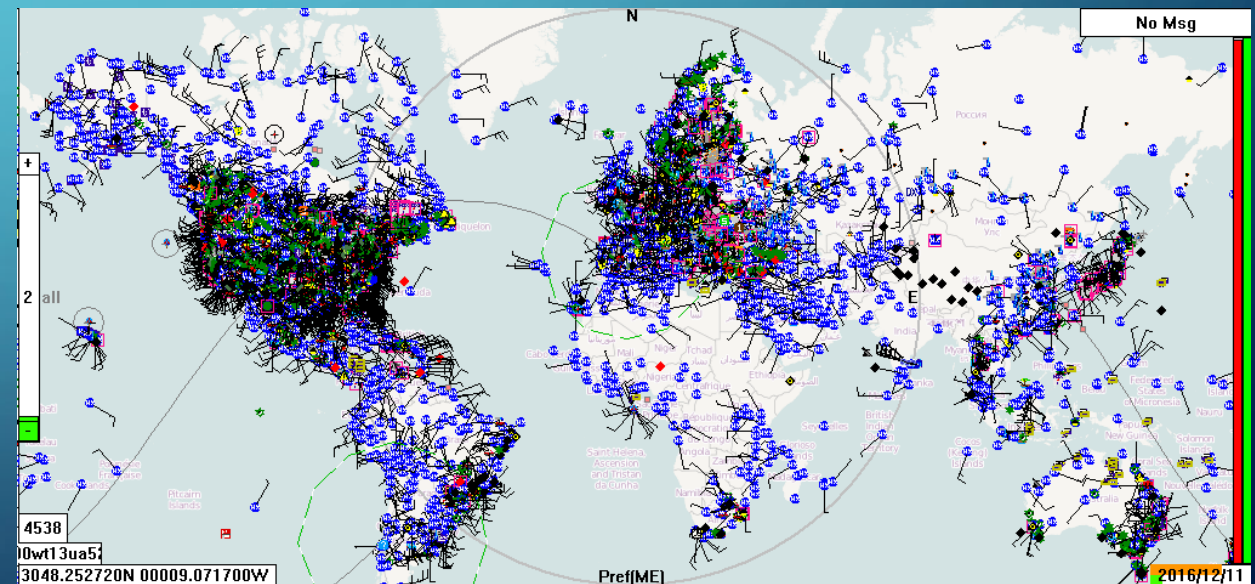
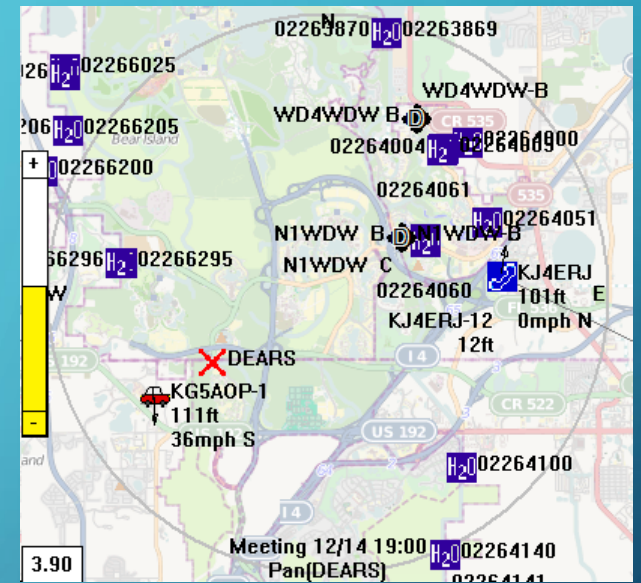


APRS* FROM A TO Z

*APRS is a registered trademark of Bob Bruninga, WB4APR

(AX.25 TO APZXXX)

BUT NOT EVERYTHING IN BETWEEN!



