

APRS

Introduction to the Technology, and
Its Use in the Yukon

Oct 2025, C.Gale

In the beginning...

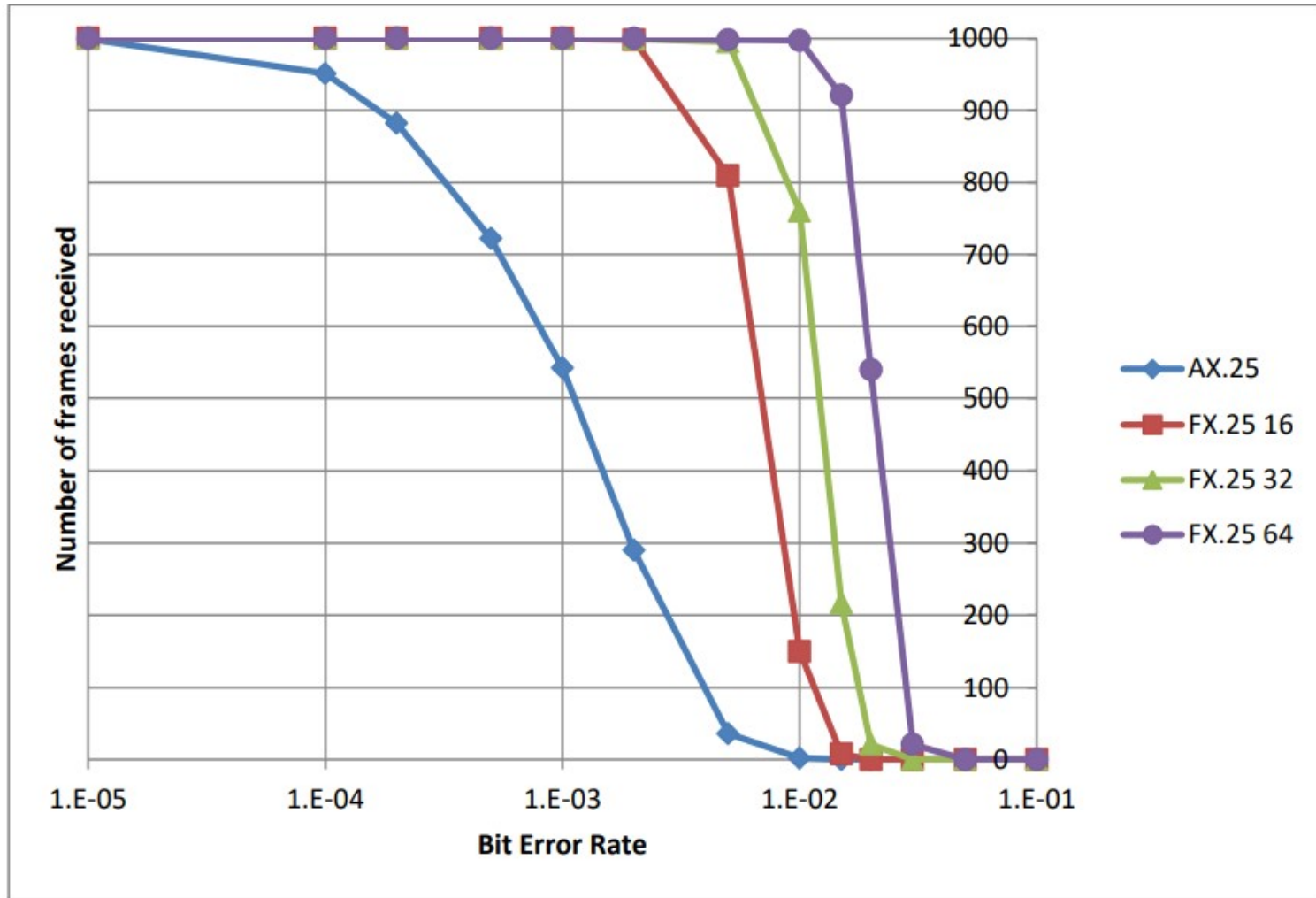
In the mid 1970's, long before the World Wide Web, large mainframe computers at businesses and universities were accessible by a dial-up MODEM. Services were quite limited; usually a "Bulletin board" where users could post messages, pick up messages, and in some cases run programs or even play simple games.

The framing protocol was FX.25 which has error correction, and is intended for one to one communications. Amateurs soon tried using those dial-up MODEMS over radio, and with a few tweaks to the handshaking, were soon able to connect home computers or terminals to their radios, and then connect to their Bulletin Board Servers at 1200 Baud. This system was so robust, (dial-up and Packet Radio) that X.25 protocol is embedded in most Operating Systems still today, including Windows and Linux.

The radio based "Packet" system fell out of favor once the World Wide Web became popular, because it is inherently slow and simplex in nature. Start downloading a multi megabit graphical web page in error, and you can go out for coffee before you have control again.

Nevertheless, Packet is still used for text services like 2 Meter Winlink.

Impact of Error Correction



So Why APRS?

Packet Radio has major limitations.

First - it is between 2 stations only. I must know where my destination station is located, and worse, the path my message needs to take. For example, if I send you a message by 2M Winlink, I have to tell my packet program to send the packet to VE3NRR, and tell NRR to forward to VE3STP, and also ask STP to pass it to VA3OFS, then ask OFS to send to VE3OCE-10, which will give it to VE3BPQ-10 which hosts the Winlink RMS. Lots of opportunity for drops, re-sends, and so on.

