern radios already include built in audio interface.





Controlling Your Audio Levels

ALC

An Automatic Level Control (ALC) circuit governs the signal strength going into the power amplifier in a ham radio transmitter. It keeps the amplifier input in the designed range for linear operation.

Depending on the ALC circuit design and how hard it is driven (by the microphone output level and mic gain setting), the ALC circuit can distort the signal and cause interference.

Avoid Distortion - The clarity of your signal depends in part on the particular ALC circuit in the transmitter and how hard it is driven (as indicated by the ALC meter reading).



Target is 1/3 level on ALC meter
Adjust to avoid distortion, over/under modulation.



Introduction to my favorite digital mode



WINLINK GLOBAL RADIO EMAIL®...

...is a network of amateur radio and authorized government stations that provide worldwide radio email using radio pathways where the internet is not present.

- Built, Operated, and Administrated Entirely by licensed “HAM” volunteers.
- Supports Email with attachments, position reporting, weather and information bulletins.
- Well known for its role in interoperable emergency and disaster relief communications.
- Capable of operating completely without the internet.



Who is using Winlink to Support Emergency Communications?

- Amateur Radio Emergency Services (ARRL ARES)
- Military Auxiliary Radio System (DOD/MARS)
- Radio Amateur Civil Emergency Services (RACES)
- National American Red Cross (ARC)
- Southern Baptist Disaster Relief
- Salvation Army
- US Coast Guard
- Many Federal, state, and local government agencies, world-wide

Why use Winlink?

- **Reliability**

- Over a 15 year period, it demonstrated 99.99% availability and 100% accuracy in message transmissions.

- **Radio Connection Bridge to Internet e-mail.**

- Messages sent via radio from a user without internet to a Winlink radio node that has internet connectivity to inject the message into the normal internet email system and conversely from internet back to radio.

- **Standard email formats and Features**

- ICS forms embedded within program; i.e., ICS 213 General Message Form, ICS 309 Communications Log, etc.
- Binary file attachments such as pictures, PDF's, spreadsheets
- Automatic message compression/decompression to minimize message size
- Whitelist used to control SPAM.

Why use Winlink?

- **Modes of Operation**

- Normal Mode – stores in an internet connected E-mail server (Common Message Server)
- Peer-to-peer connections between radio end-users. Two operators using same frequency & same protocol to exchange traffic.
- Radio only store and forward without internet

- **Interoperability**

- Winlink does not restrict users to a single communications protocol, RF frequency, or band. The system supports a constellation of RF gateway nodes that operate on a wide range of HF, VHF, and UHF frequencies. The system also supports wide range of communication protocols such as PACKET, VARA, ARDOP, and PACTOR.

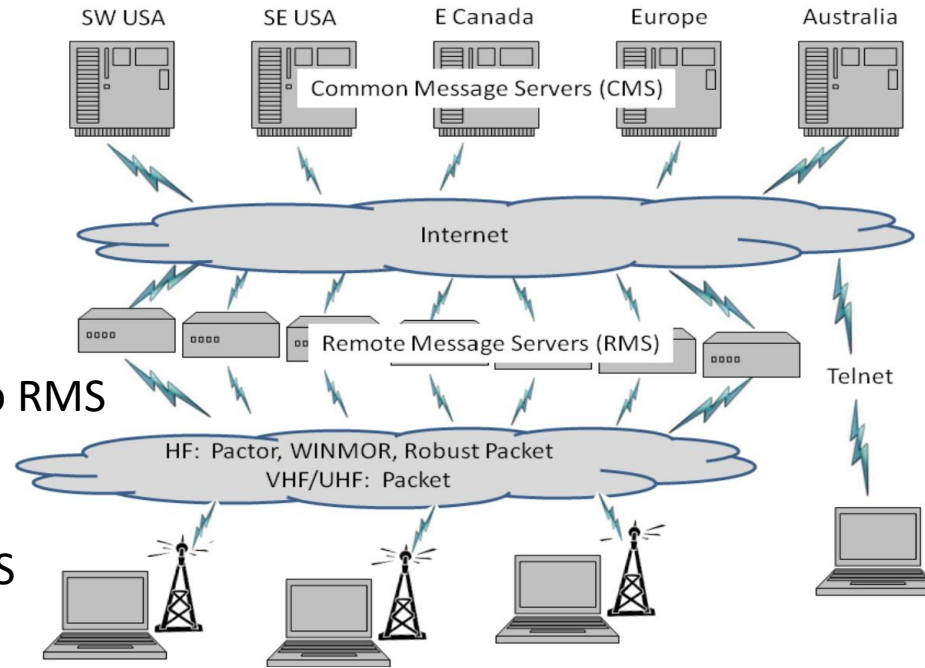
- **Geographical Dispersion & Redundancy for Reliability**

- Wide range of RF gateway nodes located in a variety of locations.
- If one gateway fails, other gateways are available (especially via HF).

