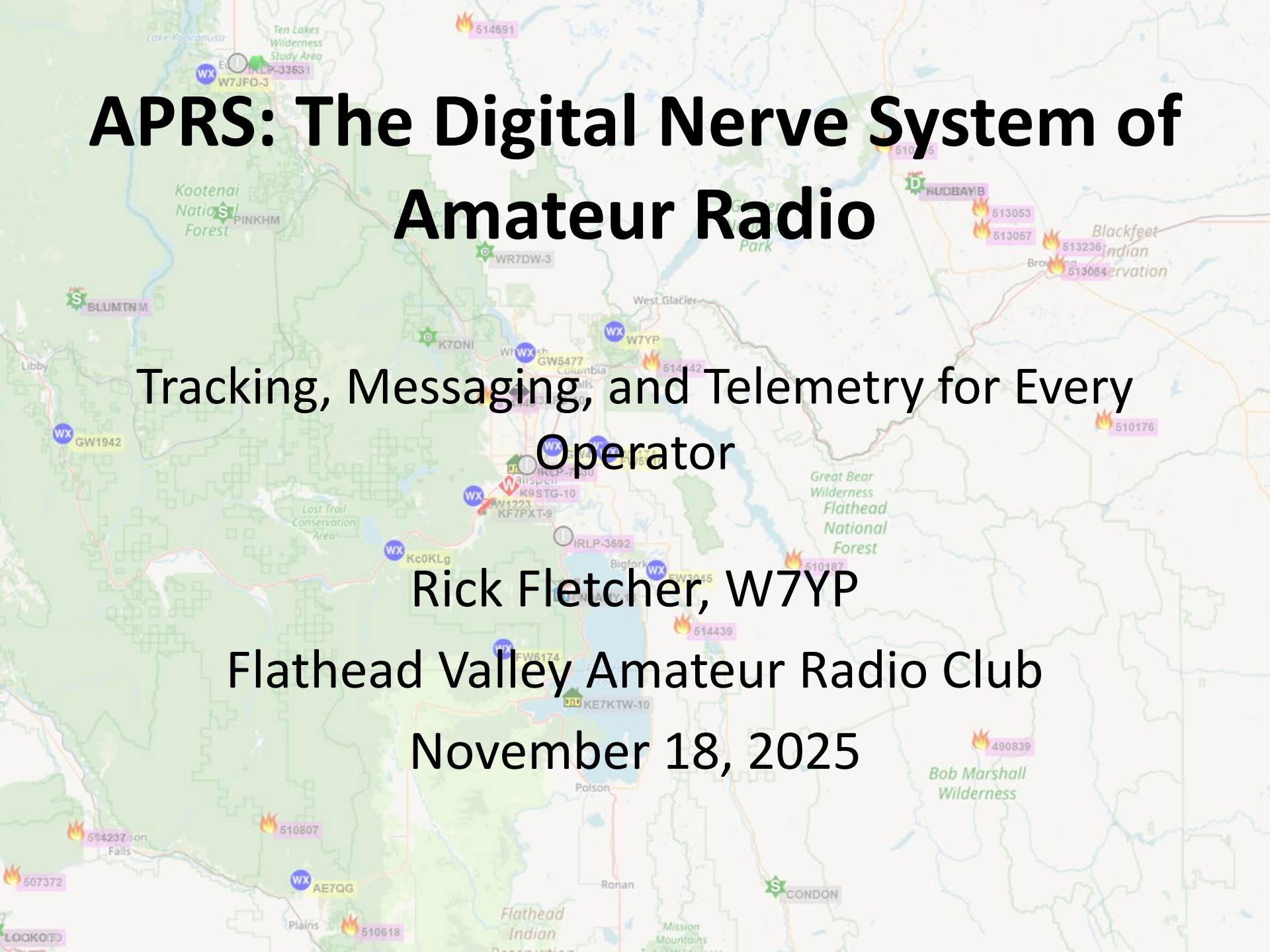




APRS: The Digital Nerve System of Amateur Radio

Tracking, Messaging, and Telemetry for Every
Operator

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TOPICS

- What is the APRS system?
- What is the purpose of APRS?
- How APRS works
- Why use APRS?
- What you need to use APRS
- Other APRS software and services

What Is APRS?

