APRS AND ITS FEATURES

AN OVERVIEW OF THE AUTOMATIC PACKET REPORTING SYSTEM AND ITS FEATURES

PRESENTED BY PATRICK MATHIS, N4LKZ

WHAT IS APRS?

WB4APR

- APRS stands for *Automatic Packet Reporting System.*
- APRS is a real-time tactical digital communication system
- Created in the early 90's by Bob Bruninga WB4APR, hence APRS
- APRS provides situational awareness, message delivery and information in emergency situations or public service events.
- Virtually any 2m or HF transceiver can be used for APRS
- APRS uses the AX.25 packet radio protocol, using AFSK (Audio Frequency Shift Keying)

NATIONAL APRS FREQUENCIES

144.390 MHz (2m FM, primary)

145.825 MHz (2m FM, satellite)

10.151 MHz LSB

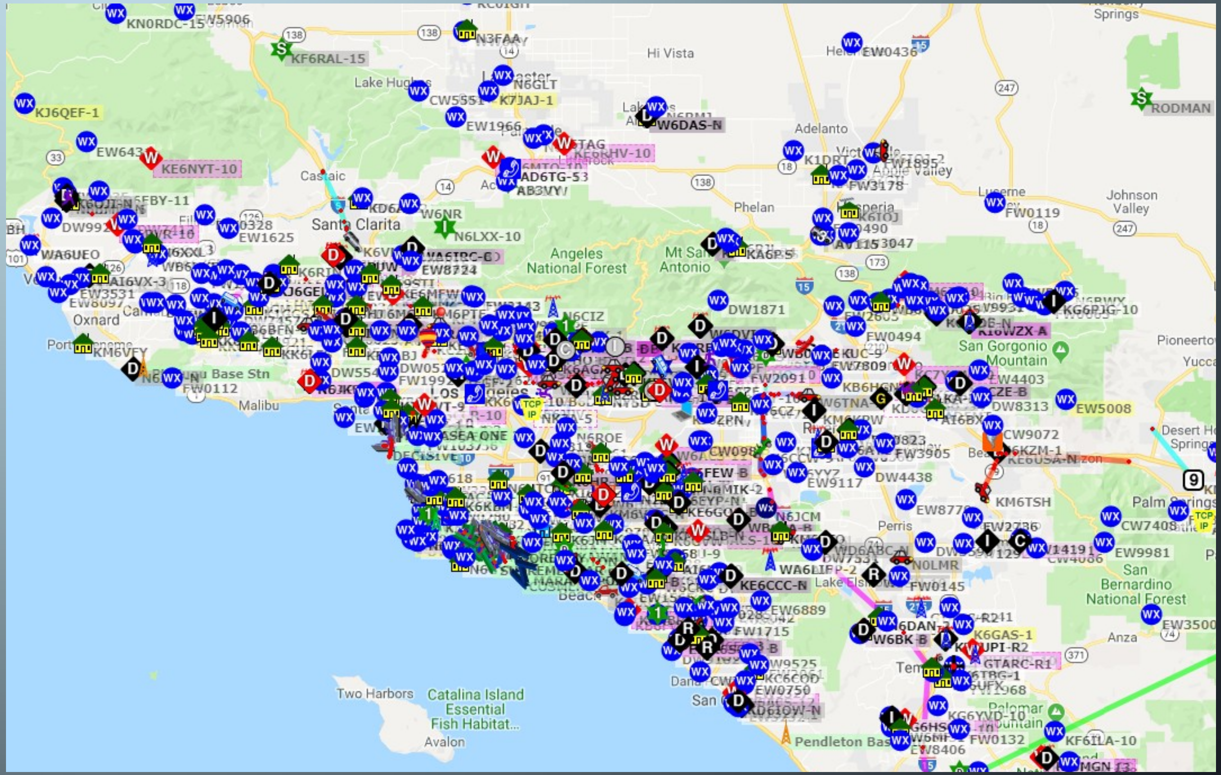
WHAT IS APRS ALL ABOUT?

