# Packet Radio 101

Wait, that still exists?

## Topics

- What is Packet
- How does it work
- What value does it have in an emergency
- What is this statewide network I have heard about?
- What do I need to get started?
- What the heck is a Direwolf?

## What is Packet - History

- May 31, 1978 First ASCII transmission over the amateur bands in Montreal
- March 1980 FCC approves ASCII on the amateur bands
- December 1980 KA6M put up possibly the first digipeater on 2M
- 1981 Groups across the US formed to develop hardware, standards, and protocols
- 1981-1983 These groups adapted the commercial X25 protocol to amateur use creating AX.25 by adding support for callsigns and unconnected operation.
- November 1983 TAPR releases the first AX.25 TNC as a kit
- 1984 Experimentation continues, BBS software is developed, and the mode takes off

### What is Packet Radio in 2021

- Primarily used as a protocol for other applications on top of it.
- Two modes of operation Connected and Connectionless
- 3 common speeds 300 baud on HF, 1200 and 9600 baud on VHF/UHF
  - HF activity concentrated on "Net105" 14.105MHz LSB, and "Net40" 7.104MHz LSB
  - VHF/UHF activity in this area can be found on 145.670, 145.030, and 145.010MHz at 1200 baud
- NOTE: Packet on HF uses LSB
- AX.25 packets can also be sent over the internet using AXUDP.
- Packet is the ultimate mode for remote operation

### Unconnected Packet (Datagrams)

- Commonly used to call CQ and for station ID
- Most frequently used for APRS
- Often referred to as unproto



### **Connected Packet - IP Connections**

- Can be used for TCP/IP (computer network) connections, but it is very slow.
- IP and TCP protocols have headers to allow traffic routing. This further decreases the amount of information contained in a packet.



## **Connected Packet - Digipeaters**

- Look for their own callsign and retransmit the packet if it is addressed to it.
- There is an acknowledgement for each hop or each time a packet is digipeated.
- This can cause congestion



### **Connected Packet - Nodes**

- Several types exist KA-Node, NET/ROM, BPQ, and others
- Keep track of other nodes and heard stations in a network.
- Users can connect to a node, then connect through the network to distant nodes maintaining a single connection and reducing acknowledgement traffic.



### Connected Packet - Bulletin Board Systems (BBS)

- BBS systems run as an application on a node.
- Users exchange personal messages similar to email.
- Bulletins (messages of general interest) can be posted to be read by all users.
- BBSs can be interconnected and there is a network of BBSs using HF, VHF, and AXUDP connections that permit the exchange of messages and bulletins with other hams worldwide.