How does Winlink work?

Email over RF

- **VHF/UHF** – local line of sight
 - Packet (core use – locally)
 - Ability to Digipeat from RMS to RMS
 - VARA FM (growing popularity)
- **HF** – long distance, or regional using NVIS
 - Several dozens of RMS gateways
 - Various modes
 - VARA HF (“fast” speeds)
 - Free – limited speed
 - \$80 – Registered, “fast” speeds for HF



Telnet – Internet only

No transceiver required

Uses Winlink Common Message Servers

Internet Connection Required

Requirements



Typical Winlink Station

- Basic Requirements
 - Amateur Radio License
 - Winlink.org registration + issue of ID AB5MC@winlink.org
 - Winlink Express software (FREE)
- Telnet Station = computer + internet connection
- VHF/UHF station = Radio + TNC + computer + antenna
 - Or Radio + soundcard + computer with TNC software + antenna
- HF station = Radio + soundcard + computer + antenna

Winlink Global Radio Mail – What it isn't and things to remember.

• It is not designed for:

- Daily personal email - Same as all amateur radio digital modes, messages are non-encrypted, in open.
- Large volume - keep traffic light / minimal for gateway sharing.
- Large attachments; photos, file sharing, etc. Larger file size, longer to send/receive over RF.

• Things to remember:

- Replies and email string history needs to be removed / minimalized to reduce file size.
- Don't expect super high speeds
 - Remember this over RF, speeds are similar to 90's era slow dial up. Some modes are faster than others, but it's still sending data over RF.
- Expect to encounter multiple attempts on some days with operation over RF
 - Propagation varies and affects gateway communication. A certain station that worked yesterday may be difficult today.
- Stay in practice
 - Winlink Wednesday Nets over RF is a very good way to stay familiar and in practice sending mail over RF.
 - Winlink Wednesday Virginia – every Wednesday, large traffic, the original Winlink Wednesday; winlinkwednesday.net, KN4LQN@winlink.org
 - North Texas Winlink Wednesday – local, good for capturing Grayson Co. traffic. 1st & 3rd Wednesdays; groups.io KF5VO@winlink.org
- **Don't get discouraged with initial set up. Station configuration can be a challenge at first.**

Winlink Global Radio Mail – How to operate

Winlink Express Software

Similar to basic email programs you may have used in past.

Post messages to outbox while offline, then sync with RF or Telnet connection.

The screenshot displays the Winlink Express 1.7.7.0 interface for user KI5NUI. The main window shows a list of messages with columns for Date/Time, Message ID, Size, Source, Sender, Recipient, and Subject. A 'Post to Outbox' dialog box is open in the foreground, allowing the user to compose a new message. The dialog includes fields for From, To, Cc, Subject, and Attach, along with a 'Send as' dropdown and a 'Request message receipt' checkbox. The message list in the background contains several entries, including one from KI5NUI to KN4LQN with the subject 'Winlink Wednesday Check-In'.

Date/Time	Message ID	Size	Source	Sender	Recipient	Subject
2023/06/22 00:19	IO2QTBQIGROD	252	KI5NUI	KI5NUI	KN4LQN	Winlink Wednesday Check-In
2023/06/14 14:53	9RKLNNX9LICG	259	KI5NUI	KI5NUI	KN4LQN	Winlink Wednesday Check-In
2023/06/07 14:55	YCG6U6FONYM5	316	KI5NUI	KI5NUI	KF5VO	QTC 1 R SHERMAN TX 75090
2023/06/07 14:49	MKNYLHXX6JQP	291	KI5NUI	KI5NUI	KN4LQN	Winlink Wednesday Check-In
2023/06/01 10:12	1A7I4530YSBV	226	KI5NUI	KI5NUI	coffmanma@gma...	testing winlink
2023/05/24 23:09	X4YM1C1LH65J	259	KI5NUI	KI5NUI	KN4LQN	Winlink Wednesday Check-In
2023/05/17 15:12	DVE78WJ324MQ	259	KI5NUI	KI5NUI	KN4LQN	Winlink Wednesday Check-In
2023/05/17 15:10						