- Immediate local digital and graphical information exchange between all participants in a local area or event. This includes:
  - *Positions* of all stations and objects
  - *Status* of all stations
  - *Messages*, Bulletins and Announcements
  - *Weather* data and *telemetry*
  - *DF bearings* and *signal strengths* for quick transmitter hunting
  - *RF connectivity* plots of all stations
  - Local *objects* on a common map display for all users
  - Local *frequencies, IRLP, ECHOlink, Winlink, nets, meetings*

- Typical applications are:
  - *Routine local awareness of all HAM radio events and assets around you*
  - Marathons, races, events and public service
  - Search and rescue
  - Family communications, tracking and one-line emails
  - *Mobile-to-mobile global text messaging*
  - Weather data exchange and display
  - *Efficient multi-user satellite communications*

SCOPE OF APRS

- Over 75,000 users worldwide
- 2,500,000 packets handled every day on APRS network, 5,000,000 on APRS-IS
- Relays every 20-30 miles called “digipeaters”
- All linked by home station iGates
- Global links by OSCARs
- Thousands of weather stations
- Telemetry and data everywhere



The distribution of APRS stations just in L.A. and surrounding areas

HOW DOES APRS WORK?

- APRS uses AFSK (*Audio Frequency Shift Keying*) to transmit data packets.
- Data packets carry binary data containing position data, messages, etc.
- Any VHF or HF transceiver with a TNC and a data source (GPS, computer, etc) can transmit an APRS packet.
- APRS packets can be handled in one of two ways:
  - Repeated ("digipeated") like a typical FM voice repeater
  - Sent to the internet through iGates.

DIGIPEATERS AND IGATES

- Digipeaters (*digi*tal re*peaters*) are repeaters that receive an APRS packet, decide whether to relay it (based on the path), and retransmit.
- iGates are receivers that listen for APRS packets and send it to the APRS-IS system.
- APRS-IS (Automatic Packet Reporting System – Internet Service) is an internet service that interconnects APRS networks around the world (and even into space).

APRS DESTINATIONS AND PATHS

- APRS packets may be sent to a specific callsign, groups of callsigns, or to all stations in the vicinity.
- The “path” is an instruction to digipeaters and iGates for how to route the packet to get to its destination.
- A typical path format is WIDEn-n.
  - This path allows for the packet to be retransmitted ‘n’ times.
  - For example, WIDE2-2 would allow the packet to be retransmitted twice.
- You can also explicitly name a station in your path, such as YUCCA,WIDE2-2 if desired.
- Due to congestion on 144.390, do not use paths longer than WIDE3-3!

COMPOUND APRS PATHS

- Some APRS paths can be combined to achieve different effects.
- Low-level home digipeaters will ignore WIDE2-2 or higher to prevent congestion.
- A path such as WIDE1-1,WIDE2-2 would:
  - Take advantage of a home fill-in digipeater or a high-level digipeater on the first hop
  - Use wide area, smart digipeaters on subsequent hops
- Different combination of paths can reduce congestion on 144.390 MHz