Second – it is slow! And can be unreliable With all these handoffs.

Third – if any of these stations are down, I can not connect, and I would need to keep alternate routes handy if any are possible, or perhaps an alternate RMS if I knew of one.

Fourth – If I travel to a new area, I have lots of research to do before I can use the system

APRS addresses these issues, and adds capability

What is APRS?

APRS stands for Automatic Packet Reporting System (formerly "position reporting.") It was developed by Bob Bruninga WB4APR (SK) while he was a senior research engineer at the United States Naval Academy in the 1980s, for the purpose of tracking Navy ships at sea. It has since evolved into much more than a mere location-tracking system.

What APRS is now is a tactical, real-time information sharing and communications system that provides situational and spatial awareness of your immediate local area. It can let you know about everything happening or of interest near you. It also allows both local and global communications via text messages or emails. It provides access to much more information via queries and responses to and from information servers and access to gateways to other services.

All of this can take place on your radio's display, although you can also employ a cell phone or laptop, or tablet to get a visual representation of everything overlaid on a map. Bob Bruninga said, "The goal is communications and local info[rmation] updates, not just vehicle tracking."

How APRS works

APRS uses X.25-framed packets, usually at 1200 baud, usually over a single, shared 2-meter simplex frequency that's country / region wide, so everywhere you go where there's APRS coverage, you can get all of the local information. Unlike standard packet radio, APRS is a one-to-many information-sharing system utilizing a "fire and forget" paradigm, similar to UDP over the Internet vs. TCP/IP.

Digipeaters form the backbone of local-area APRS networks. They use store-and-forward to essentially relay or rebroadcast what they receive on the same frequency, hopefully at a higher signal level and with greater range than the transmitting station. Wide-coverage digipeaters are often co-located at repeater sites, and since there is typically no Internet connectivity at those locations, they're usually RF-only.

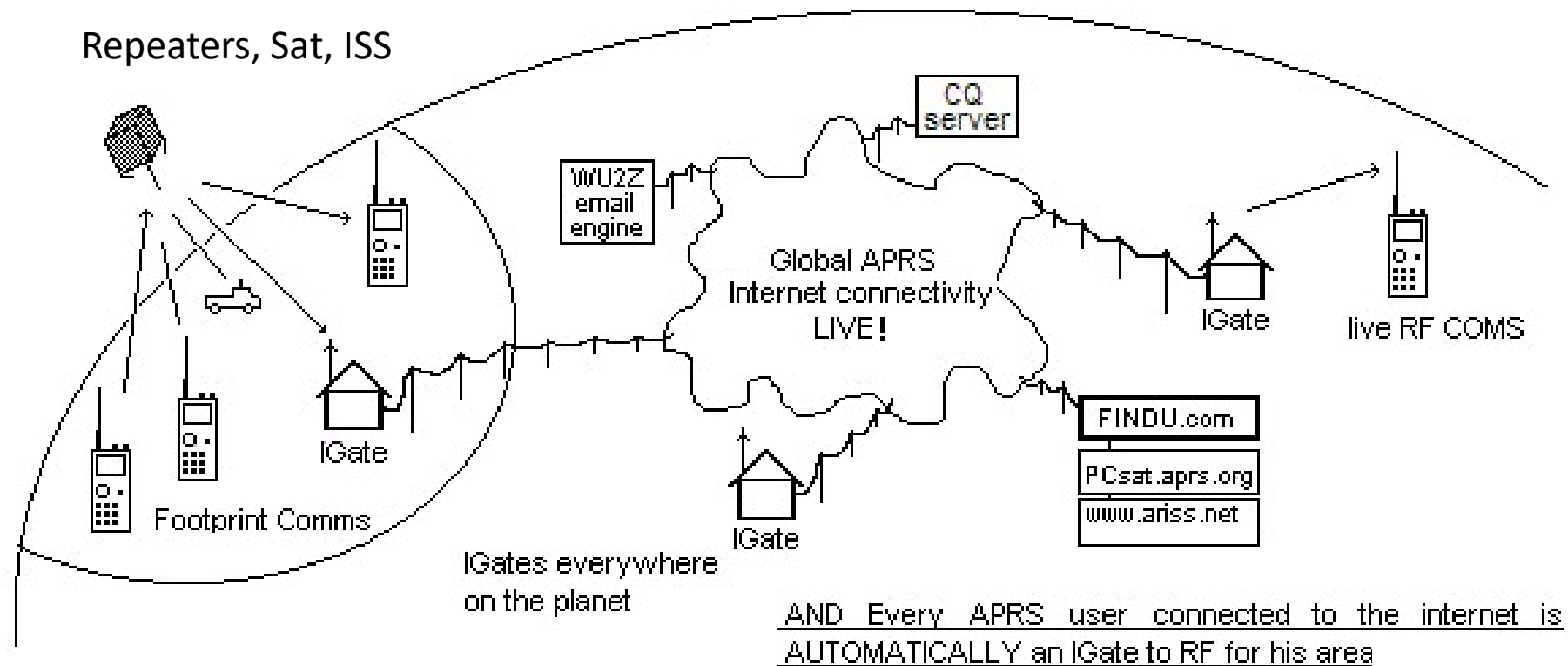
Fill-in digipeaters, often located at hams' homes, usually don't have nearly the range. However, they can be used to fill in coverage in RF dead zones, and as there's usually Internet available often do double-duty as IGates.

