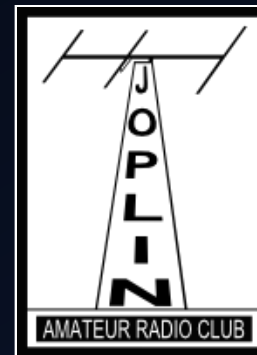


# Intro to APRS

22 SEP 2012  
BY  
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EDITED:  
APRIL 2016  
JASON ARENDS, KOJAA  
JOPLIN AMATEUR RADIO CLUB



APRS is a registered trademark of Bob Bruninga, WB4APR

# Overview

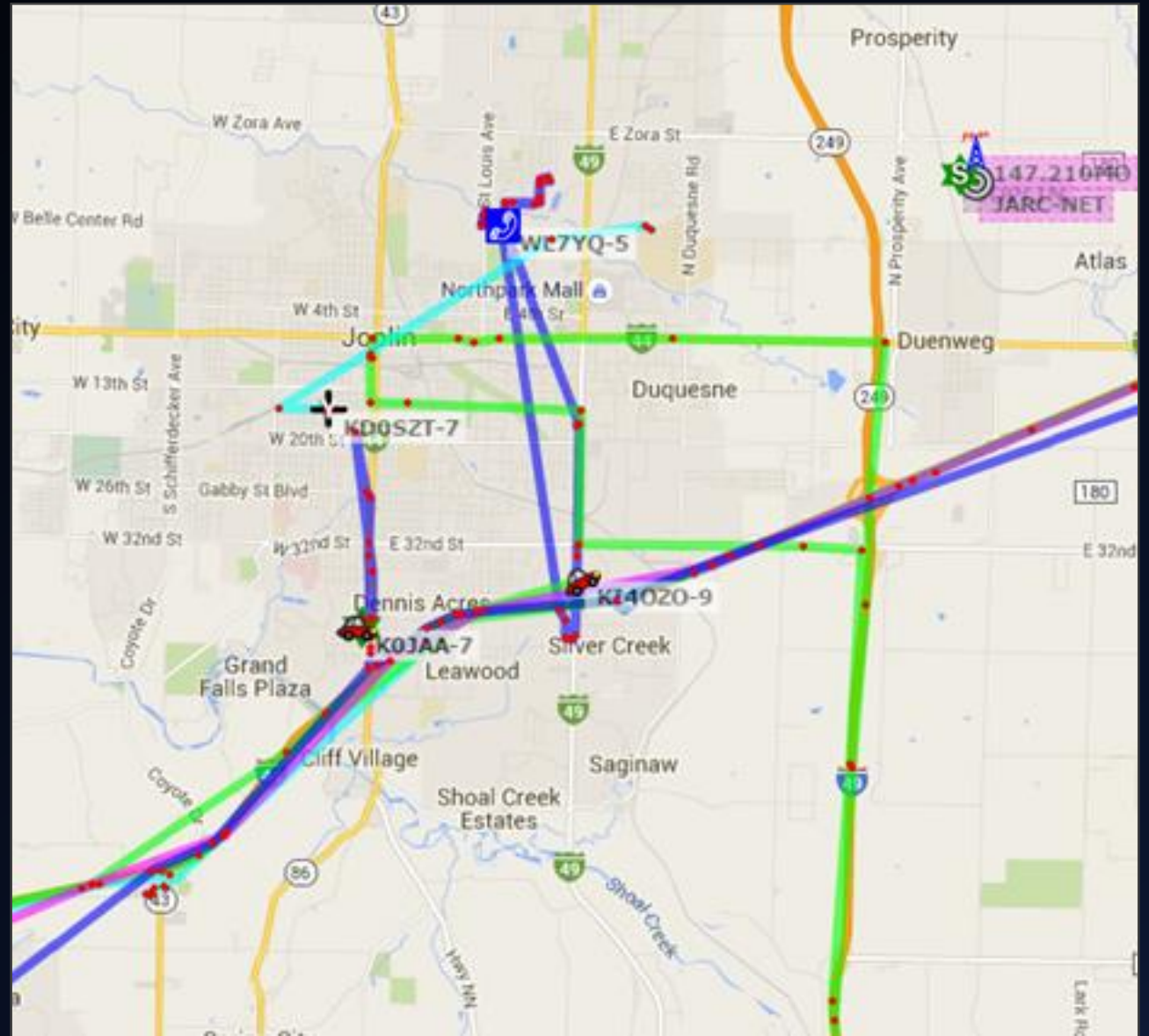
- What is APRS
- Getting Started
  - Online
  - Software
  - Hardware
- Digipeaters
- Setting up
- APRS-IS
- Interesting Things to Do
- Appendix

# What is APRS?

- A tactical, real-time **information sharing system** using standard protocols over packet radio
- Developed by Bob Bruninga around 1992
- Supported by several major radio manufacturers (Kenwood, Yaesu, Alinco)
- Useful for both emergency operations and standard day-to-day operations
- An example of highly successful integration of RF and Internet technologies

# WHAT IS APRS NOT

It is **NOT** all about maps



# Bob's "Mission Statement"



- Remember, the primary purpose of the APRS Radio was **NEVER** vehicle tracking. It was to provide the handheld and mobile operator an information **CAPTURE** and **DISPLAY** system and a single continent wide data channel for keeping the operator informed of everything going on in ham radio in his immediate area instantly (**10 minute refresh**). Notice: **RECEIVE AND DISPLAY DATA**, Not just TX your GPS coordinates that no one cares about.