Post to Outbox Select Template Attachments Spell Check Save in Drafts Close

From: KI5NUI Send as: Winlink Message Request message receipt Set Defaults

To: KN4LQN;

Cc:

Subject: Winlink Wednesday Check-In

Attach:

Message ID: H5N2
Date: 2023/06/25
From: KI5NUI
To: KG5VK
Source: KI5NUI
Location: 33.562
Subject: Field D
6 R KI5NUI 15 K5
STEVE LOTT SMITH
DENISON TX 75090
KG5VK ATSIGN WIN
BT
GREETINGS FROM K
AMATEUR RADIO CL
AT EISENHOWER BI
BT
MICHAEL COFFMAN
OP NOTE K5GCC
AR

Winlink Global Radio Mail – How to operate

Open Session for mode: Packet, Vara FM, Vara HF, etc.

Channel Selection – update propagation estimates via internet or over RF.

- Another reason for regular practice, keeps propagation estimates updated.

Listen to make sure channel not busy, then start session.

Receiving gateway station will acknowledge and session will automatically start until complete or signal loss.

Confirmation will be given if successful or unsuccessful.

Call sign CW will be transmitted at end to identify your station.

DEMONSTRATE Winlink Session

The screenshot displays two windows from the Winlink software. The top window, titled 'Vara HF Winlink Session - K15NUI', shows session parameters: Call sign KD5EOC, Center Freq. (kHz) 7103.000, Dial Freq. (kHz) 7101.500, Bearing 236, and Quality 101. It also shows a status bar indicating 'Channel Free In: 0/0 Out: 0/0 BPM: 0/0 Disconnected' and a log of messages including 'Launching VARA TNC', 'Successfully connected to VARA TNC.', and 'Ready'. The bottom window, titled 'HF Channel Selector', displays a table of available channels with columns for Callsign, Frequency (kHz), Mode, Grid Square, Hours, Group, Distance (km), Bearing (Degrees), Path Reliability Estimate, and Path Quality Estimate.

Callsign	Frequency (kHz)	Mode	Grid Square	Hours	Group	Distance (km)	Bearing (Degrees)	Path Reliability Estimate	Path Quality Estimate
KD5EOC	3589.000	V2300	EM13KF	00-23	PUBLIC	66	236	99	99
KD5EOC	7103.000	V2300	EM13KF	00-23	PUBLIC	66	236	96	96
W5WK	3596.000	V2300	EM12HL	00-23	PUBLIC	143	213	85	47
WASTED	7103.800	V2300	DM93AN	00-23	PUBLIC	502	271	84	48
W5STX	7102.000	V2300	EL16DF	00-23	PUBLIC	822	188	82	48
K5EOC	7115.000	V500	EL09SI	00-23	PUBLIC	502	202	82	49
K5RAV	7102.000	V2300	EL16CE	00-23	PUBLIC	828	189	82	48
W5RGV	7102.000	V2300	EL16DE	00-23	PUBLIC	826	188	82	48
W5RMW	7103.000	V2300	EL09TK	00-23	PUBLIC	490	201	81	49
XE1CRG	10146.000	V2300	DL90HQ	00-23	PUBLIC	1507	200	80	48
W0MAC	7101.600	V2300	EL29GR	00-23	PUBLIC	438	166	79	48
W0MAC	7066.000	V500	EL29GR	00-23	PUBLIC	438	166	79	48
KB5HCD	7101.900	V2300	EL29FU	00-23	PUBLIC	423	167	78	48
KB5MAC	7103.300	V2300	EM20FA	00-23	PUBLIC	404	166	78	48
KB5OZE	7103.000	V2300	EL49WU	00-23	PUBLIC	732	123	78	46
XE1VP	14092.900	V2300	EK09JI	00-23	PUBLIC	1601	190	78	49
W5KAM	7103.500	V2300	EM20BE	00-23	PUBLIC	380	170	77	48