Igates, as you've probably figured out, bridge information between radio and the internet, in both directions. Igates send your information to APRS-IS, and any messages for you will be sent via the Igate that saw you last.

Modified Stolen Chart ☺

APRS Global Network

(End-to-End Everywhere)



Scope of APRS (10 years ago)

Over 40,000 users worldwide.

RELAYS every 30-50 km called
“digipeaters.”

All linked by home station
lgates

Global links by Amateur
Satellites

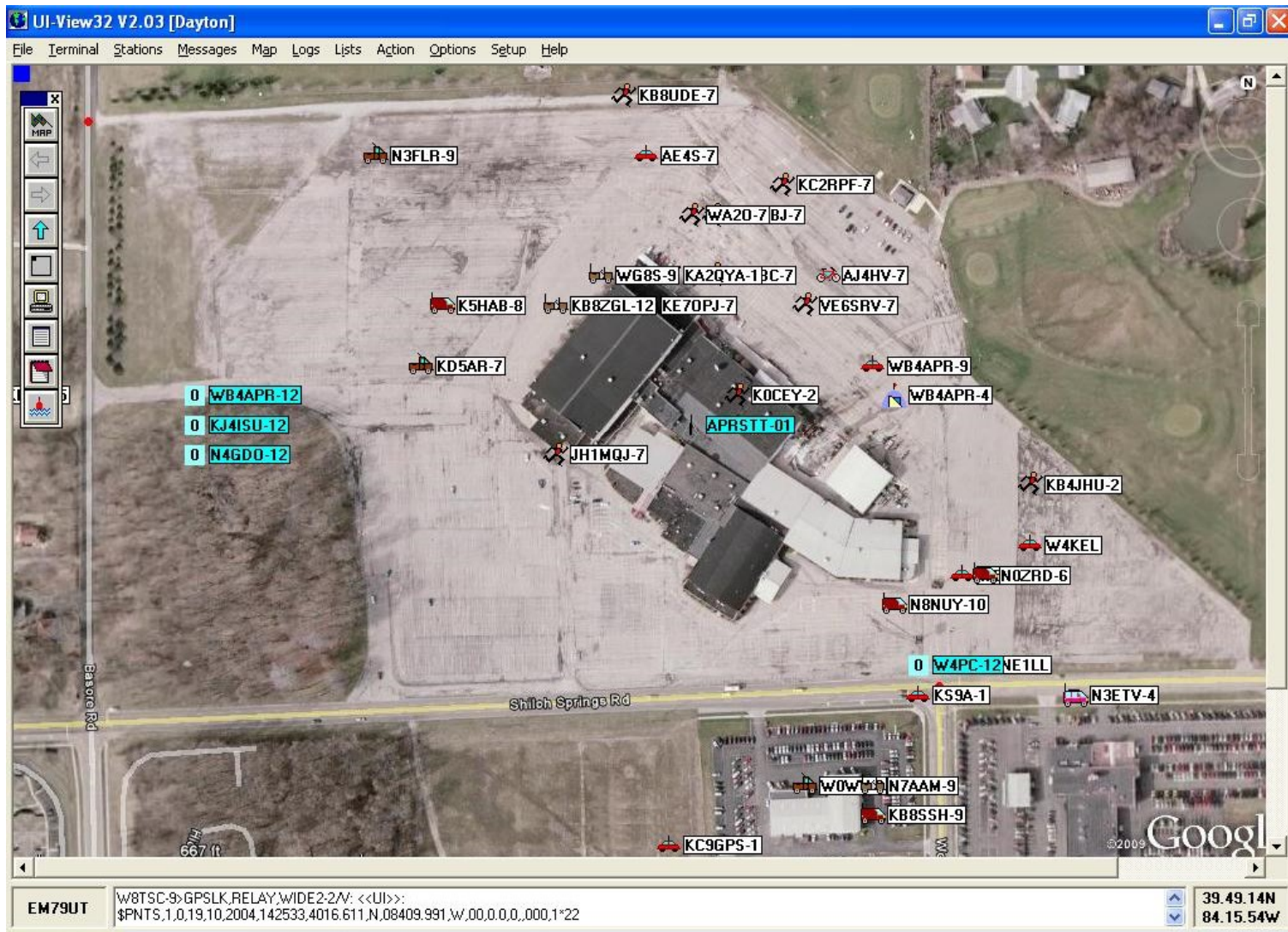
Thousands of Weather
stations

Telemetry and data
everywhere

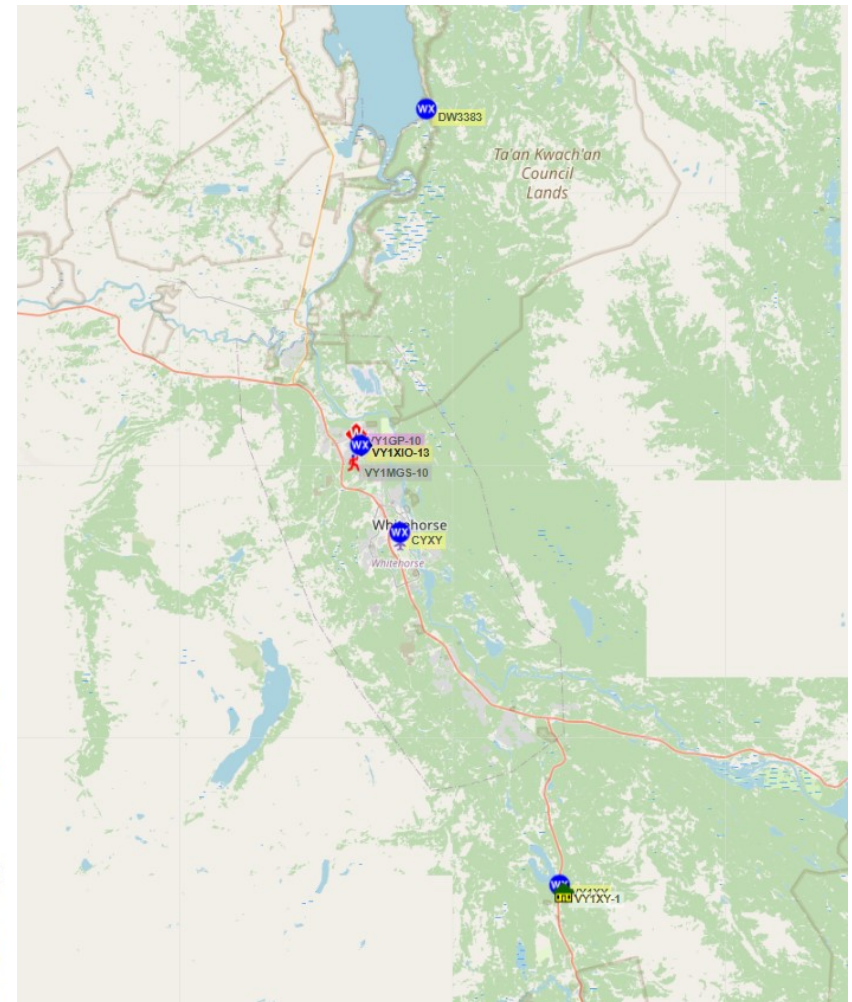
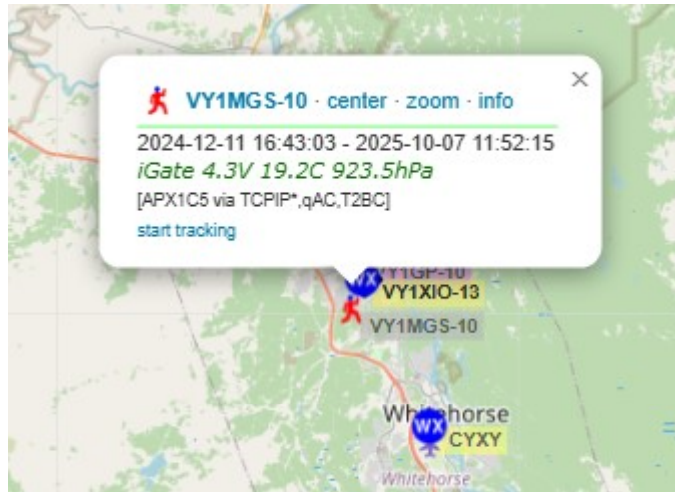


But, only 2% of local ham radio users...

Example display program



From aprs.fi



```

2025-10-06 17:45:33 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZCAEAST:16045.60N/13507.66W[iGate 4.4V 24.5C 916.9hPa
2025-10-06 18:46:02 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZLANE:16045.60N/13507.66W[iGate 4.3V 26.0C 917.1hPa
2025-10-06 20:46:50 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZSJCI:16045.60N/13507.66W[iGate 4.3V 24.9C 918.3hPa
2025-10-06 21:47:06 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZUSANE:16045.60N/13507.66W[iGate 4.3V 24.3C 919.2hPa
2025-10-06 23:47:52 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZCAEAST:16045.60N/13507.66W[iGate 4.3V 22.8C 920.2hPa
2025-10-07 00:48:21 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZBC:16045.60N/13507.66W[iGate 4.3V 22.7C 920.5hPa