- APRS = Automatic Packet Reporting System
 - Created in late '80s by Bob Bruninga, WB4APR (SK)
 - Real-time digital information exchange
 - More than GPS tracking: also messaging, telemetry, weather, email and more

Built on AX.25 Packet Radio

- Packet radio transmissions are sent in small data blocks called “frames”
 - Information Frames (I frame)
 - UI frame requires no acknowledgement and is the frame type normally used by APRS
 - Supervisory Frames (S frame)
 - Unnumbered Frames (U frame)
- Each frame consists of fields:

Flag	Address	Control	Info	FCS	Flag
01111110	112/224 Bits	8/16 Bits	N*8 Bits	16 Bits	01111110

U & S Frame

Flag	Address	Control	PID	Info	FCS	Flag
01111110	112/224 Bits	8/16 Bits	8 Bits	N*8 Bits	16 Bits	01111110

I Frame

Address field identifies source and destination and possibly also a digipeater address

Protocol Identifier (PID) Field

- Only in I and UI frames
- PID Definitions:

HEX	Binary	Layer 3 Type
**	XX01XXXX	AX.25 Layer 3 Implemented
**	XX10XXXX	AX.25 Layer 3 Implemented
0x01	00000001	ISO 8208/CCITT X.25 PLP
0x06	00000110	Compressed TCP/IP Packet Van Jacobson (RFC 1144)
0x07	00000111	Uncompressed TCP/IP Packet Van Jacobson (RFC 1144)
0x08	00001000	Segmentation Fragment
0xC3	11000011	TEXNET Datagram Protocol
0xC4	11000100	Link Quality Protocol
0xCA	11001010	Appletalk
0xCB	11001011	Appletalk ARP
0xCC	11001100	ARPA Internet Protocol
0xCD	11001101	ARPA Address Resolution Protocol
0xCE	11001110	FlexNet
0xCF	11001111	NET/ROM
0xF0	11110000	No Layer 3 Protocol
0xFF	11111111	Escape Character - Next octet contains more Layer 3 protocol Information

← APRS UI frame

APRS UI frames can carry any kind of data, including text messages, location (GPS), Wx information, status messages, position comments and icons