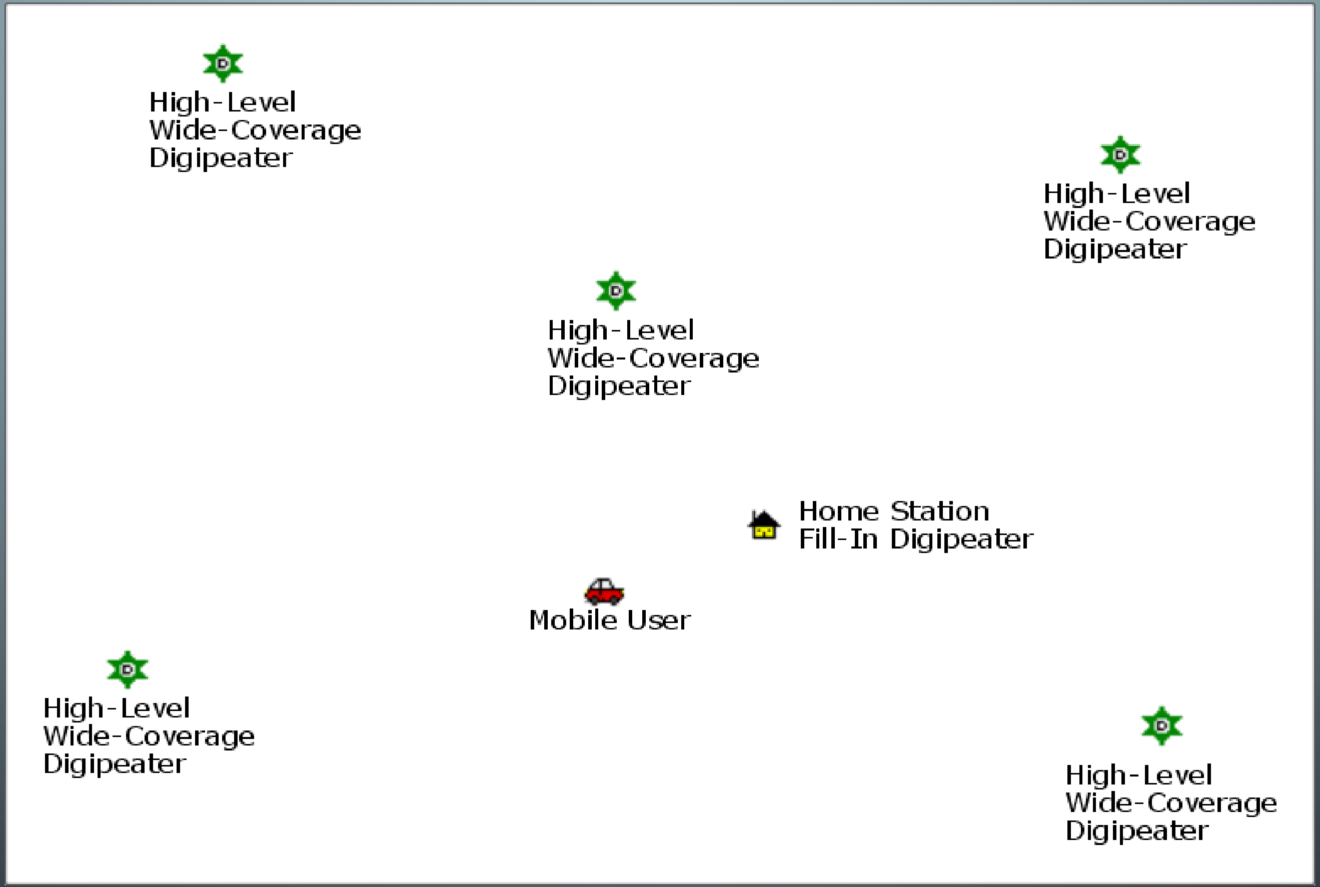
PATHING CONSIDERATIONS

- NEVER put WIDE1-1 in the path anywhere but the first position.
  - If you do this, dozens (or hundreds here in SoCal) of home digipeaters within earshot of your packet's last hop will needlessly clog the channel.
- Paths longer than WIDE3-3 are almost entirely useless.
  - In our case, WIDE3-3 can relay a packet all the way from San Diego to Salt Lake City.
  - Excessive WIDEn-Ns can relay your packet clear across the continent.
  - In many areas, intelligent digipeaters reformat long or abusive WIDEn-N paths to something more sensible like WIDE2-2 or WIDE3-3.

RECOMMENDED PATH SETTINGS

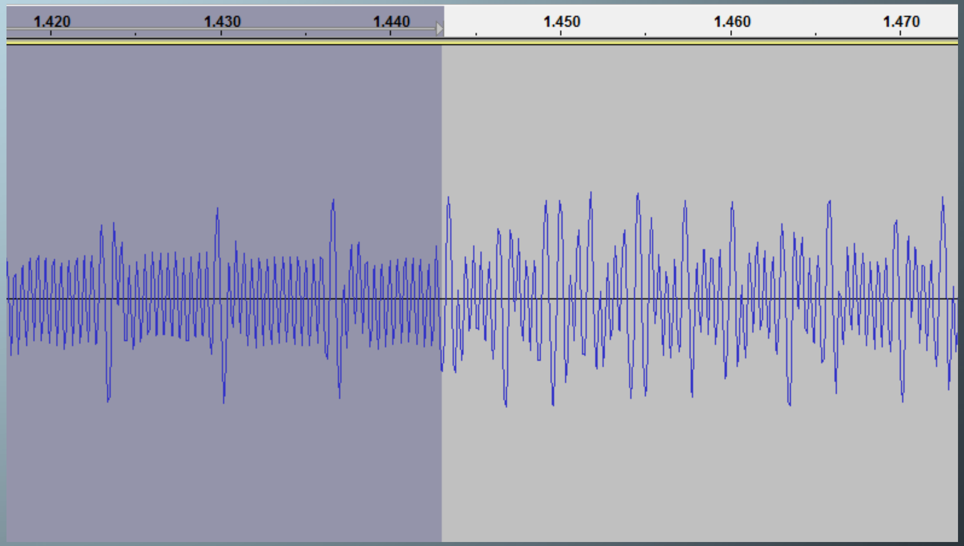
- For urban SoCal, use WIDE2-2 to prevent home digipeater congestion.
- Common paths are WIDE1-1,WIDE2-1 (for mobile) and WIDE1-1,WIDE2-2 (for home / fixed stations).
- Always use the least number of hops as necessary to get the point across to avoid congestion!
- Do not use obsolete paths such as RELAY, GATE or WIDE!