2025-10-07 01:48:43 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZTEXAS:16045.60N/13507.66W[iGate 4.2V 22.2C 920.8hPa
2025-10-07 02:49:09 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZLANE:16045.60N/13507.66W[iGate 4.3V 21.7C 921.3hPa
2025-10-07 03:49:32 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZALBERTA:16045.60N/13507.66W[iGate 4.3V 21.7C 921.7hPa
2025-10-07 04:49:56 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZCAEAST:16045.60N/13507.66W[iGate 4.3V 21.6C 921.9hPa
2025-10-07 05:50:16 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZRDU:16045.60N/13507.66W[iGate 4.3V 21.1C 921.8hPa
2025-10-07 06:50:19 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZUSANE:16045.60N/13507.66W[iGate 4.3V 20.5C 922.1hPa
2025-10-07 07:50:38 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZCAEAST:16045.60N/13507.66W[iGate 4.3V 20.2C 922.2hPa
2025-10-07 08:51:04 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZRDU:16045.60N/13507.66W[iGate 4.3V 20.1C 922.5hPa
2025-10-07 09:51:25 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZUSANE:16045.60N/13507.66W[iGate 4.2V 19.6C 922.6hPa
2025-10-07 10:51:53 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZBC:16045.60N/13507.66W[iGate 4.3V 19.5C 923.2hPa
2025-10-07 11:52:15 EDT: VY1MGS-10>APX1C5,TCPIP*,qAC,TZBC:16045.60N/13507.66W[iGate 4.3V 19.2C 923.5hPa

```

[< previous](#)