# What can you **LEARN** with APRS?

- The **Frequency, Tone** and **Offset** of the locally recommended travelers' voice repeater
- Day and time of the **weekly net** on that repeater
- Locations, day, and time of the monthly **club meeting**
- Freq, Tone, Offset, and Node # of Echolink, IRLP, and WIRES **nodes**
- Any local special meeting **announcements**
- Location, date and time of any **HAMfests** in the area

## What can you **LEARN** with APRS?

- Location of significant civil **events** (wrecks, fires, problems, etc)
- Speed of traffic past designated choke points in area
- Direction (az/el), distance, and freqs of any **AMSATs** in view once per minute
- Schedule of any **AMSATs** in view in next 90 minutes
- Local weather **conditions** (temp, wind, pressure, precip)
- Finally, the location and voice freq of all **APRS stations** nearby

# What can you **DO** with APRS?

- Send and receive global APRS **messages**
- Send and receive global **e-mail** messages
- **Query** the system for closest IRLP and Echolink nodes (All-Star coming soon)
- **Look up** names/locations based on callsigns
- Join a global **round-table** messaging discussion with like-minded APRS hams (msg to CQ)
- Receive near-real-time **NWS messages** for county notifications





# Getting Started

APRS WEB SITES



# APRS Websites

- <http://www.aprs.fi>
- <http://www.findu.com>
- <http://openaprs.net> (allows messages with registration)
- Free to use
- Generally one-way, only (you can see RF stations, but can't send messages or interact with them.)
- Best maps are when you're on-line (Google does maps better than anyone)

# Additional Websites

- [www.aprs.org](http://www.aprs.org) – Bob Bruninga's site
- [www.kcaprs.org](http://www.kcaprs.org) – Kansas City APRS Org
- [www.aprs-is.net](http://www.aprs-is.net) – APRS-IS information
- [www.tapr.org](http://www.tapr.org) – Tucson Amateur Packet Radio



# Getting Interactive

APRS CLIENT SOFTWARE

# Getting Serious, Staying Cheap

- Clients, clients, and more clients.
- Clients for every major Operating System
- **Android** – APRSDroid by Georg Lukas (DO1GL)
- **iOS** – PocketPacket (SV1OAN)
- **Windows** – APRSISCE/32
- **Linux/Unix** – Xastir, Wine Options
- **Mac OSX** – Xastir, PocketPacket for OSX
- **Cross-Platform** – YAAC (Yet Another APRS Client) KA2DDO
- Native Clients generally interface with both the APRS-IS and local radio hardware (TNC and Radio). Most can act as gateways between the RF world and the Internet. No hardware is needed to just use as an Internet Client.



# Getting On The Air

APRS-CAPABLE HARDWARE



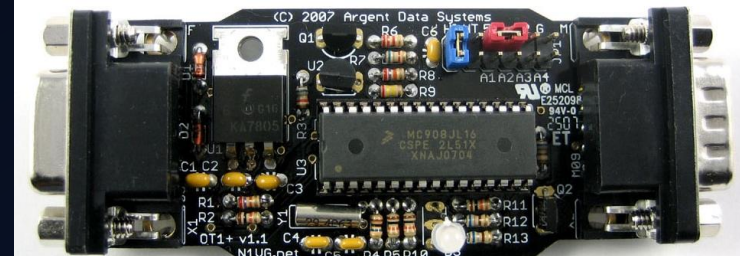
# Trackers Available Today

- **Byonics TinyTrak4**
- Does 300, 1200, 9600 baud packet
- User upgradable firmware update regularly
- Does KISS, Digipeating, Wx, has optional display and keyboard
- \$65 kit, \$75 ready to go
- <http://www.byonics.com/>



# More Trackers

- OpenTracker+ from Argent Data Systems
- Does 1200 and 300 baud
- Free firmware, actively developed
- Newer version supports USB out
- Kit: \$32, Assembled:\$46, USB: \$55
- <https://www.argentdata.com/catalog/index.php?cPath=22>





# More Trackers

- **PLXTracker Blue**
- Free upgradable firmware, actively developed
- Bluetooth TNC
- Standalone with GPS connection
- Weather Station support
- Can do fill-in digipeating
- \$58
- <http://microsat.com.pl/>



# Straight TNCs

- Many can operate in stand-alone mode with a Serial GPS attached
- Configuration ranges from “Huh?!” to “@#X%&#%\$&!!!!”
- [www.tnc-x.com](http://www.tnc-x.com)