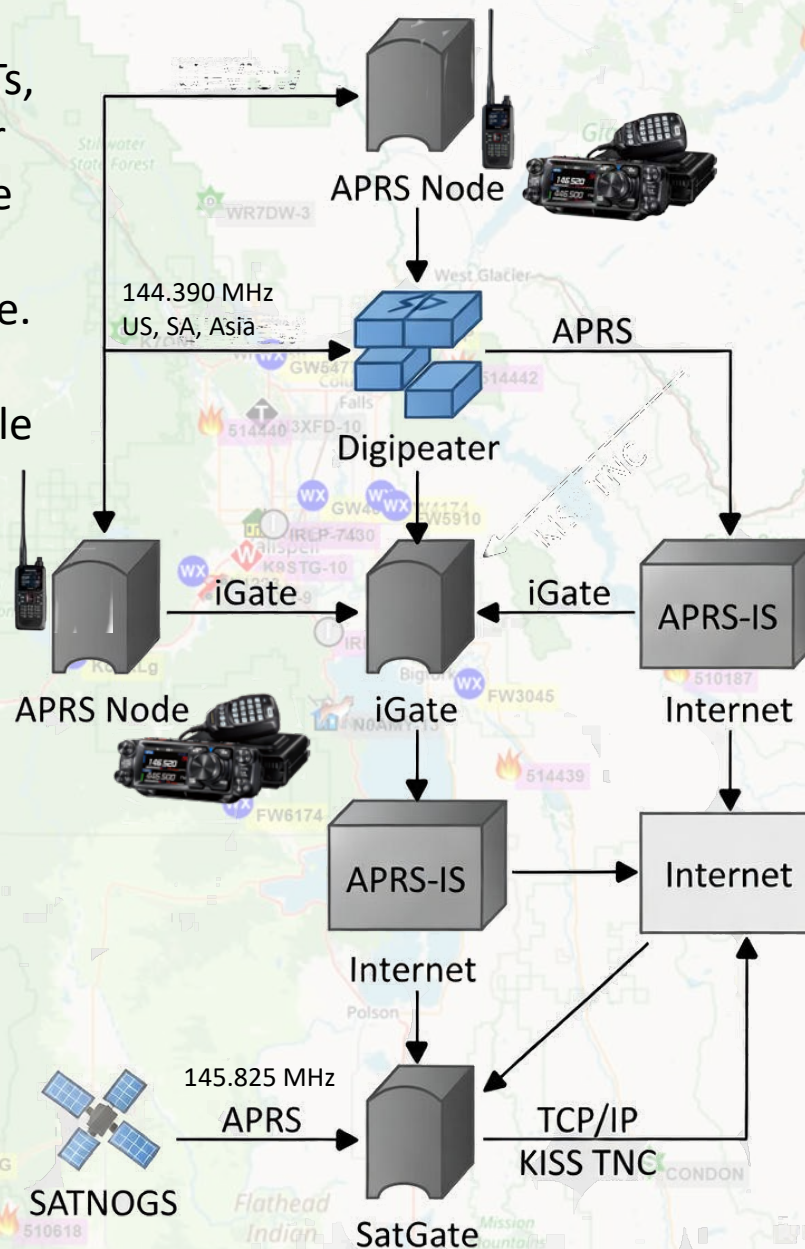
APRS Network Overview

- RF stations: handhelds, mobiles
- Digipeaters extend coverage
- I-Gates bridge RF to Internet
- SatGates bridge to the Internet where conventional Internet connectivity isn't available
- APRS-IS distributes globally

APRS Network Flow Diagram

Client nodes can be HTs, mobile transceivers, or computers, which have an internal or external TNC and APRS software. A PC would have to connect to a compatible radio.

SatNOGS (Satellite Networked Open Ground Stations) is a global network of open-source satellite ground stations which track and communicate with amateur satellites which contain digipeaters (e.g., ISS)