APRS-IS (Messages)

from	to	time	message
WB4APR-9	JA1RBY-4	10/25 00:07:04z	no msg list?{44
WB4APR-9		10/25 00:02:47z	qsl!{43
JA1RBY-9	WB4APR-9	10/24 23:59:59z	hello{15
N3HEV-1	WB4APR-9	10/14 14:09:06z	GM hve a grt day! 73! {0
WB4APR-9	ALL	10/14 13:53:03z	in d700... ignore that msg. It was 4 satellite.{42
WB4APR-9	ALL	10/14 13:50:24z	in d700 {41
WB4APR-9	ALL	10/14 13:49:07z	in d700 use ptt mode to TX while RXing{40
KE4NYV-15	WB4APR-9	09/30 21:55:30z	S1, if that{7
KE4NYV-15	WB4APR-9	09/30 21:51:01z	noisy{6
WB4APR-9	KE4NYV-15	09/30 21:50:32z	6.85?{38
KE4NYV-15	WB4APR-9	09/30 21:49:45z	noisy{5
N8PK	WB4APR-9	09/30 21:12:16z	Try again on 6.835 {003
WB4APR-9	KE4NYV-15	09/30 20:48:11z	52?{37
N1TI	WB4APR-9	09/29 02:47:14z	Good luck @ DCC{82
N3IDX-1	WB4APR-9	09/28 02:06:44z	Greetings from Huntingtown, Md{2b}
KD8ATF-2	WB4APR-9	09/28 01:55:17z	r u going to be on the next pass of go-32 bob?{26
WB4APR-9	ALL	09/28 01:51:40z	ck in!{35
N1TVZ	WB4APR-9	09/28 01:45:12z	%private line{M
WB4APR-9	ALL	09/28 01:43:14z	what is pl?{34
N8PK	WB4APR-9	09/28 01:40:41z	Gud 2 C U on the CARA last night! -Pat {000

Also:

APRS.fi

OAPRS.net

Etc...

Using APRS in a Sporting Event

Using an HT to report ALL 100 runners!

HIKER-2 messages			
http://www.findu.com/cgi-bin/msg.cgi?call=HIKER-2			
from	to	time	message
HPRSFY	HIKER-2	05/07 20:26:24z	AJ on the air now?{25}
WA0DYJ-9	HIKER-2	05/07 17:45:01z	rej11
HIKER-2	ALL	05/07 17:44:53z	1342 078. hiker2 @ washmnt, car to gathland{11
WA0DYJ-9	HIKER-2	05/07 17:36:03z	rej10
HIKER-2	ALL	05/07 17:34:58z	1333 095 073 019 120 018 103 056 028 043{10
HIKER-2	ALL	05/07 17:29:34z	1328 041 011 072 069 030 068 063 050{9
HIKER-2	ALL	05/07 17:22:36z	1321 060 066 062 044 124 123 097 084{8
HIKER-2	ALL	05/07 17:14:44z	1313 109 105 033 045 085 038 026 013 047 024{7
WA0DYJ-9	HIKER-2	05/07 17:14:21z	rej6
HIKER-2	ALL	05/07 17:12:15z	1310 117 015 075 053 119 003 017 016 014 125{6
HIKER-2	ALL	05/07 16:55:10z	1250 052 128 093 106 046 098 107 100 020 086{4
HIKER-2	ALL	05/07 16:41:08z	1240 037 104 004 057 070 113 090 132{3
WB4APR-9	HIKER-2	05/07 16:28:38z	rej2
HIKER-2	ALL	05/07 16:28:34z	1226 023 059 096 135 101 058 130 071 032 049{2
W3TDH	HIKER-2	05/07 16:07:30z	rej1
HIKER-2	ALL	05/07 16:05:08z	1203 112 091 067 054 126 009{1
W3TDH	HIKER-2	05/07 15:44:42z	rej0
HIKER-2	ALL	05/07 15:44:25z	1142 029 129 108{0

Hike
Across
Maryland
(40 miles)

Location/time of
over 100 runners
reported by APRS
messages.

Hams (youth < 23)
agreed it was as
easy as Texting or
Tweeting.

APRS Misconceptions

That APRS is just Vehicle Tracking instead of a **Real-Time Information Distribution System**.

That APRS is dependent on GPS for its value **GPS is not needed**.

Must use APRS clients that do maps **Much broader application set**.

Failure to understand the importance of **Objects and Operations**

Unaware of **Real-time Messaging**

Unaware of **Telemetry capability**

Most Common Error:

Ignore the fundamental **Decay Algorithm**

APRS-IS

The APRS Internet System is a global backbone network of interconnected Tier I and Tier II servers. These servers belong to regional "pools" such as `na.aprs2.net` and `asia.aprs2.net` for North America and Asia respectively: there is a pool for every region or continent. Roughly, the way it works is an IGate sends its call sign and a passcode to the regional pool. A Tier I server verifies the call sign and hands off the connection to a Tier II server in that region at random.

After that's happened, APRS packets received over RF by an IGate will be forwarded to APRS-IS, which incidentally is where the mapping websites get their data from so they can overlay it as symbols on a map, getting the locations from the GPS coordinates or the configured latitude and longitude of the transmitting stations. The information servers and gateways are also connected to APRS-IS. This is what allows you to query them for things like someone's call sign or weather information, receive the responses on your radio, and send Internet email and reports. It is also what allows near-real-time text messaging globally.