DIGIPEATING AND PATHING VISUALIZED



APRS SIGNAL CONSIDERATIONS

- In order for iGates and digipeaters to successfully decode your packet, the packet must be transmitted in a way that is understandable.
- Be careful to not overmodulate your signal.
- Pre-emphasis is normally good for FM voice communications, but can distort the APRS waveform by increasing the amplitude of one of the AFSK tones.
- Too little TX lead and tail times (padding before and after the packet) can prevent clock synchronization at the receiver, resulting in missed packets.



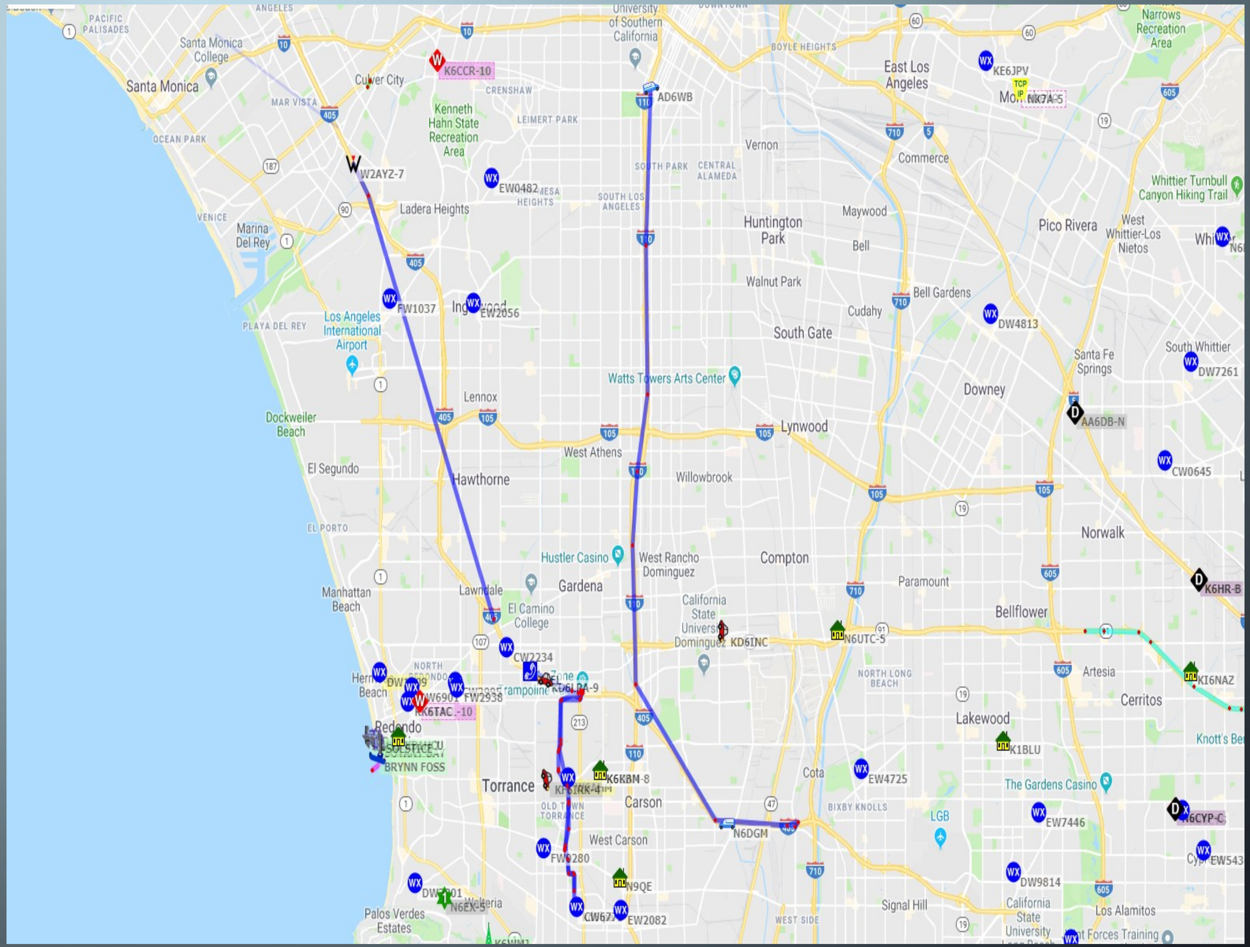
A pre-emphasized AFSK signal

BEACONING CONSIDERATIONS

- High beaconing rates (less than 1 minute per packet) generates congestion.
- For mobile stations, a 1 minute beacon interval is typically as fast as you need.