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	0HN>			
	ae #192 Killed			
lm				
1259	15-May PN	177 KU0HN		SYSTEM Housekeeping Results
1248	14-May PN	177 KU0HN		SYSTEM Housekeeping Results
1172	14-May PN	177 KUOHN		SYSTEM Housekeeping Results
1123	13-May PN	175 KU0HN		SYSTEM Housekeeping Results
1080	12-May PN	1835 KUOHN		W9GM Re:RF Link - Success
1070	12-May PN	175 KU0HN		SYSTEM HOUSekeeping Results
1023	11-May PN	175 KUOHN		SYSTEM HOUSEKEEPIng RESULTS
987	10-May PN	2362 KUUHN		WOCH REFLIN-100DR
973	10-May PN	174 KUUHN		SYSTEM HOUSEKeeping Results
900	09-May PY	439 KUUHN		WSum FIM-Loopk
927	09-May PN	174 KUOHN		SYSTEM Housekeeping Results
883	08-May PN	1050 KUOLN		NOCH Housekeeping Results
020	07-May PN	174 KUOHN		SVETEM Househopping Recults
702	OF May PN	174 KUOHN		SYSTEM Housekeeping Results
776	00-May PN	4865 KURHN		WIGH ReiNy SSID on other nodes and a packet presentation
743	A5-May PN	174 KUOHN		SVETEM Hausehaning Results
785	04-May PN	174 KUOHN		SVSTEM Housekeening Results
664	03-May PN	174 KUOHN		SYSTEM Housekeening Results
617	02-May PN	174 KUOHN		SYSTEM Housekeening Results
567	01-May PN	174 KU0HN		SYSTEM Housekeeping Results
	30-ADF PN	174 KU0HN		SYSTEM Housekeeping Results
		174 KU0HN		SYSTEM Housekeeping Results
	28-Apr PN	174 KU0HN		SYSTEM Housekeeping Results
		174 KU0HN		SYSTEM Housekeeping Results
	26-Apr PY	1896 KU0HN		W9GM Re:GM Ben
343	26-Apr PN	174 KU0HN		SYSTEM Housekeeping Results
	25-Apr PY	110 KU0HN		W9GM GM Ben
			<b>@KUOHN</b>	W9GM Re:Terminal for LinBPQ
			@KU0HN	W9GM Terminal for LinBPQ
			<b>ØKUOHN</b>	
		1070 KUOHN		
	23-Apr PN	175 KUOHN		SYSTEM Housekeeping Results
	22-Apr PF	697 KU0HN		
194	22-Apr PF	297 KU0HN	<b>ØKUGHN</b>	W9GM Re:Testing Fowarding
193	22-Apr PF	445 KU0HN	@KU0HN	WSGM Re:MAP for yourself
191	22-Apr PF	333 KUOHN		W9GM Re:MAP for yourself

### **Connected Packet - Chat**

- Another node-based application
- Keyboard-to-keyboard chat with other hams
- Chat servers can be connected across nodes
- Chats are organized by topic

554 KUOHN @KUOHN W9GM Good Morning 267 KU0HN @KU0HN W9GM Darn, still looping 697 KUOHN @KUOHN W9GM Looping 297 KU0HN @KU0HN W9GM Re:Testing Fowarding 22-Anr PF 445 KU0HN @KU0HN W9GM Re:MAP for yourself 333 KU0HN @KU0HN W9GM Re:MAP for yourself 22-Apr PF User KUOHN

### **Connected Packet - Winlink**

- Regular email over the air.
- Uses VHF packet among other protocols.
- Other modes are available on HF and VHF
- Popular in emergency communication and disaster response
- Clients available for several platforms, including Android.

KB1HNZ - Settings Message	Attachments Move To:	Saved Items	v De	elete Ope	n Session: Ardop	Winlink ~	Logs Help	
No active session								
System Folders	Date/Time	Message ID	Size	Source	Sender	Recipient	Subject	
Inbox (0 unread)	2018/03/24 17:48	UMERBG50QYBP	208	WX1GYX	WX1GYX	KB1HNZ.	//WL2K Test message	
Read Items (0)	8 2018/03/24 17:22	H6KPJU1SSPCY	26939	SMTP	SMTP query repl	KB1HNZ	GFS:39N.48N.74W.60W	_
Sent Items (12)	2018/02/02 16:19	ESRPL003S7RF	528	SYSTEM	SERVICE	KB0FX	//WL2K User Notice	
Saved Items (0)	2017/10/05 21:52	EWUX8M3D87NE	186 WS1EC	WS1EC	WS1EC SERVICE	KB1HNZ	//WL2K test message	
Deleted items (0)	2017/06/25 17:13	204NOBHJVW3G	381	System		K81HNZ	Undelivered Message	
Drans (0) V	2017/06/25 01:15	QV545N5ACUX9	547	KBIYTR	KBIYTR	WS1SM	//WL2K Happy Field Day	-
Personal Poliders	A 2017/05/01 16:20	L VVI NATOTADIO	153	MISCOA	111101	1011017	LOND DK hand	-
	AU. Navassite							
Global Folders	Source: WEBMAIL Downloaded-from: Subject: test me: test message	Telnet:Halif	ax.Win	link.or	2			
Giobal Folders Contacts	Source: WEBMAIL Downloaded-from: Subject: test me: test message	Telnet:Halif	ax.Win	link.or	r )			
Giobel Folders Contacts	Source: WEBMAIL Downloaded-from: Subject: test me test message	Telnet:Halif: saage	ax.Win	link.or	3			
Global Folders Contacts	Source: WEBNAIL Downloaded-from: Subject: test me test message	Telnet:Halif	ax.Win	link.or	3			
Global Folders Contacts	Source: WEBNAIL Downloaded-from: Subject: test me test message	Telnet:Halif	ax.Win	link.or	7			
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### Packet in Emcomm