The APRS Packet

First we need to understand what a standard display format is telling us. There is a variable length **address part** and an **information part**.

source > destination : *information*

source > destination , digipeater1 : *information*

source > destination , digipeater1, ... , digipeater8 : *information*

The address part has:

Source - Origin of the packet.

Destination - Since APRS is connectionless, this usually identifies the type of system that generated the packet. (Example: APDW18 for DireWolf 1.8)

Digipeater via path - List of digipeaters that a packet has traversed already. And the path identifier.

Example VY1CC>APDW18,WIDE1-1,WIDE2-1: *information*

How often do we repeat a packet?

The currently accepted method is to specify classes of APRS digipeaters in the generic form **XXXn-N**.

- | | |
|------------|---|
| XXX | The routing prefix, up to 5 characters. Usually this is “ WIDE ” but others are allowed for geographical regions, special events, or other uses. For example, “YT” might be used for information of interest in Yukon but not other places. |
| n | This is the digipeater role or class. Usually 1 for a local “fill-in” short range digipeater. 2 is normally for a good location with wide-area coverage. Numbers up to 7 can be used, but in practice only 1 and 2 are normally used. You might see mention of this as being the initial maximum number of times the packet can be digipeated. That is wrong. |
| N | The remaining number of times the packet can be digipeated, also known as the remaining hop count. Initially it is in the range of 1 thru 7. This is decremented until it reaches 0 and it is all used up. Once this reaches 0, the address should be removed from the path. |

The APRS Packet Decay Algorithm

When a packet is transmitted for the first time, it looks something like this:

VY1CC>APDW18,WIDE1-1,WIDE2-2:information-part

All of the digipeater addresses are “unused.” There is no asterisk (“*”) character in the digipeater address part so you know that you are hearing the original source station.

Suppose that digipeater VY1XXV retransmitted this packet. The result would be:

VY1CC>APDW18,VY1XXV*,WIDE2-2:information-part

WIDE1-1 had a remaining hop count of 1 so it is discarded and replaced by the digipeater address. The asterisk (“*”) after the digipeater address means that you are hearing that digipeater and the address has been used.

Suppose that digipeater VY1RHP retransmitted this packet. The result would be:

VY1CC>APDW18,VY1XXV,VY1RHP*,WIDE2-1:information-part

Suppose that digipeater VY1IRL retransmitted this packet. The result would be:

VY1CC>APDW18,VY1XXV,VY1RHP,VY1IRL*:information-part

You are hearing WY1IRL. All of the digipeater addresses have been used up and this can’t be digipeated anymore (but it can be I-gated if heard by the I-gate)

Information Types

Examples of the types of information that may be sent over APRS packets include:

- **Position**

- of the transmitting stations

- **Station capabilities**

- such as TX power, antenna height above average terrain, gain, approximate range, and also any extra capabilities such as Echolink, or frequency of the voice repeater

- **Objects**

- like position reports but sent on behalf of other entities, e.g. weather stations

- **Telemetry**

- such as monitoring repeater sites

- **Text messages**

- **Bulletins**

- messages of general interest to ham radio operators such as announcing local gatherings or activities, swap meets, etc.

- **Queries and responses**

- access to Internet gateways to other services such as information servers.
- SMS, email, and Winlink gateways

- **Comments**

- **User-defined data types**

APRS status in the Yukon

- APRS units have been deployed at various repeater sites for many years.
- Not all repeaters have APRS
- Not all APRS units collect telemetry
- Not all APRS units are programmed correctly
- Not All APRS units are functional
- Key I-Gates are down

What should we do?

- Make **APRS at all sites a priority** for collecting status and environmental data
- Weekly voltage and temperature historical data
- Could add wind speed and direction
- Could add raw solar voltage data
- Could add control of partner equipment to conserve power in off season
- Could add backup onsite communications
- Could add to bike race / road relay for position tracking / emergency messages

Current Situation

Deployed Equipment

Manufacturer	Model	Internal Telemetry	External Inputs	Control Outputs	APRS I/O Security	Internal Radio	Web Access	Password (web)
Byonics	MTT4BT	volts, temperature	5 in ou out 3.3V	5 in ou out 3.3V	None	Yes	no	N/A
Argent Data	T3-301 D	volts, temperature	13 digital I/O, 4 analog	13 digital I/O, 4 analog	Yes	Yes	no	N/A
Argent Data	Tracker 2	volts, temperature				no	no	N/A
Kantronics	KPC-3	Volts,	5 Analog (2 default)	2-4 digital	Yes, limited	no	no	N/A
Microsat	WX3in1 plus	Volts	DS18B/S20 input	Requires I/O card	none	no	yes	see site data
YARA	Pi -Direwolf	multi Volts, Multi Temp	2 Volts, 3 DS18B20	1 if populated	Yes, if populated	no	yes	written on hardware