- For home stations, a 5 minute beacon interval is more than sufficient.
- Most APRS software provides “smart beaconing” for mobile stations, only sending a packet when the position is different by a certain distance.

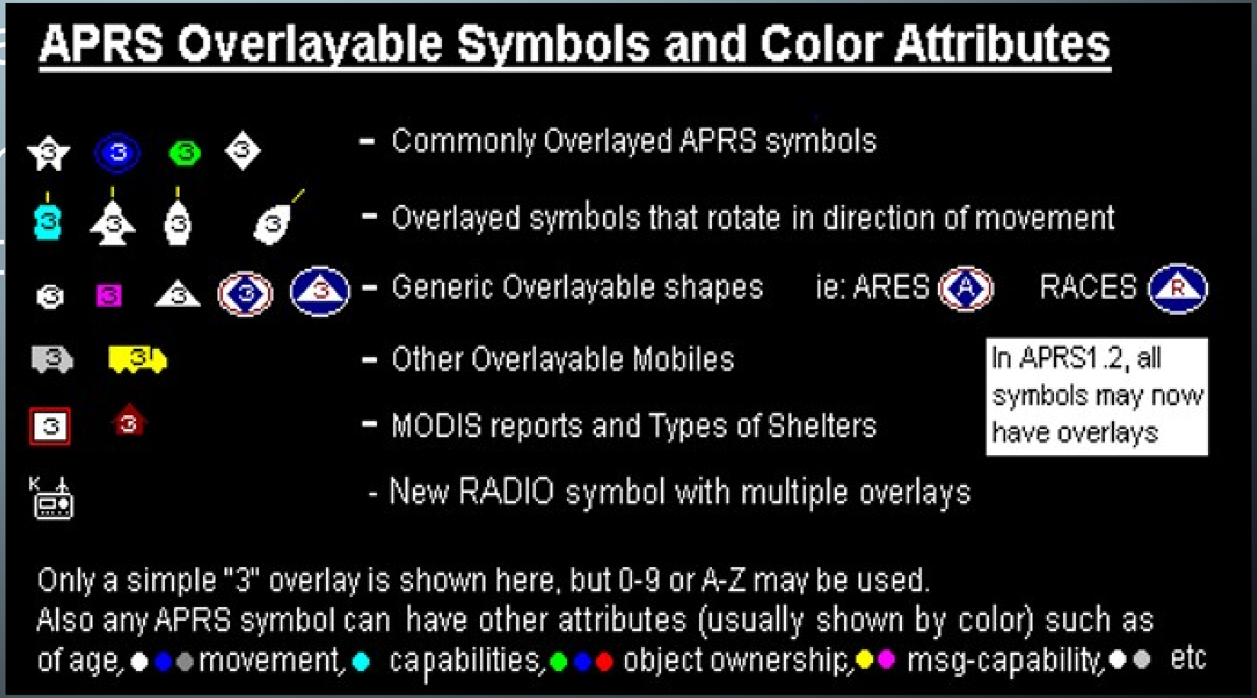
APRS POSITION REPORTS

- The primary function of APRS is to transmit position reports.
- Position reports may contain course, speed, altitude and more.
- Position reports can also contain over 200 user-defined symbols for their icons on a map.
- Position reports are received by APRS-IS and shown on a map (aprs.fi)



SYMBOLS

- APRS position packets also contain symbol information, describing the type of sta
- Since April 2007, all alter symbols may now have t overlays (0-9 and A-Z)