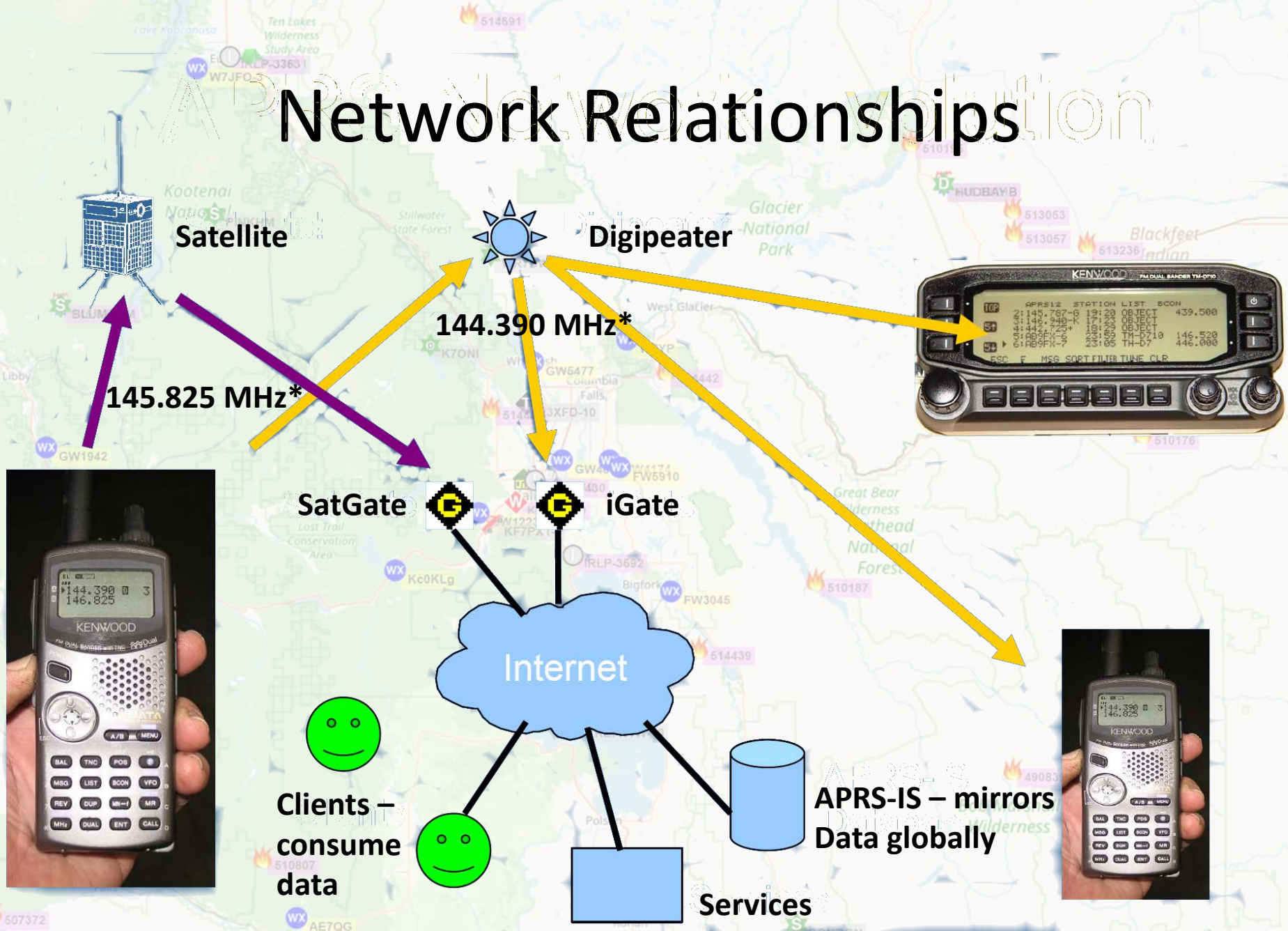


HTs and Mobiles without a TNC can only beacon

Digipeaters extend the range of the system, allowing APRS nodes to hear other node's transmission, even though they're too far apart for simplex communication.

Digipeaters often also host the iGate function, as shown here

Network Relationships



* 1200/9600 Baud AFSK

APRS Paths Involving Digipeaters

- For efficient routing of APRS packets, standardized aliases are used instead of callsigns for digipeaters
 - Format: "WIDEn-N", where "n" is the alias and "N" is the number of remaining hops ("1" or "2")
- Mobile/HT: "WIDE1-1,WIDE2-1" added to outgoing packet header
- Digipeater: WIDE2-1 or WIDE2-2
 - Relays the packet if the alias is a match
 - Appends its own callsign to the path for traceability
 - Decrements the hop count, so WIDE2-2 → WIDE1-1
 - Decrementing to "0" ends relaying
- Smart Beaconsing adjusts rate
- Goal is to avoid overloading network

Needed to Connect as Client to APRS

- At least a Technician Class license
- An APRS-enabled transceiver with a built-in Terminal Node Controller (TNC)
 - Handhelds: Many Yaesu, some Kenwood, some Radioddity and Anytone HTs
 - Some of the Radioddity's don't have true KISS-style TNC and only do GPS beaconing
 - Mobile transceivers: Many Yaesu, Kenwood, some Alinco and Anytone radios
- A transceiver with an external TNC and host running APRS software (e.g., Btech, APRS-K1 cable and Smartphone software/TNC)
 - APRSPro, APRSDroid – Android and iOS compatible



Typical Hardware Setups

- Radios with APRS and built-in TNCs
- External KISS TNCs Connected to a radio

- Mobilinkd (\$150)

- Bluetooth (to PC, tablet, smartphone)
- USB (to PC, tablet), Serial to radio
- Relies on host for GPS (e.g., Smartphone)