Winlink Global Radio Mail – Recap & More Information

Winlink

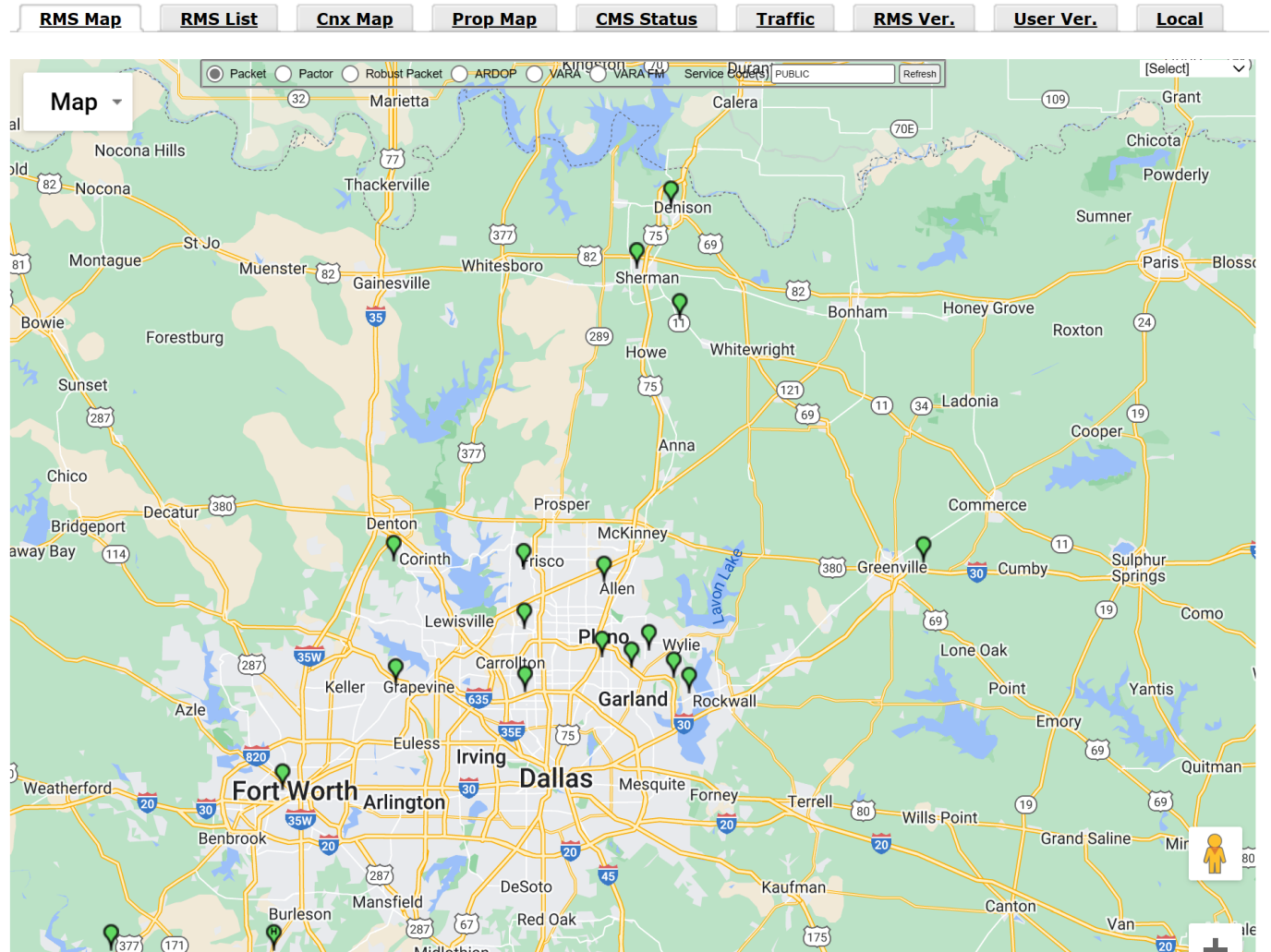
North Texas Packet Gateways

Available to all licensed amateur operators on 2M.

- Technician
- General
- Advanced
- Extra

VHF/UHF

- Equipment you probably already have except audio interface and software.
- Great for local use.