APRS OBJECTS / LOCAL FREQUENCY INFO INITIATIVE

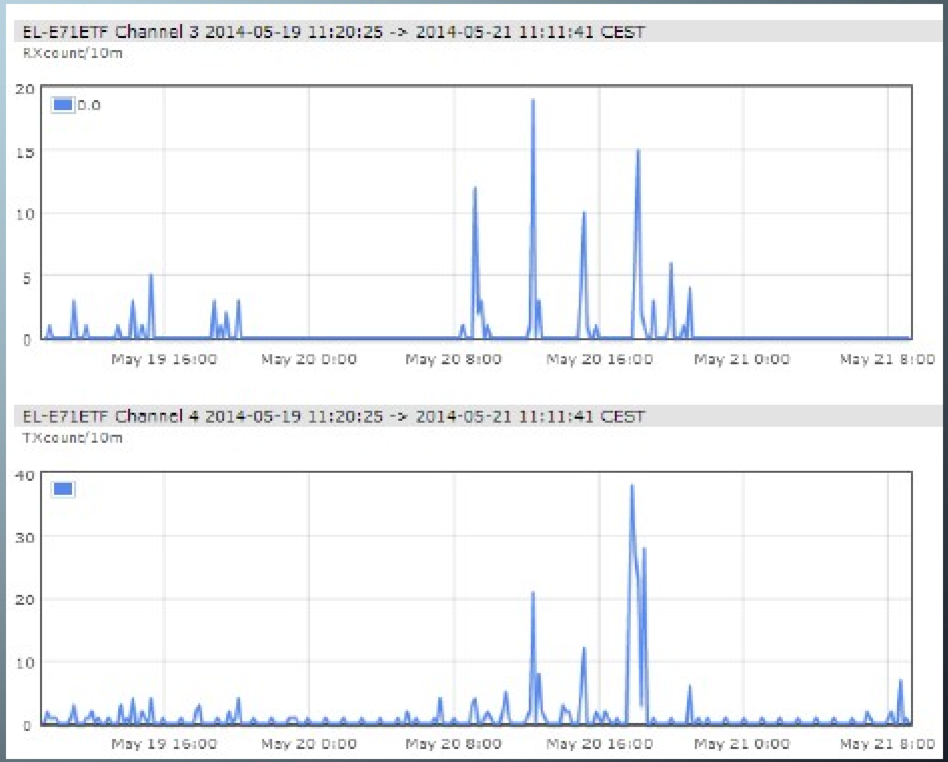
- Anyone can create an object on APRS to inform everybody of:
  - Voice repeater frequency, offset and tone
  - Echolink and IRLP nodes
  - HAMfest objects
  - Local on-the-air nets
  - Club meetings
- Dale Huguley KG5QD maintains a server which translates NWS data into a format for APRS.
- Winlink uses APRS objects to show Winlink nodes that do not transmit APRS on their own.

BULLETINS AND ANNOUNCEMENTS

- A bulletin or announcement may be sent to all stations within your packet's range.
- A bulletin is created by sending a packet to BLN# (0-9 and A-Z).
- Bulletins may also be grouped by adding the group identifier to the destination, i.e. BLN1LOCAL, but the destination may not be longer than 9 characters.

TELEMETRY

- APRS also telemetry using binary or the Mic-E format.
- A good example is weather stations transmitting battery voltage or other important statistics along with meteorological data.
- Digipeaters can also transmit rail voltages, battery temperature, enabled features, etc.
- High altitude balloons are known to transmit pressure, measurements, etc.



Digipeater packet TX/RX count telemetry

WEATHER

- Personal Weather Stations (PWS) can transmit meteorological information either via APRS or through the internet.
- These stations help the NWS create accurate forecasts by aggregating PWS measurements throughout an area.
- Meteorological data can contain temperature, dewpoint, humidity, pressure, wind direction & speed, rain and solar radiation.
- Weather data is also synchronized from the Citizens Weather Observation Program (CWOP)

VOICE ALERT

- Voice Alert is effectively a 3rd and 4th radio channel for APRS transceivers with internal TNCs
- Set PL tone 100.0 Hz on APRS channel, volume UP!
  - All packet noise is MUTED
  - You are available for a voice call using PL-100 on 144.390 MHz
  - You will hear an alert if another voice alert enabled station comes in range of you
- Great for long haul traveling and meeting other APRS users.