APRS FROM A TO Z

- AX.25 Packet Format (WAY under the covers)
 - APRS Packet Format
 - APRS Infrastructure
 - APRS Hardware
 - APRS Uses
 - Getting Started w/APRS
- BUT FIRST!
 - WHAT IS IT?
 - WHO IS KJ4ERJ?

APRS – WHAT IS IT?

- A tactical, real-time **information sharing system** using standard protocols
- Developed by Bob Bruninga WB4APR 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

KJ4ERJ – WHO IS HE?

- From the APRSISCE Wiki: <http://aprsisce.wikidot.com/kj4erj-story>
 - Magazine article in the (19)70s – Likely AX.25
 - Licensed in 2008 thanks to KJ4DXK, W4WCQ, W4SGC
 - Fun with GPS, GeoCaching, and Digital Speedometer (from KJ4DXK)
 - APRSISCE on Windows Mobile – August/September 2008
 - APRSIS32 on Windows Desktops w/OpenStreetMaps – August 2009
 - APRSISMO on Android – August 2013

And now, ready to dive
straight into the deep end?

AX.25 PACKET FORMAT

- What is AX.25? – Link Access Protocol for Amateur Radio - conforms to HDLC
<https://www.tapr.org/pdf/AX25.2.2.pdf>
- Connected Packet vs UI (Unnumbered Information) – TCP vs UDP
- Station IDs – Callsign-SSID (Secondary Station Identifier)
 - 6 Character call sign, 4 bit –SSID (-0 through -15)
 - NOT WiFi's Service Set Identifier
- Checksum, not Error Correcting – all or nothing
- Address: Destination, Source, Repeaters – aka Path

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

Figure 3.1b. Information frame construction.