# Bluetooth TNCs

- **Mobilinkd**
  - KISS protocol over Bluetooth
  - Various connectors for radio interface
  - Rechargeable battery or USB powered
  - Use with APRSDroid on Android, or with Bluetooth dongle on PC with APRSCS/32 in Windows or Xastir in Linux
  - \$65
  - <http://www.mobilinkd.com/>
- Some PLXTracker and TinyTrak models also support Bluetooth



# APRS Radios

- **Kenwood** offers the TH-D72 and TM-D710
- **Alinco** has the DR-135 (add-on TNC option)
- **Yaesu** has the VX8 series and FT1DR, FT2DR, FTM-100DR, FTM-350R, FTM-400DR

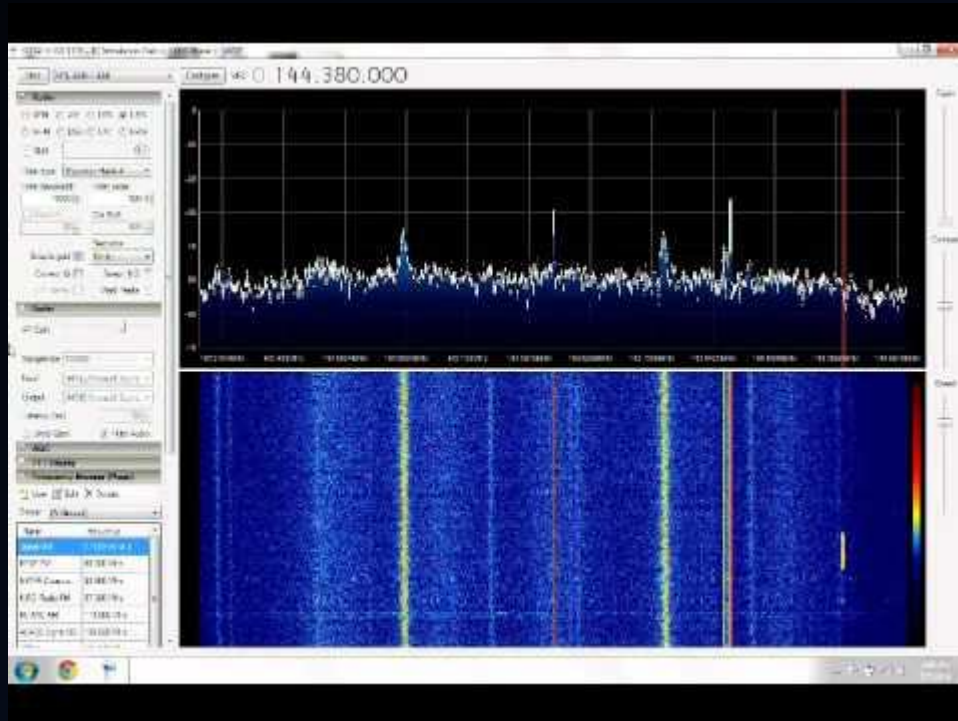


# GPS – Where Are You?

- GPS sentences look like this:
- `$GPGGA,213439.687,3410.9072,N,08407.9259,W,0,00,99.9,00376.7,M,0000.0,M,000.0,0000*5C`
- `$GPGSA,A,1,,,,,,,,,,,,,99.9,99.9,99.9*09`
- `$GPGSV,3,1,12,18,77,043,,22,62,270,20,21,48,127,34,06,42,261,20*7E`
- `$GPGSV,3,2,12,03,36,276,,15,35,053,32,14,26,197,,19,25,312,*7A`
- `$GPGSV,3,3,12,27,24,076,,09,23,100,10,26,,034,16,-5,244,*6E`
- `$GPRMC,213439.687,V,3410.9072,N,08407.9259,W,,170111,,*00`
- BEWARE OF USB GPSs