Mountain Top Repeaters

Call Sign	Location	Radio	TNC	Link	Distance	Wide	Status
VY1RPT-1	Pilot	N/A built in	Argent Data TC-301	Yukon College	39 KM	Wide1-1	down
VY1RMB-1*	Berdoe**	Daniels??	KPC3	Pilot (currently Haeckel)	117 KM	Wide1-1	
VY1RFH-1	Ferry Hill	Daniels??	KPC3	Berdoe	156 KM	Wide3-3	
VY1RHJ-1***	Decoli****	Daniels??	KPC3	Pilot (currently Haeckel)	130 KM	Wide1-1	down
VY1HCH-1	Horse Camp	N/A built in	Argent Data TC-301	Decoli	194 KM	Wide3-3	down
VE7RFT-1	Panacea	Motorola MT-1000	YARA	Pilot (currently Haeckel)	129 KM	Wide3-3	working but needs reboot for telemetry
VY1RHP-1	Hayes Peak	Icom H-16	Argent Data Tracker 2	Pilot (currently Haeckel)	124 KM	Wide1-1	
VY1IRL-1	Haeckel Hill	N/A built in	Argent Data TC-301	Yukon College			
VY1XXV-1	Jubilee	N/A built in	Argent Data TC-301	Haeckel Hill			
VY1RMD-1	Dawson	unknown	unknown	Ferry Hill			down
VY1RMM	Montana	N/A built in	Argent Data TC-301	David's I-gate	*David believes this should be MTT4B		Installed?
VY1RRH	Rose Hill						?
VA7ATN	Atlin	Motorola MT-1000	YARA	Hayes Peak			Down
VY1MCU	Trailer	H-16	YARA (type 2)	Mobile		WIDE 2-2	Not installed

I-Gates

Call Sign	Location	Radio	Type	IP	IP Mask	Gateway	DNS	Password
VY1YC-1	Yukon College Dawson City? Haines Junction? Teslin?	??	Microsat WX3in1 Plus 2	199.247.159.117	255.255.255.0	199.247.159.254	198.135.216.162	18110

Notes:

*Currently incorrectly programmed as BERDOE

**Currently incorrectly programmed as VY1RMB

***Currently incorrectly programmed as DECOLI

****Currently incorrectly programmed as VY1RHJ

Installation

There are two primary requirements at repeater sites:

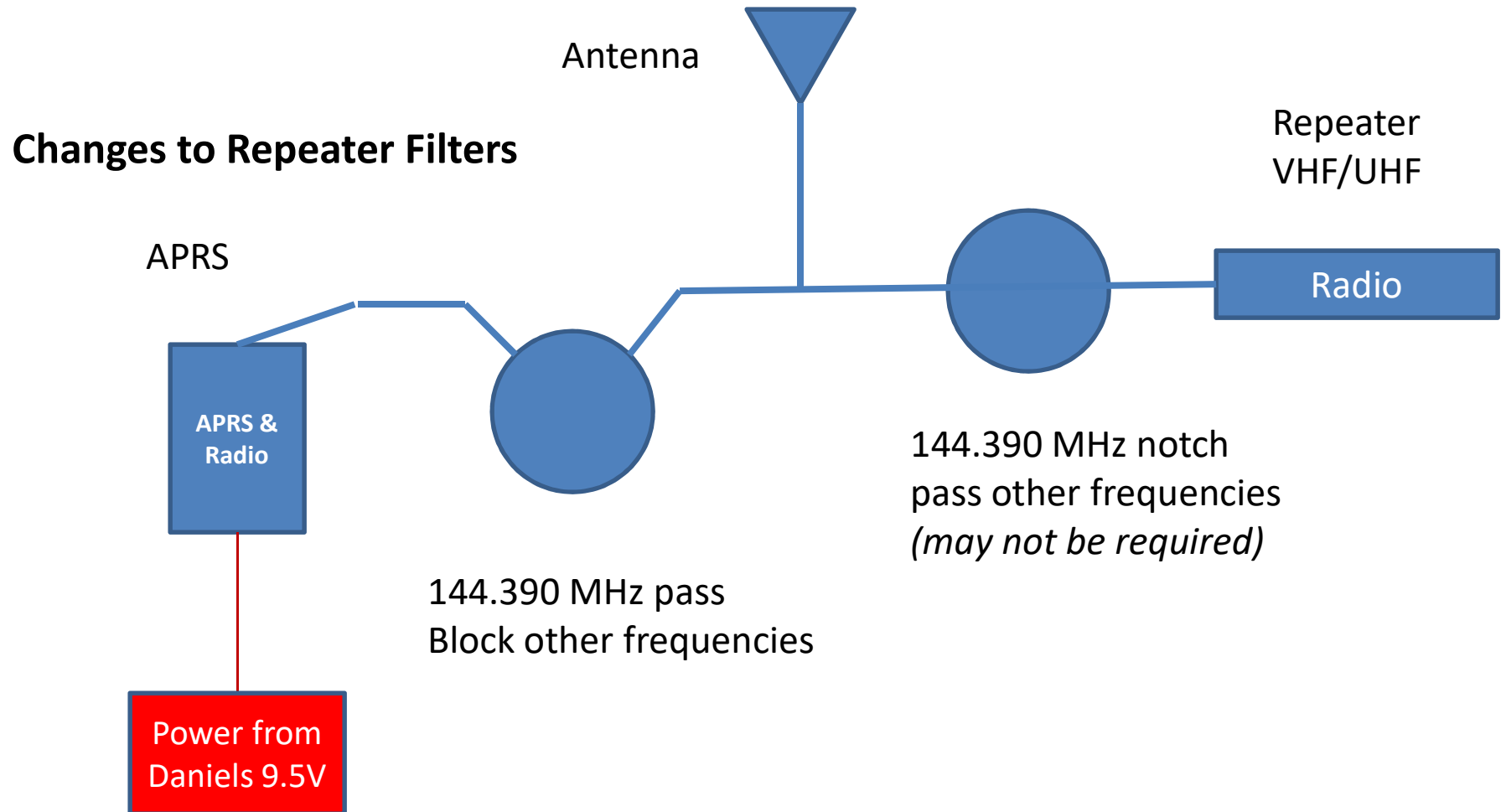
- Power
- Filter network

Power should be tapped from the Daniels so that APRS shuts down with the Daniels when power gets low in winter. Units can also be driven directly from 12V if battery reserve is not an issue.