- TinyTrak4 (\$100; \$170 with GPS5)

- Built-in APRS controller and digipeater
- Serial ports for radio and GPS

- Kantronics KPC-3 Plus (\$290 new)

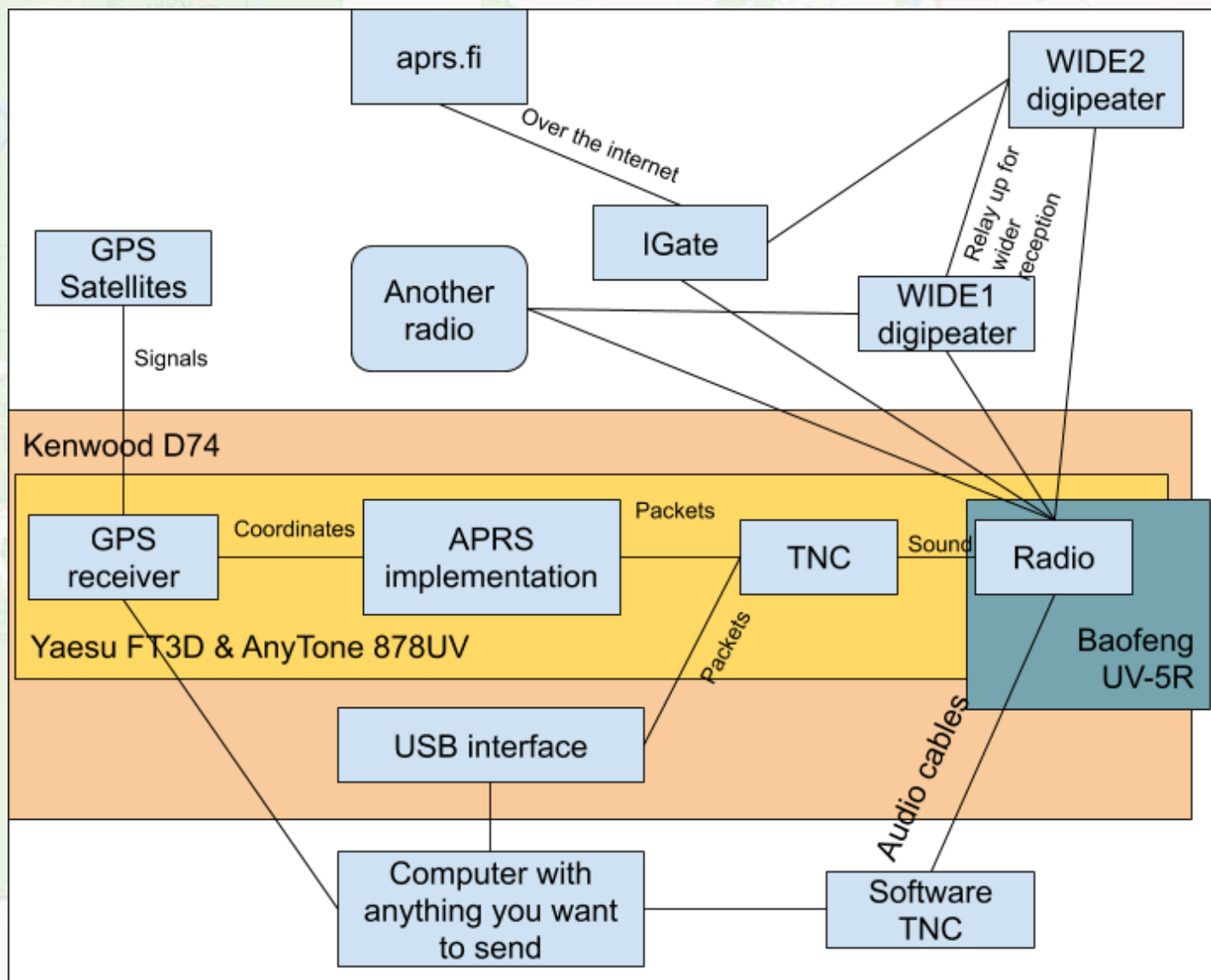
- Used from \$100
- USB, Serial

- Software TNCs (Dire Wolf)