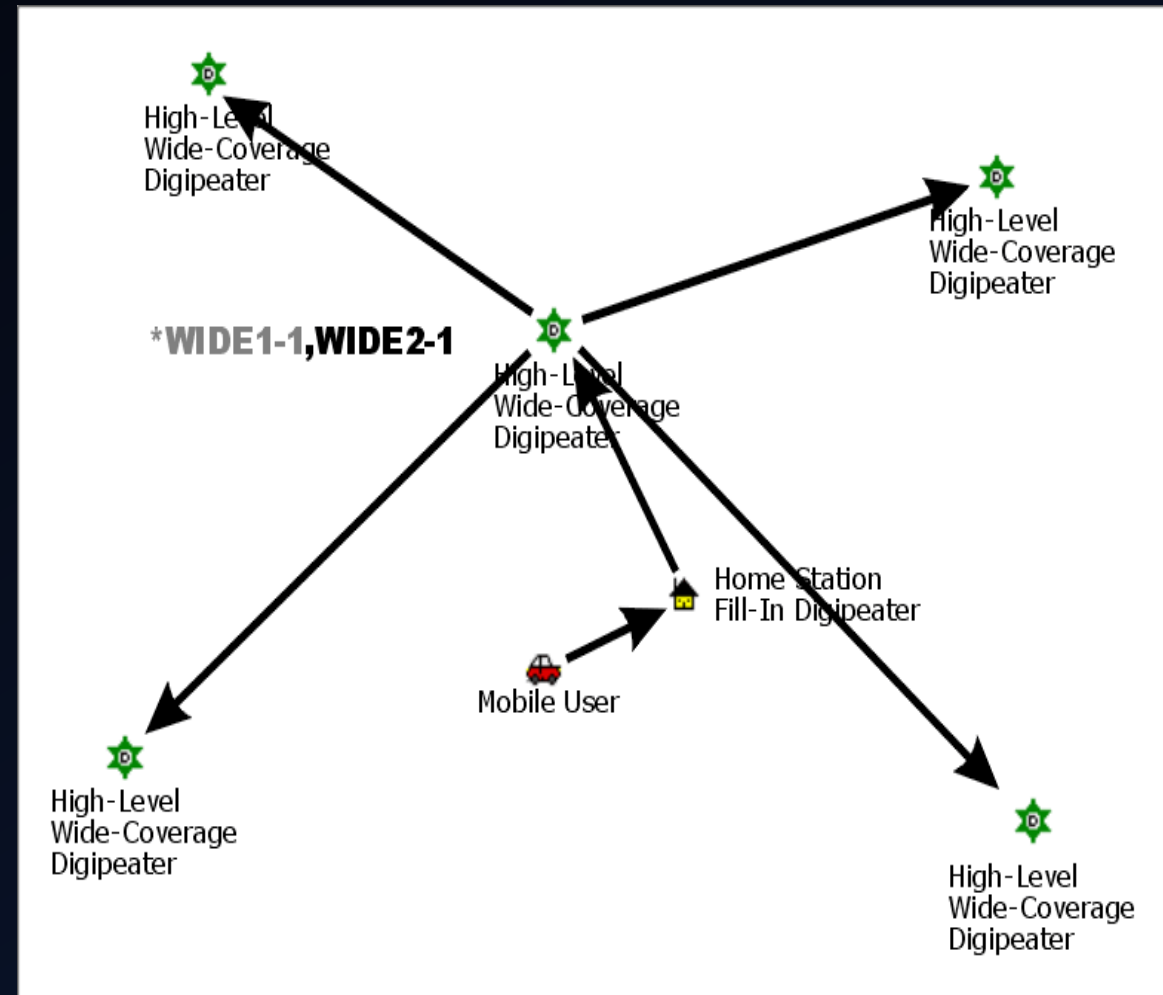
# A Little Packet Primer



- APRS uses AX.25 packet
- 2M APRS uses AFSK (Bell 202, 1200/2400hz tones) 1200 baud
- 440 APRS usually uses 9600 baud AFSK
- HF APRS uses 300 baud or PSK63
- Digipeaters assist in moving the packet along

# Digipeating 101

- <http://wa8lmf.net/DigiPaths/>
- **Paths** are used to determine how far your packet goes (number of hops)
- **WIDEn-N** “New Paradigm” designed to prevent flooding of duplicate packets in an area
- Remember APRS is designed for **local information**



# Wide Area Digi Design

- Most WIDE Digis in the US are purpose-built hardware with limited functionality and **no Internet access**.
- Most **IGates** are home stations with poor RF footprints.
- Local-coverage IGates **double the amount of traffic** for all Internet to RF operations (once up to the WIDE, then WIDE to end-user)
- Better design and use of bandwidth is co-locate the IGate with the wide-coverage DIGI, cutting the number of packets by half and improving packet success rates.





## Recommended SSID Usage

- -0 Your primary station usually fixed and message capable
- -1 generic additional station, digi, mobile, wx, etc
- -2 generic additional station, digi, mobile, wx, etc
- -3 generic additional station, digi, mobile, wx, etc
- -4 generic additional station, digi, mobile, wx, etc
- -5 Other network sources (Dstar, Iphones, Blackberry's etc)
- -6 Special activity, Satellite ops, camping or 6 meters, etc
- -7 walkie talkies, HT's or other human portable

## Recommended SSID Usage

- -8 boats, sailboats, RV's or second main mobile
- -9 Primary Mobile (usually message capable)
- -10 internet, lgates, echolink, winlink, AVRS, APRN, etc
- -11 balloons, aircraft, spacecraft, etc
- -12 APRStt, DTMF, RFID, devices, one-way trackers\*, etc
- -13 Weather stations
- -14 Truckers or generally full time drivers
- -15 generic additional station, digi, mobile, wx, etc

# Recommended SSID Usage

- -63 for PSK63 HF stations
- -tt for APRS TouchTone users (DTMF)
- -ID for RFID
- -A through -Z for Dstar