APRS PACKET FORMAT

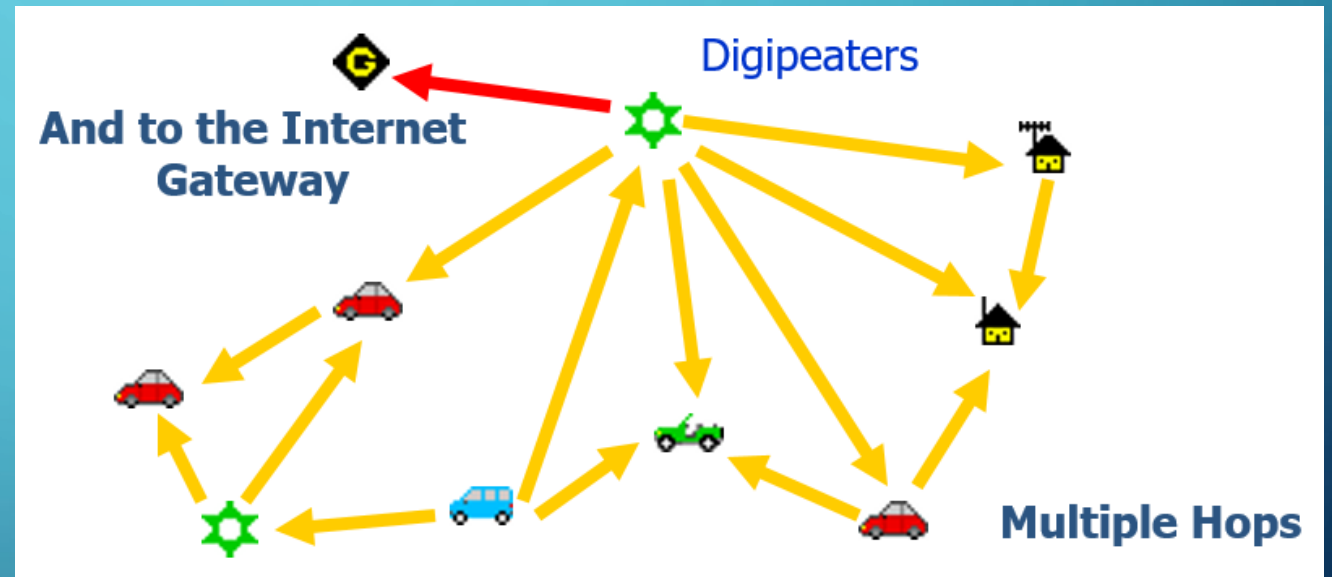
- Humanly Readable TNC2 format
 - SrcCall>DstCall,Path:Payload
 - Payloads include:
 - [APRS101.pdf](#)
 - Position reports, including Objects
 - Telemetry & Definitions
 - Messages (& acks)
 - Weather
 - Capabilities & Status
 - Queries
- ```
SQ3GOK-9>UR0P90,WIDE1-1,qAR,SP3KWA-4:`..;+1S>>/`"5j}Ania Antos Robert ZIMOTKI 2016_#
HS5NFP>APESPG,TCPIP*,qAC,T2THAI:!1954.25N/09948.55E&PHG3260F/Chiangrai APRS Group
F1BIV-1>APU25N,TCPIP*,qAC,T2SWEDEN:=4849.61N\00219.73Eo/PHG2130 - Qth:Paris 14e - VHF&IP {UIV32N}
JH1HWT>API31,DSTAR*,qAR,JP1YDS-A:!3555.76N/14036.56E[/
K1CKK-2>APN383,qAR,N1RCW-2:!4145.79NS06959.43W# W2,MA n APRS DIGI ORLEANS MA
TG9AOS-9>Q4SW0R,WIDE1-1,WIDE2-1,qAR,TG9AFX-3:`v>jlq k/`"EB}_%
W3GXT-1>APOT30,WIDE2-1,qAR,N3GXH-1:>
N2MH>TQ0Q6W,K2PUT-15*,WIDE2-1,qAR,WB2ZII-15:`f*Tng6u\`"4g}442.600MHz C141 +500_%
WA5ETK-9>APT311,AMA39*,WIDE3-2,qAR,KE5KUL:!3514.16N/10149.88W>179/052/A=003575/Gene - Chevy Aveo Mobile
CA2DMR-7>APRS,DMR*,qAS,Xe3ra-10:=2954.91S/07114.02W[000/000/A=000440DMR ID: 7302003
DB0FBG>APND13,WIDE2-2,qAR,DG1JLA-3:;439.025- *111111z5055.75N/01320.91Er1750 R30k DB0FBG Freiberg/Sa.
EA5AHQ-10>APDW12,WIDE1-1,WIDE2-1,qAR,EA5IIE-10:!3925.89N\00036.40WSPHG1260APRS RX 144.800 + APRS SAT 145.825
ISS Estacion Espacial Internacional
```

# OVER-THE-AIR FORMAT

- AFSK – 1200 Baud on 2m – 1200hz 2200hz tones w/bit-stuffing
- FSK – 300 Baud on HF – 200hz separation
- PSK63 – [http://www.crosscountrywireless.net/aprs\\_messenger.htm](http://www.crosscountrywireless.net/aprs_messenger.htm)
- WSPR - <http://hojoham.blogspot.com/2016/05/wisp1-telemetry-revisited.html>
- Still no Error Correction, mostly just Checksums...
  - **ALL** of a packet must be received **PERFECTLY** before **ANYTHING** will be recovered from it.
- <http://robust-packet.net/> - SCS Tracker / DSP TNC