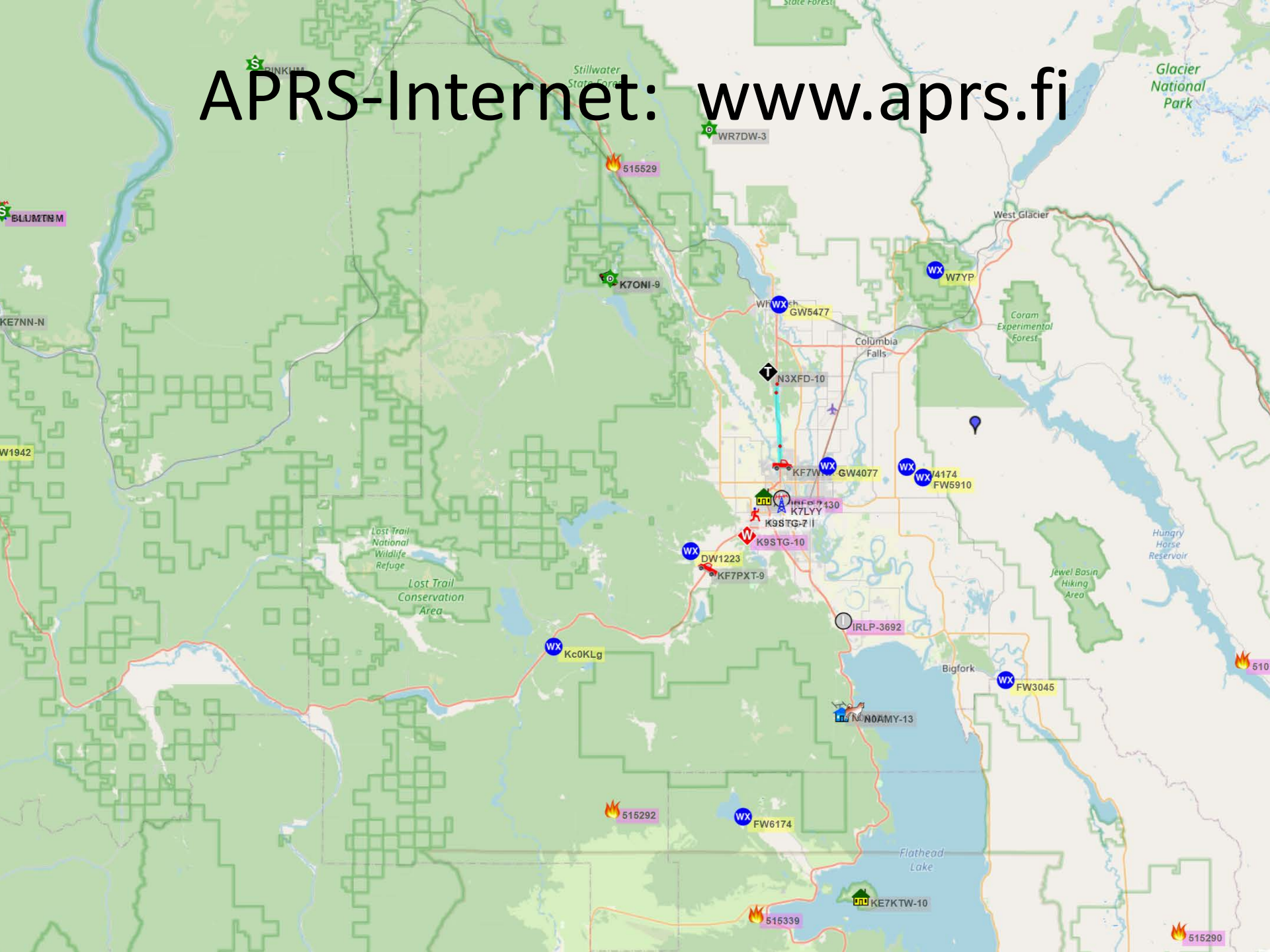
- Radio + GPS + TNC = APRS station



Examples of APRS Nodes



APRS-Internet: www.aprs.fi



Less Self-explanatory Map Icons

- Digipeater: 
 - D = Standard Digipeater
 - ½ = Fill-in vs WIDE Digipeater
 - I = Digipeater plus iGate combo
 - S = S-Digipeater which supports new routing protocol
- iGate: 
 - T = Transmits gate to RF
 - R = Receive only
 - D = iGate plus Digipeater combo
- Weather Station: 
- Winlink Gateway: 