# APRS-IS

- Adding **Internet** connectivity to APRS adds to the fun
- A variety of **auto-responders** and **information** services become available when Internet Gateways – IGates – are in reach
- **Global 2-way messaging** is possible if both stations are in reach of a Tx IGate

# APRS-IS

- Generally ~40,000 APRS stations in operations in any 24h period
- Almost 100 APRS-IS hub and leaf servers online at any time (7 core, 5 hub2, and 80+ leaf servers)
- Generally see 40-50 packets per second, 86400 seconds per day
- Approximately 7-10 pps are malformed or unparseable
- Without filtering, all servers receive all packets, each server is responsible for duplicate detection on its own
- Variety of servers that provide services to online and RF clients, such as WHO-IS, LOCATE, satellite, EMAIL, etc.
- This is really an amazing demonstration of the size and popularity of APRS worldwide.

# What now?

- APRS is an inclusive community, there's room for everyone, and everyone can contribute
- **Got a Radio?** Advocate and get involved in community events that need tracking (bike races, marathons, scouting, spotting)
- **Got a home station?** The network needs TX/RX IGates, weather stations, event operators and network controllers with APRS eyes
- **Got a broad coverage RF Site?** We desperately need INTELLIGENT wide-area digis, preferably with internet links
- **Got a data center?** The data storage and processing needs for APRS-IS are many and expanding. Having high-bandwidth server space with hefty storage is a huge need.
- **Got code?** There are several open-source projects looking for authors to push client and server technology forward.

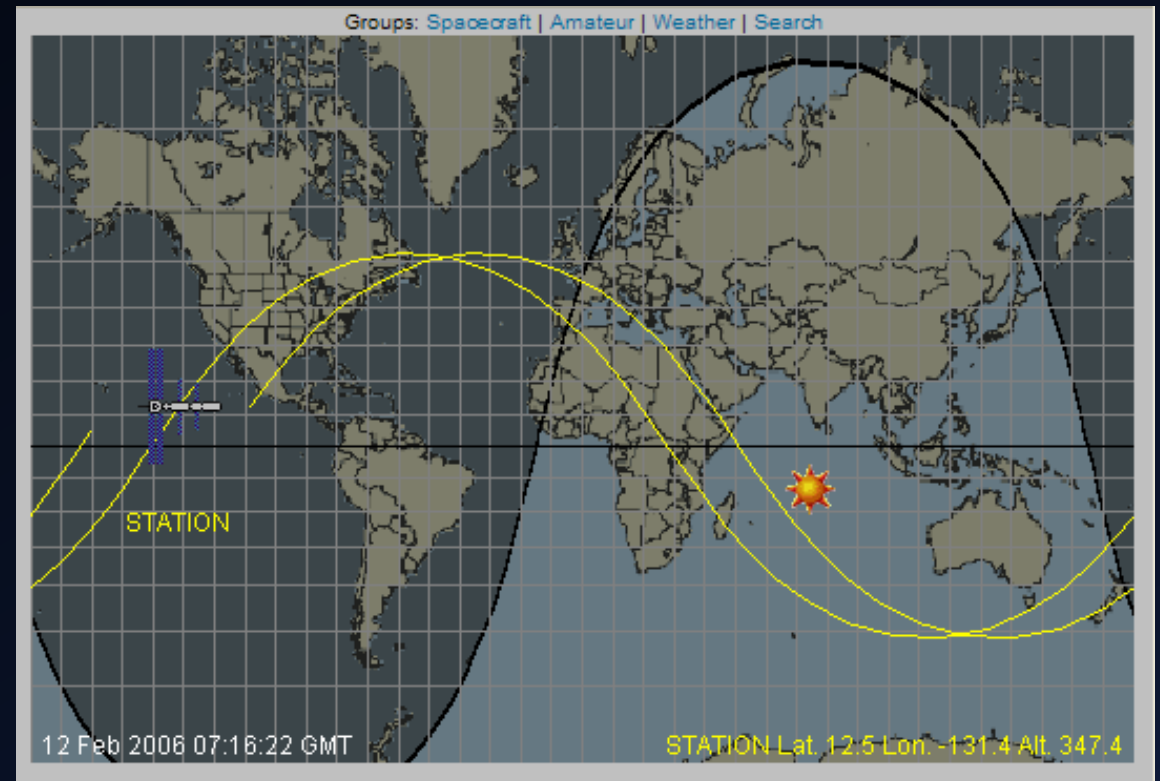
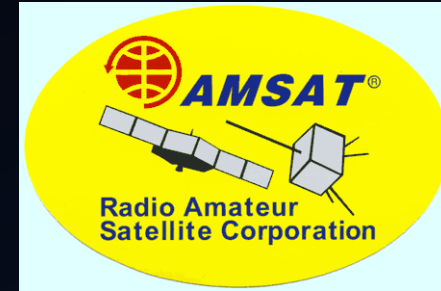