- Winlink seems to be the preferred tool for disaster response over the past few hurricane seasons.
- BBS systems can be used to coordinate volunteers, pass traffic, or post bulletins relating to the emergency or public service event.
- Chat can be used for real-time communications
- Public service events database of injuries, etc...
- According to the 145.670 network managers, the Minnesota Department of Health is "not Impressed" with 1917-era radiogram forms.

### 145.670 Network

- Statewide network of KA-Node nodes (Kantronics).
- Installed after the Sept. 11 attacks.
- Primary focus seems to be emergency and event communications.
- Used during the Super Bowl in 2018.
- Nearest node is in Rochester (MNROC2).
- This network does \*NOT\* pass BBS traffic.

#### 4/24/2021 MN 1200 bps Packet (145.67 MHz) Status



on the backbone nodes to reduce complexity/cost and rule out viruses/worms, unattended bulletin forwarding congestion and Internet distributed denial of service attacks. The primary traffic is keyboard-keyboard "instant"

messaging, which requires less than 70 bits/second/user.

### Other regional packet activity - 145.030MHz



Map created by W9GM of nodes his node has a route to.

### What do I need to get started?

- 1. A radio and antenna
- 2. A TNC (Terminal Node Controller)
- 3. A terminal (Computer)
- 4. The mode also lends itself to remote station use.



# **Getting Started - Radio**

- You probably already have one that will work.
- For a dedicated station, used monobanders and surplus commercial radios are an inexpensive choice.
- 9600 baud requires a discriminator tap.
  - VHF/UHF radios with a "data" or "9600" mini-din port support this
  - Many commercial radios have a discriminator output.
- Avoid Baofeng UV5R-based HTs and KT-8900-type mobile radios.
  - They do not switch from tx back to rx fast enough, and they miss reply packets in connected mode.



## Getting Started - Common types of TNC

- Full featured TNCs
- KISS TNCs
- TNCs built in to the radio
- Software TNCs

### Full Featured TNCs

- Only require a "dumb" serial terminal or terminal emulator to operate.
- All packet operations are handled by the TNC
- They often have a PBBS or Mailbox for messages
- Often support other modes including PACTOR, RTTY, and CW



### **KISS TNCs**

- KISS TNCs only convert audio tones to data and data to audio tones
- Connection handling, packet generation, etc... is handled by computer software.
- Less expensive than a full featured TNC can be built from junk box parts.
- Full featured TNCs can also run in KISS mode.
- Many sold as kits.







### Software TNCs

- Most common examples are Direwolf and SoundModem
- Computer generates audio tones and sends them over a soundcard interface.
- They can emulate a KISS TNC for compatibility.
- Most complicated option in terms of PC setup.
- Least expensive option overall.
- Best decoding performance in adverse conditions.





## Built-in TNCs

- Radios with built-in APRS have a TNC on-board
- Not all radios expose the TNC to the user (check your manual).
- Built-in TNCs run in KISS mode.



## Terminal or PC

- Any terminal or terminal emulator will work with a full-featured TNC.
- If using a KISS TNC or Software TNC, dedicated packet software is required.
  - EasyTerm by UZ7HO is a popular choice on Windows.
  - LinPac is a good option on Linux.
- APRS apps, Winlink, and others support KISS TNCs out of the box.

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# Questions?