PRIVATE VOICE ALERT

- Set PL tone to your own tone on APRS channel, volume UP!
  - All packet noise is MUTED
  - All other voice alert proximity pings are muted
  - You are available for a selective voice call using PL-xxx on 144.390 MHz
- Mutes APRS, but allows for voice contact with PL-xxx
- Include “V-Alert Txxx” in your status text

EMAILS AND TEXT MESSAGING

- For SMS, send an APRS message to SMSGTE
  - Prefix your message with @ and the phone number, for example:
  - “@2398234244 This is a test message.”
- For Email, send an APRS message to EMAIL-2
  - Prefix your message with the message with the email address, for example:
  - “patrickmathis@hotmail.com This is a test message.”

SATELLITES AND THE INTERNATIONAL SPACE STATION

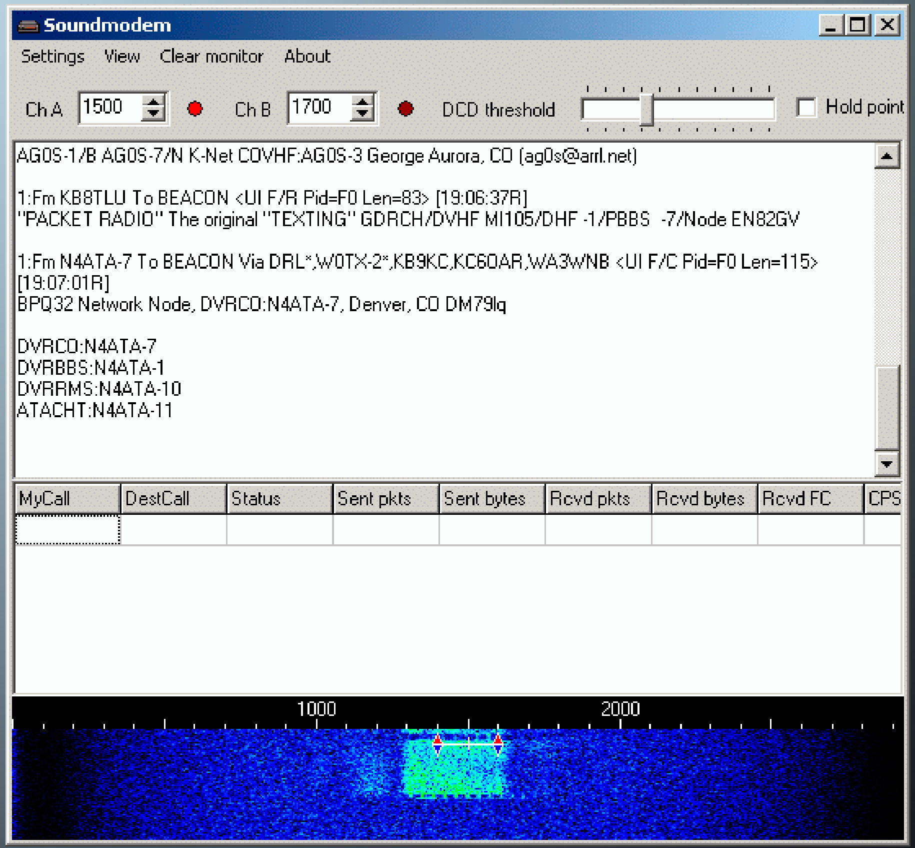
- The International Space Station contains a digipeater!
- ISS and OSCAR digipeaters operate on 145.825 MHz.
  - Trivia: OSCAR stands for Orbiting Satellite Carrying Amateur Radios
- The WIDEn-N path does NOT work on satellites, you must use ARISS or RS0ISS (for the ISS only)
- It is not unusual to have packets heard by stations across the United States in a single hop!
- Astronauts onboard the ISS have been known to reply to messages sent to RS0ISS.

HOW DO I GET STARTED?

- There are multiple ways to start with APRS.
- The simplest way is to use a software TNC, and feed the audio straight into the transceiver.
- A more permanent installation involves a hardware TNC (such as TNC-X) or a SignaLink connected to your transceiver.
- An APRS software is required to generate the packets to send to the TNC.
- Some TNCs support Bluetooth, permitting the use of mobile phones and apps such as APRSDroid.

YOU DO NOT NEED A SPECIAL TNC TO DO APRS!

- Most FM radios have the functionality to feed in an external microphone signal and a remote PTT. This is required for handsets.
- A free software TNC (like SoundModem) can generate APRS tones straight to audio, and signal an RS-232 device (think Arduino/Raspberry Pi) for PTT
- This audio can be sent to the radio with a PTT signal to transmit APRS packets.
- SoundModem also support decoding of APRS audio from the radio’s TRS jack.