# Things to Do



# Satellite Pass Info

- Courtesy of Lynn Deffenbaugh, KJ4ERJ
- Sending an APRS message to satellite name (i.e. AO-51) will return
- The next pass information, or direction/elevation for an in-progress pass
- Would be supremely helpful if we had more functional satellites
- (works for **ISS**)



# Location Lookups

- Part of the AVRS Service provided by John Gorkos, AB000
- Sending a message to "LOCATE" with a callsign in the body will return a message containing the last known location for that callsign/SSID
- (no A-Star or AVRS in our area – did not work for me)



# Callsign Lookups

- WHO-IS server, operated by Pete Loveall, AE5PL
- Send a message to “**WHO-IS**” with callsign in the message and it will return callbook information about the holder of the callsign

# APRS-Alert.net

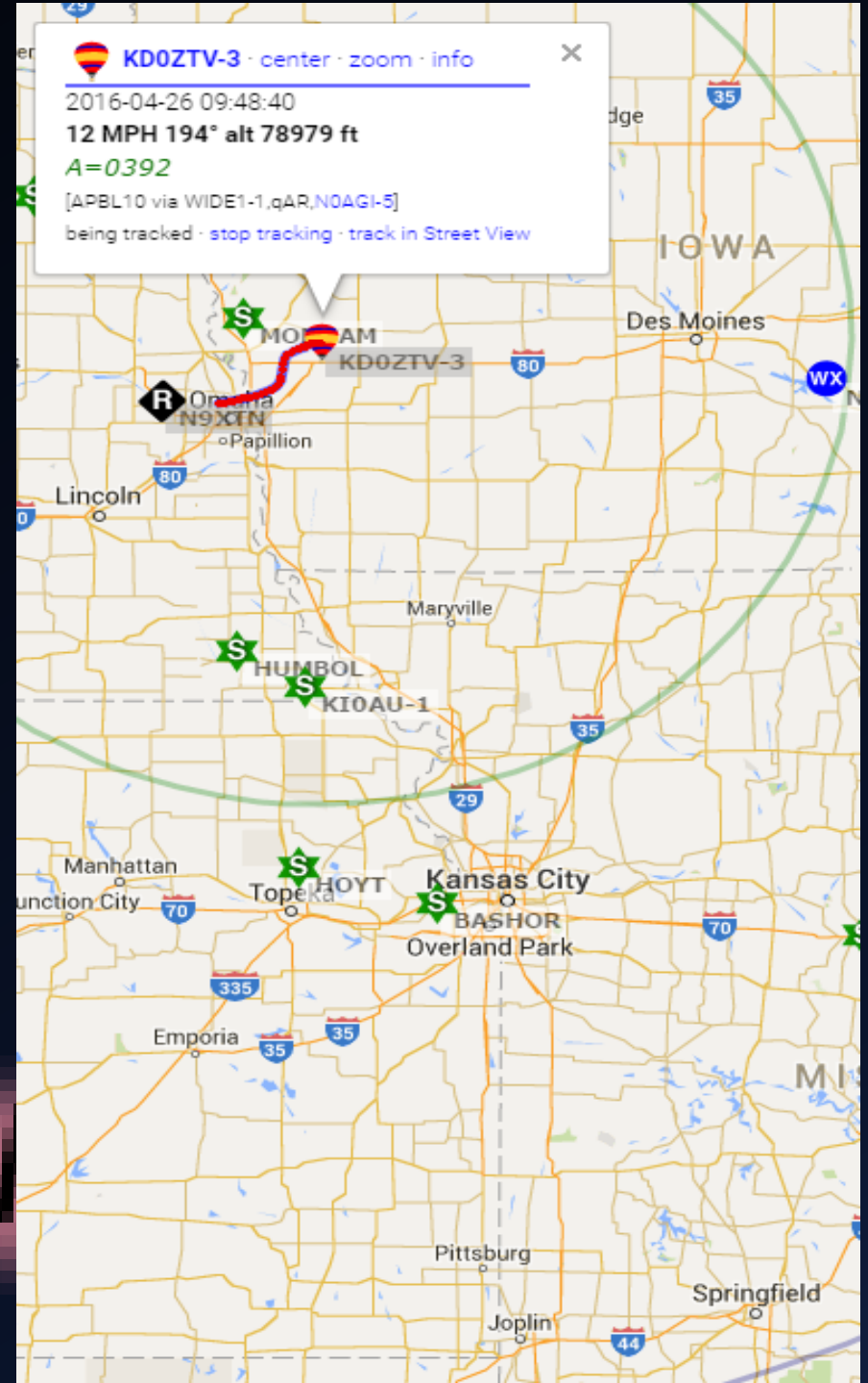
- Web site that allows users to set up complex rules for notification of movement, or incursion or excursion from user-defined zones
- Useful for bridging the gap between ham radio and other wireless communications methods (i.e. SMS messaging)



# High Altitude Balloons

- Neat, but should **not** have a digi path when **high altitude**, no reason to repeat
- JOPLIN repeated this one from **320** miles away
- KD0ZTV-3>APBL10,JOPLIN\*,WIDE1-1:!  
4134.89N/09531.86W0086/011/A=082444

**Device:** BigRedBee: BeeLine GPS (tracker)  
**Last path:** KD0ZTV-3>APBL10 via WIDE1-1,qAR,NOAGI-5 **Seriously bad path.**  
This station appears to be flying at high altitude and using digipeaters, which causes serious congestion in the APRS network. The tracker should be configured to only use digipeaters when at low altitude.