Digipeaters and iGates in Our Area

- Digipeaters:

- WR7DW-3 (Werner Peak)
- K7ONI (Olney)
- PINKHM (Pinkham Mt; K7EUR)
- W7JFO-3 (Eureka)
- BLUMTN (Blue Mt; N7LT)

- iGates:

- N3XFD-10
- W7JFO-3
- KE7KTW-10
 - Wild Horse Island
- AK7WS (North of Hamilton)
- W7DQL-1 (South of Stevensville)

- Project:

- Deploy more digipeaters and iGate nodes
- See me after the meeting if interested in exploring and possibly participating in this effort



N3XFD-10 · center · zoom · info

2023-12-24 12:35:10 - 2025-11-16 18:34:40

N3XFD RPi+Direwolf iGate | swdrumm@pm.me

power 9W, antenna HAAT 10 ft, gain 4 dBi omni,
range 4.6 miles

[APDW17 via qAS,N3XFD]

[start tracking](#)



APRS in Action

- **Mobile and portable beacons**
 - Automated transmissions providing location, status and other tactical data
- **Digipeaters** – tens of thousands across the U.S.
- **Weather stations reporting Wx data**
 - Thousands across the U.S. and CA alone
- **Event tracking (marathons, SAR)**
- **Fire-spotting**
- **Balloons transmitting telemetry**
- **APRS Bots (examples):**
 - Global links by satellite
 - SMS gateways
 - Wx reports
 - Email gateways
- **EMCOM messages, bulletins and location information**
- **Telemetry (e.g., remote repeater solar and battery status)**

WX FW6174 · center · zoom · info

2019-09-25 21:25:25 - 2025-11-16 16:30:51
APRS/CWOP weather 2025-11-16 16:25:41: [show weather charts](#)
Temperature 47°F Humidity 87% Pressure 1004.5 mbar
Wind 359° 0.0 MPH (Gusts 0.0 MPH)
Rain 0.0 inches/1h 0.0 inches/24h 0.0 inches/since midnight
[APRS via TCPXX*,qAX,CWOP-6]
[start tracking](#)

 **510807** (from NIFC) · center · zoom · info

2025-10-28 07:48:15 - 2025-11-16 16:23:46
RX PLN Smiley Todd Fire | Cause: Human | Size: 253 Acres | Containment: 0%
[APFIRE via TCPPIP*,qAC,WA7BF]
[start tracking](#)

Other APRS Services

- WinLink via APRSLink
- WhatsApp via WTSAPP
- Telegram via APRSD
- Twitter via custom gateways
- D-STAR via D-RATS
- POCSAG pagers via APRS-POCSAG gateway
- Echolink/IRLP text chat via custom gateways
- National Traffic System (NTS) via NTSGTE
 - Gateway to the ARRL's formal radiogram network
- Satellite messaging relay via ISS/PCSAT-1
- DMR/Fusion via APRS-D gateways

“Secret Side” of APRS Services (Bots)

- FIND (by SSID) – Last heard, iGate used, speed (if moving), distance from you, Grid square...
- APSPOT – Gateway for self-spotting during ham field activations
 - POTA, SOTA, WWFF, SIOTA, etc.
- ISS – ISS information
 - Crew status, AOS/LOS with path
 - Current location, speed and footprint
- WHO-IS – Similar to a QRZ.com lookup

“Secret Side” of APRS Services (Bots)