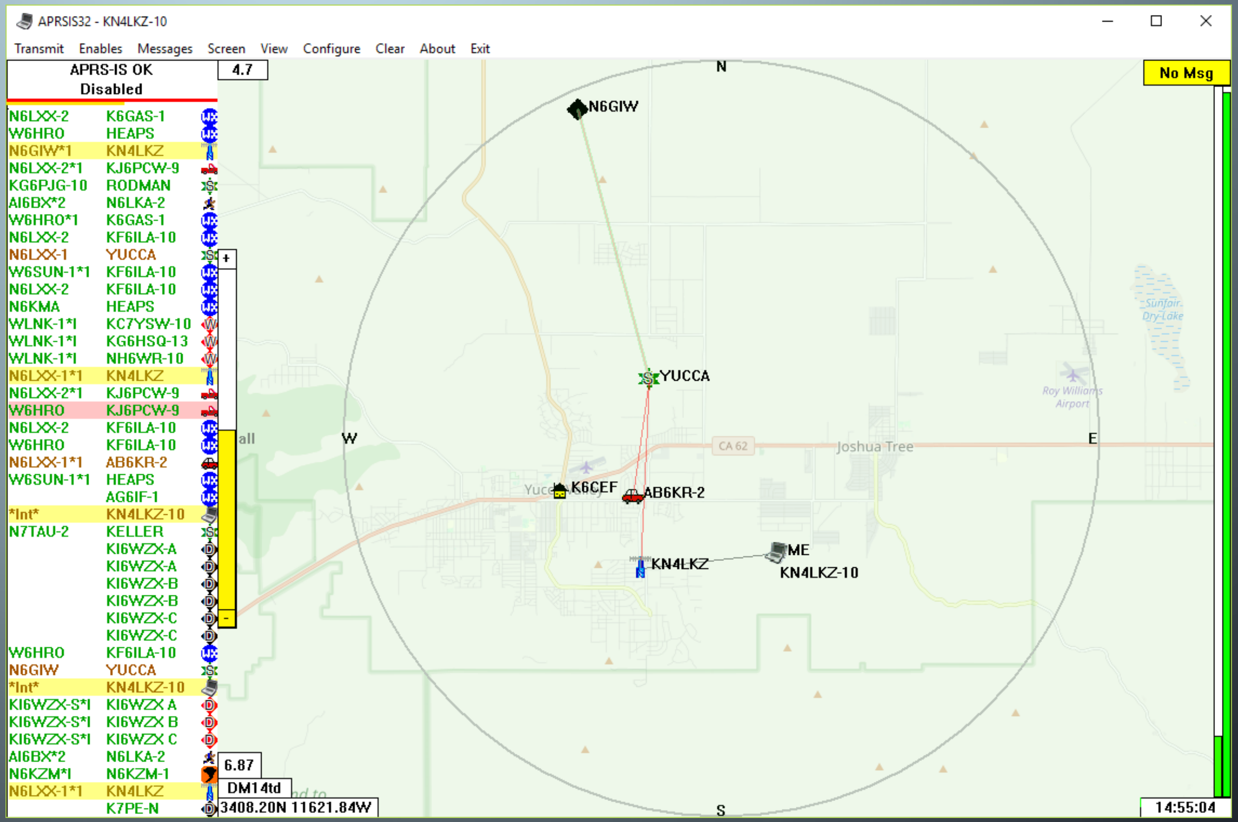


YOU DO NOT NEED A RADIO TO START WITH APRS!

- APRS-IS provides a way to interact with the APRS system without using a radio.
- Position reports can be sent to APRS-IS directly.
- Messages may also be sent via APRS-IS, and gated into RF.
- Get started at http://www.aprs-is.net/

SOFTWARE

- APRSDroid (Android)
- WinAPRS
- MacAPRS
- APRS+SA
- UI-View
- Xastir
- XAPRS
- PocketAPRS
- APRSIS32 (shown)



HARDWARE

- TNCs/Interfaces
  - MFJ-1270X TNC-X
  - Signalink
- Trackers
  - TinyTrak
  - TrackSoar
  - AVRT5
  - PicoAPRS
- Tranceivers with built-in A
  - Kenwood D710G
  - Kenwood TH-D74A
  - Yaesu VX-8DR
- iGates and Digipeaters
  - Microsat WX3IN1
  - 51 TNC

AND MUCH MORE!

THANK YOU!