## APRS ON ISS

NASA Image ISS014E18307  
(27 Mar 2007)

Astronaut Sunita Williams using the  
Kenwood D700 to talk to  
students in Brussels.



# APRS on ISS

- Digipeater up and downlink on FM 145.825 MHz
- <http://ariss.net/>
- <http://spaceflight.nasa.gov/station/reference/radio/>
- <http://www.aprs.org/iss-faq.html>



# Local Information



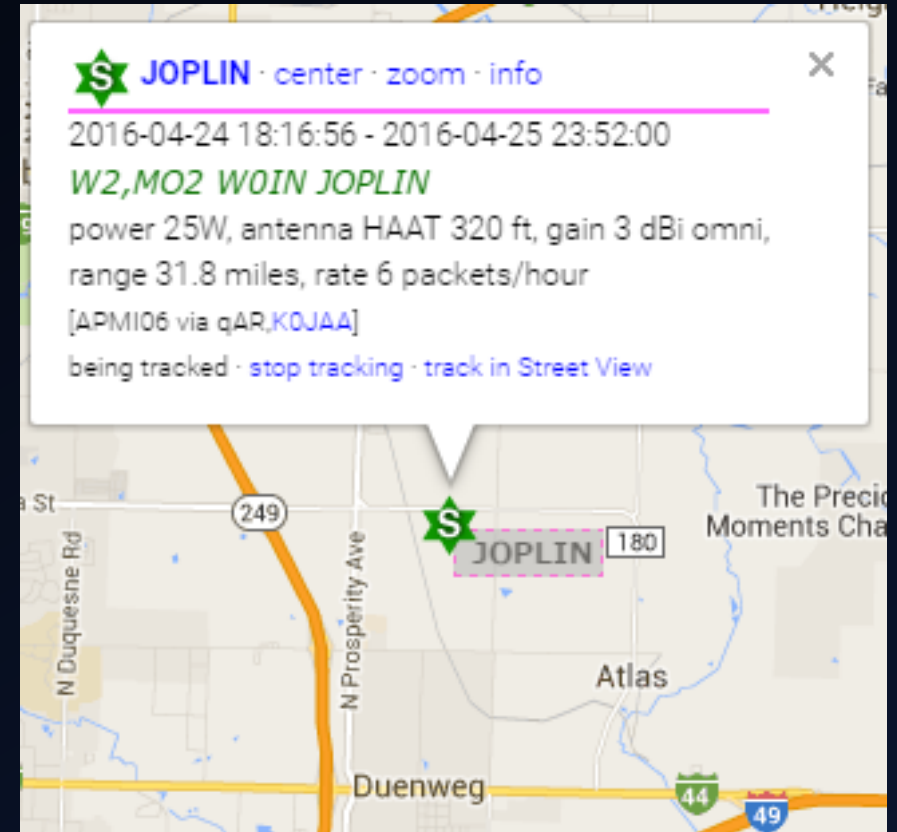
# JOPLIN Digipeater



Microsat WX3in1  
Plus 2.0  
Advanced  
Digipeater/IGate

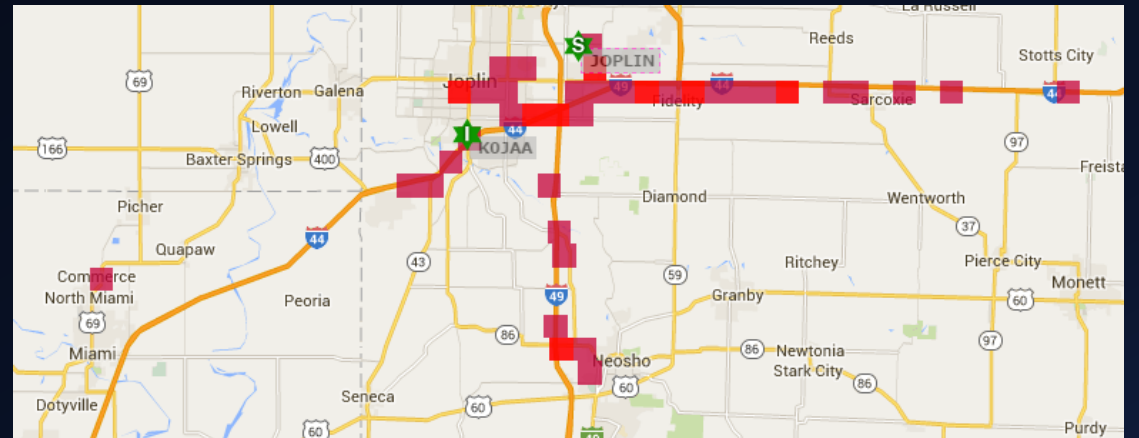


Yaesu FT-2800

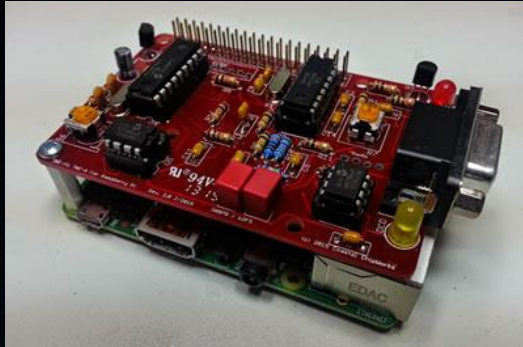


# JOPLIN Digipeater

- Plan to share repeater antenna when cans are acquired
- Set to digipeat WIDE1 and WIDE2, and MO1 and MO2
  - State paths are meant to keep packets in-state
  - When ours has higher elevation and reach, will possibly be heard in KS, OK, AR



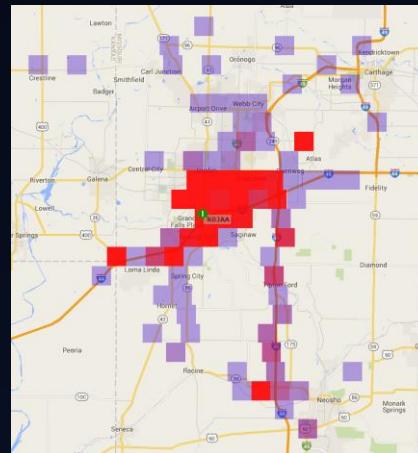
# KOJAA Tx IGate



TNC-Pi 2 on  
Raspberry Pi 2B  
running APRX



Alinco DR-135



- IGates packets from JOPLIN and area
- Fill-in WIDE1-1 digi (3 sec delay)
- IGates from IS to RF:
  - Within 50 Km position, types:
    - ITEM, MESSAGE, NWS, OBJECT, Packets with POSITION data, QUERY, and STATUS packets
- Beacons JARC Event objects (Meetings, Nets, Field Day, Hamfest, etc)

# APRS Demo

Now would be a superb time to ask questions,  
or just cough real loud if I've been talking too long and you're  
ready to leave.





# Appendix

# Packet Details

- Destination Address – usually a code signifying the device or software used, not an actual destination. Can also contain other APRS data.
- Source Address – Callsign or ID and SSID of station
  - Standard for Digipeaters to transmit name of location as ID and include Callsign in regular beacon – ex: JOPLIN digi, beacons with W0IN every 10 mins.