- SMS – Send/Receive SMS text messages
 - Messages limited to 67 characters
 - Delivery is not guaranteed nor instantaneous
 - Replies come back as normal APRS messages addressed to your callsign
 - Example: Send APRS message to SMS: +447712345678 Made the summit, all good!
 - Receiver sees a normal text message
 - They reply “Great! Be safe.”
 - A minute or so later, you get an APRS message with their reply
- REPEAT – What repeaters are closest to you
- WXBOT – Weather information
 - Current Wx conditions or forecast at your location or by zip code
 - Any active NWS Alerts
 - METAR for a specific airport
- MPAD – “Google” for APRS
 - Could justify a presentation of its own:
 - <https://www.youtube.com/watch?v=75W0UTL5eOY>

Other Clients and Software Tools

- Yet Another APRS Client (YAAC)
 - Java-based software developed by KA2DDO
 - Users can monitor, display and transmit real-time data like locations, Wx, messages, maps and lists
 - Provides bidirectional APRS-IS support from a home node
 - Uses soundcard-based TNC such as Dire Wolf
- PinPoint APRS
 - Open source Windows program
 - Prioritizes a modern, user-friendly interface for quick deployment in high-stakes scenarios, with strong offline capabilities to ensure reliability without constant internet access
 - Can function as an APRS-IS iGate
- APRSdroid
 - <https://na7q.com/aprsdroid-osm/>

Setting Up APRS

- 1. Connect radio, TNC, computer, for an APRS Client node
 - For APRS-IS connection, set proper region server:
 - noam.aprs2.net: North America
 - soam.aprs2.net: South America
 - euro.aprs2.net: Europe and Africa
 - asia.aprs2.net: Asia
 - aunz.aprs2.net: Oceania
- 2. Set callsign & SSID:
 - “-0” for fixed home location
 - “-1” for digipeater
 - “-7” for HTs (human portable)
 - “-9” for vehicle or asset tracking
 - “-13” for dedicated weather station
- 3. Choose path
 - Usually “WIDE1-1, WIDE2-1”
- 4. Configure beacon rate
- 5. Enable GPS
- 6. Verify on APRS.fi

Getting Started with Client SW Today

- Install Dire Wolf (Windows, Linux, OS X)
 - Includes software TNC
 - <https://www.youtube.com/watch?v=plOAUG7BR4o>
- Or, Install YAAC (Windows, Linux, OS X)
 - <https://www.youtube.com/watch?v=c5A6yMOv4xY>
- Try APRSdroid
 - <https://na7q.com/aprsdroid-osm/>
 - BTECH UV-Pro (\$160) is a popular radio choice
 - Connects to APRSdroid via Bluetooth
- Software TNC (Windows, Linux and Android)
 - Sivan Toledo's SoundModem (Java-based)
 - A High-Performance Soundcard AX.25 Modem
 - https://files.tapr.org/meetings/DCC_2012/DCC2012-AX.25-Modem_4X6IZ.pdf
- Hardware TNC
 - Kantronics KPC-3+
 - Radios such as the Kenwood TH-D74/D75 and BTECH UV-PRO
 - Have a built-in KISS TNC
 - AND connect to a client via Bluetooth
- Watch your station on APRS.fi



References

- APRS Symbols
 - https://www.aprs.org/symbols.html?utm_source=chatgpt.com
- APRS Protocol Reference
 - https://www.ui-view.net/files/APRS101.pdf?utm_source=chatgpt.com
- APRS SPEC Addendum 1.1
 - <https://www.aprs.org/aprs11.html>
- New Symbols, Overlays and Extensions
 - <https://www.aprs.org/symbols/symbols-new.txt>
- YAAC Developer, KA2DDO's Web Site
 - <https://www.ka2ddo.org/ka2ddo/YAAC.html>
- Complete YAAC Setup Guide
 - <https://www.youtube.com/watch?v=vERx3z31Sag>
- “Secret Side of APRS” video
 - https://www.youtube.com/watch?app=desktop&v=QPElQT_i7sl

Wrap-Up & Q&A

- APRS is a versatile digital communication system
- Works globally
- Ideal blend of RF + networking
- Thank you — 73!