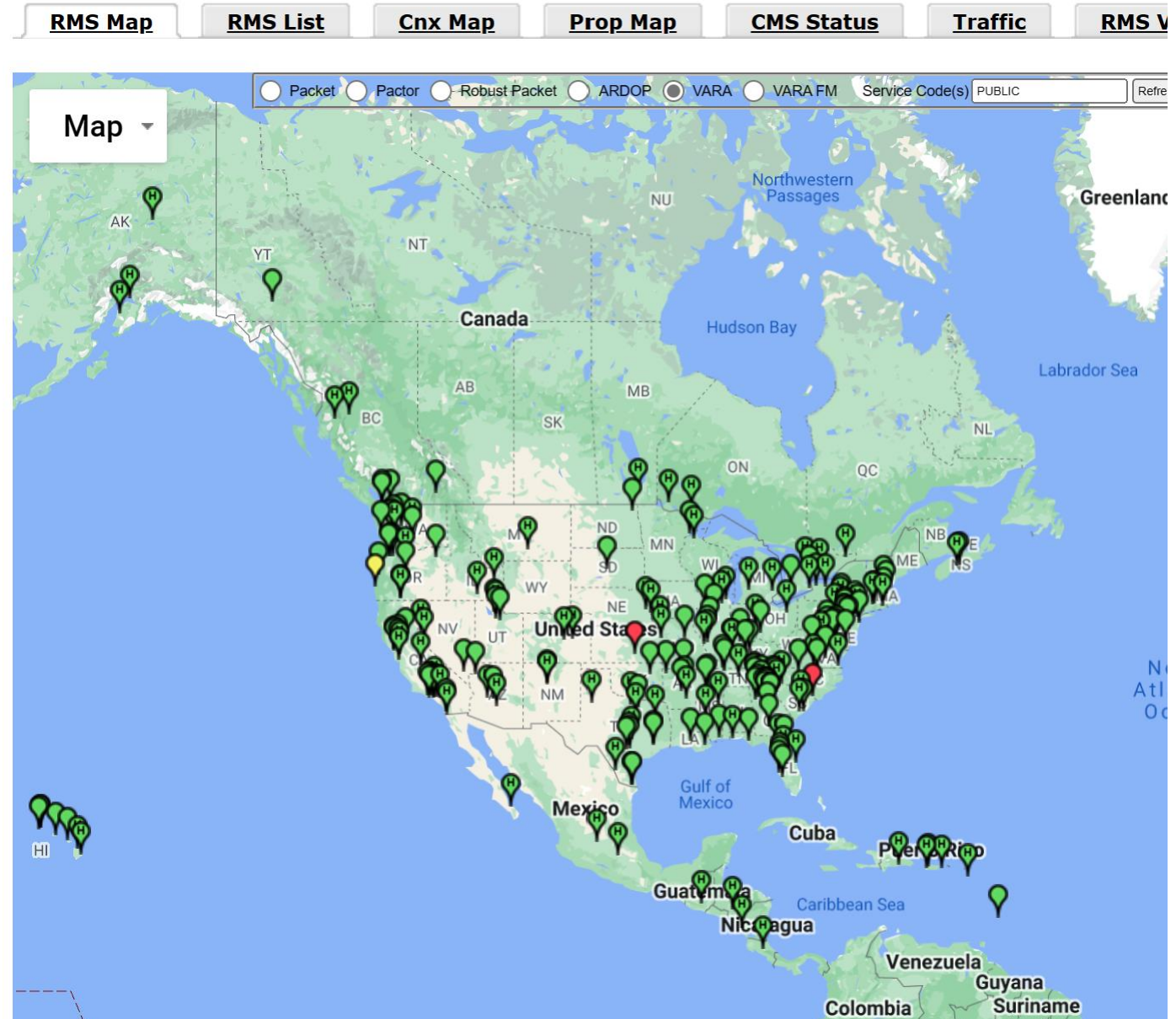


Winlink Global Radio Mail – Recap & More Information

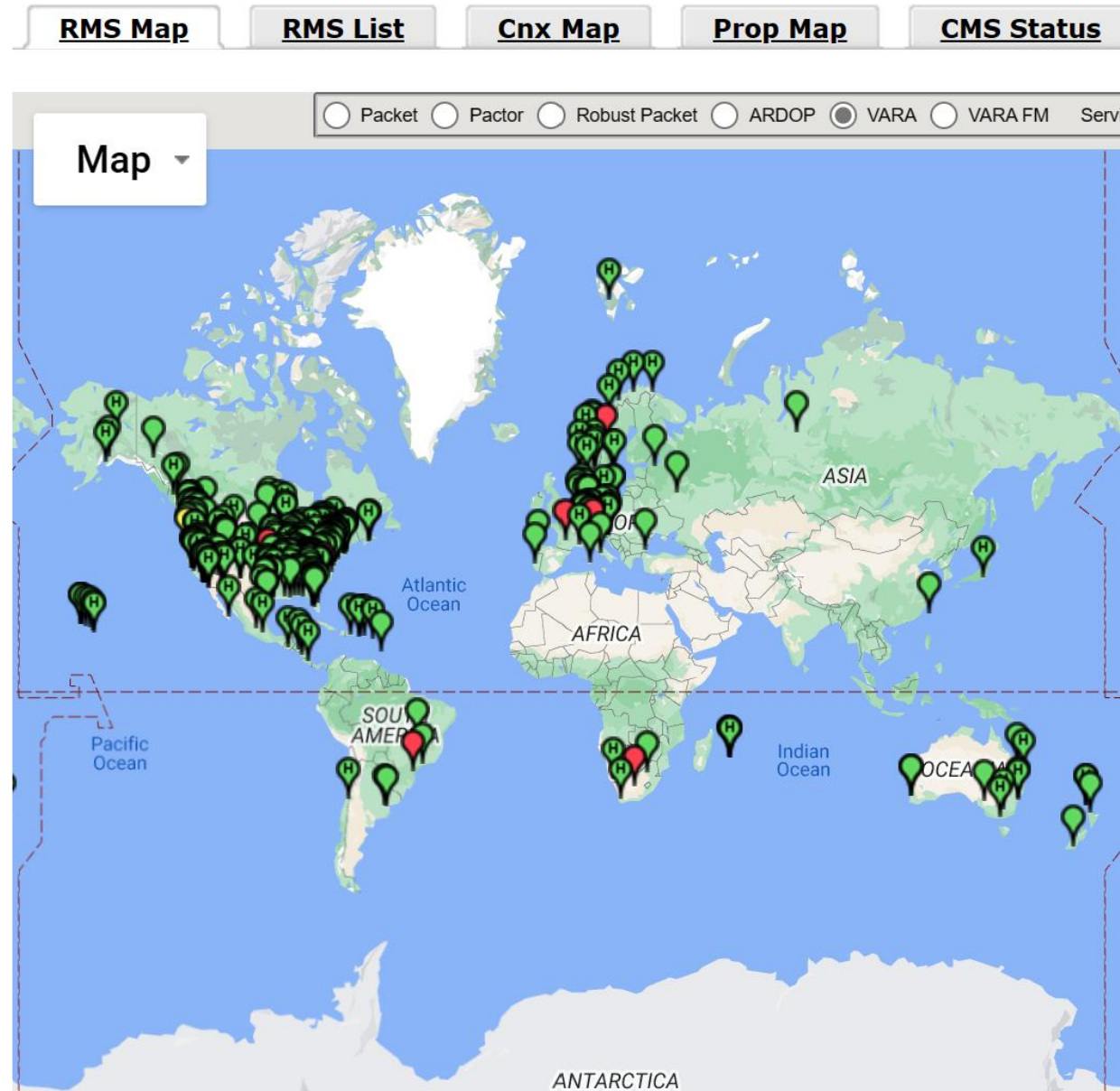
Winlink

North America HF Gateways

- NVIS Options for Regional area.
- Use antennas and transceiver equipment you currently use for HF phone and data operations.
- Weak Signal mode can be low wattage.



Winlink Global Radio Mail – Recap & More Information



**Winlink
Worldwide HF Gateways - Vara**

Winlink Global Radio Mail – Recap & More Information

Links for more information <https://winlink.org/>

Useful YouTube videos

Basic Intro to Winlink: https://www.youtube.com/watch?v=vD_G9YCoDNM&list=PLcBrg-5drc84N1GU9zhWwCF9HisFc8L_a&index=2

Getting Started with Winlink - https://www.youtube.com/watch?v=onEoKbEpGfc&list=PLcBrg-5drc86usyVmDIL8jFHc8MYep_nv&index=31

EMCOMM basics <https://wavetalkers.com/resources/digital/winlink.php>

Links for Software

Link for software downloads on Winlink site. <https://downloads.winlink.org/>

Link for soundmodem software. [UZ7HO Personal page - Packet-Radio - English version](#)

Link for Vara software. <https://rosmodem.wordpress.com/>

More Information on ALC - <https://www.hamradioandvision.com/how-to-use-an-alc-meter/>