- Digi Address – list of callsigns of digipeaters to repeat through
- Info Field – 256 bytes containing the APRS data

# Info Field Details

- APRS Data Type Identifier – 1 character symbol indicating type of data that follows
- Format varies after that but many contain:
  - Name of object
  - 2-character symbol for object to be displayed on map
  - Time
  - Lat and Lon coordinates (may be compressed)
  - Course, speed, altitude
  - PHG – Station power, height, gain, directivity
  - Other comments

# Example Packets

- K0JAA-7>APDR13,WIDE1-1,WIDE2-1  
:=3704.11N/09424.40W>235/041
  - K0JAA = Callsign
  - -7 = SSID
  - >APDR13 = destination – this one means APRS Droid v1.3
  - WIDE1-1,WIDE2-1 is list of relays for digipeating
  - : separates data
  - = position data follows
  - 3704.11N 09424.40W = coordinates (37° 04.11'N 94° 24.40'W)
  - /> = symbol for car (split before and after 2<sup>nd</sup> coordinate)
  - 235/041 = direction/speed



# Example Packets

- JOPLIN>APMI06:;147.210MO\*111111z3706.  
N/09424. WrT915 R35m Net M1930 W0IN
  - JOPLIN = Callsign
  - >APMI06 = destination – this one is a MicroSat WX3in1 Plus v2
  - No relays – packet should not be digipeated, it's only for direct
  - : separates data
  - ; = object data
  - 147.210MO = object name (for the repeater)
  - \* = live object
  - 111111z = time, this special time indicates permanent object

# Example Packets

- JOPLIN>APMI06:;147.210MO\*111111z3706.  
N/09424. WrT915 R35m Net M1930 W0IN
  - 3706. N 09424. W = coordinates – including spaces for digits gives ambiguity
  - /r = symbol for repeater
  - Rest is simply comments but there's a standard code:
    - T915 = Tone 91.5
    - R35m = Range 35 miles
    - Net M1930 = Net Mondays at 19:30
    - W0IN = Callsign