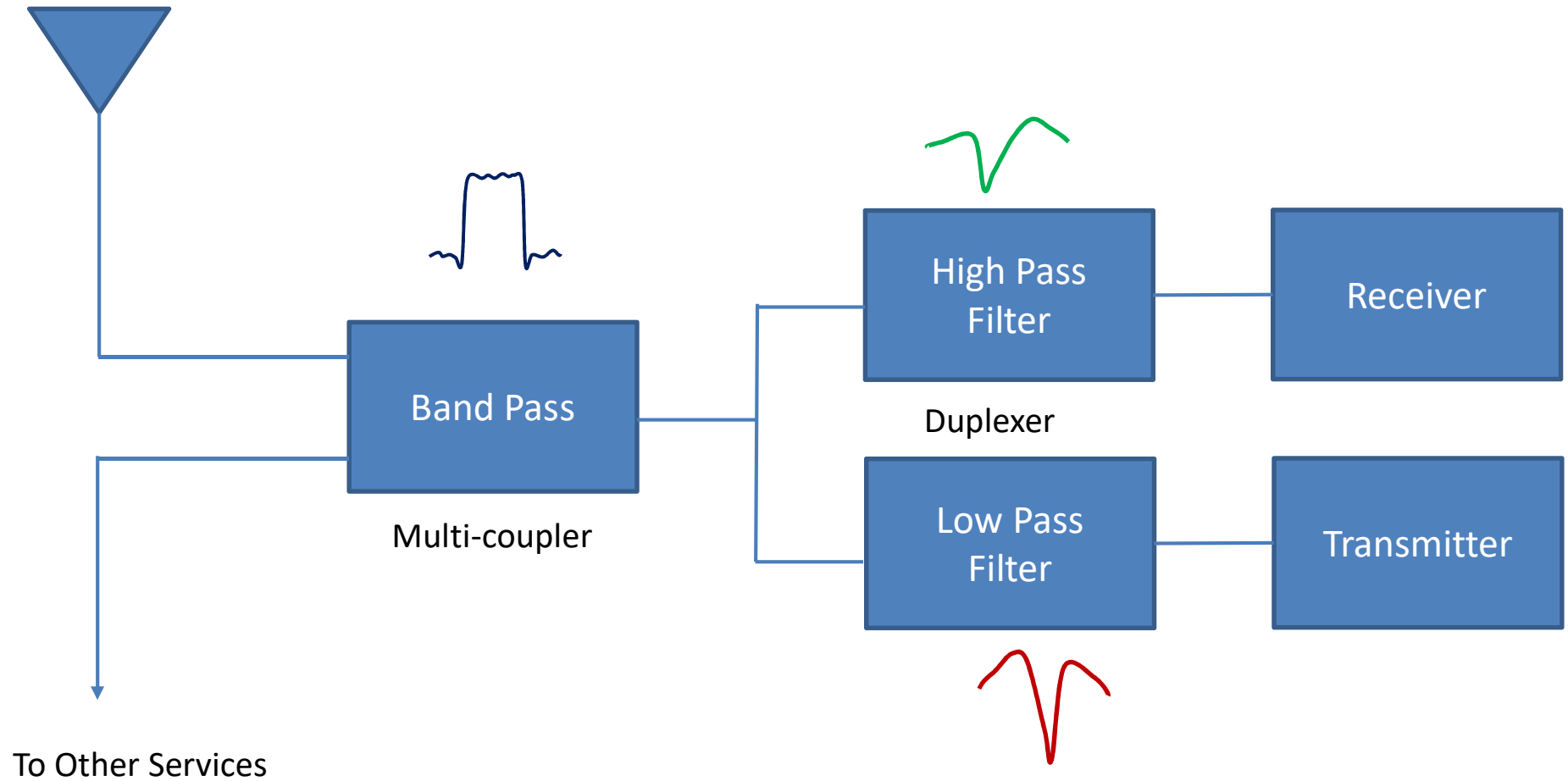
In many instances, the filter network is in place already. But if not, depending on the site, it could be as simple as adding one cavity. More typically, two cavities. Depending on the quality of the cavities, one additional may be required. Details are established and tested before visiting the site.

Finally, temperature probes and voltage sensors should be connected depending on what is needed to be measured. i.e. a temperature probe might be just in the air, or outside, or in an insulated box with LiFePo4 batteries. Voltages might be from batteries, or partner batteries if there are multiple sets. Wins speed sensors could be deployed as well or other information gathered.

Installation



Typical Configuration for Negative Offset (i.e. -600 KHz)



Strategy Discussion

What hardware should we use?

Should we enable packet on APRS frequencies?

What should we discuss next week?

Detailed hardware design of the latest units being deployed?

Detailed software design of the latest units being deployed?

How to configure?

Homework? Reading...

Recent APRS documentation site

<https://how.aprs.works/>

DireWolf User Guide (V1.6) (176 pages)

<https://raw.githubusercontent.com/wb2osz/direwolf/dev/doc/User-Guide.pdf>

An overview of APRS Packets

<https://ham.packet-radio.net/packet/aprs-wb2osz/Understanding-APRS-Packets.pdf>