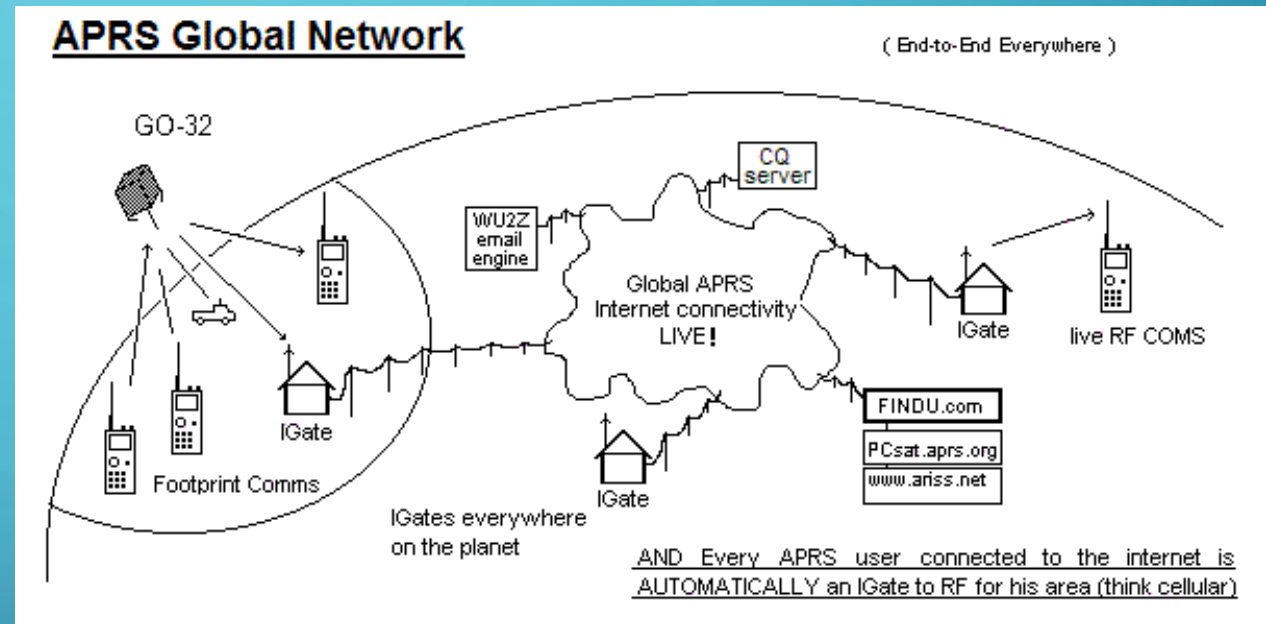
# APRS INFRASTRUCTURE – The RF Side

- Digipeaters – Digital Repeater
- Fixed & Mobile Stations
- Simplex range  $\sim 1/2$  FM voice
- Digipeat Duplicate Detect
  - Partially broken in D700/D710!
- UIFLOOD vs UITRACE
- `W4MCA>R8RX1T,W4PEM-14,WIDE1*,WIDE2-1,qAO,KJ4ERJ-12:`m.Yn{j>/`"43}_%W2XYZ-9>R7PU5S,NI4CE-10,WIDE1,W4PEM-10,W4PEM-14,WIDE2*,qAO,KJ4ERJ-12:'n2[1 -/]CALLSIGN@ARRL.NET=`



# APRS-IS INFRASTRUCTURE – The Internet Side

- RF meets the Internet
- IGates feed APRS-IS Servers
- Servers distribute globally
- Not “smart”, just a packet relay
- Realtime, no buffering, no storage
- Duplicate Suppression – Cannot use APRS-IS to evaluate RF coverage!
- Messages & “Courtesy” Posits gate back to RF – And sometimes more!



# APRS HARDWARE

- APRS-capable Integrated Radios
- Integrated Trackers
- Terminal Node Controllers – TNCs
- Sound Card Modems

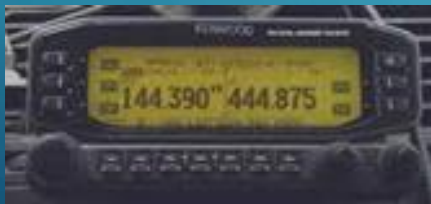


# APRS INTEGRATED RADIOS

## KENWOOD

D7/D72/D74  
(Now with BlueTooth!)

D700/D710/D710G



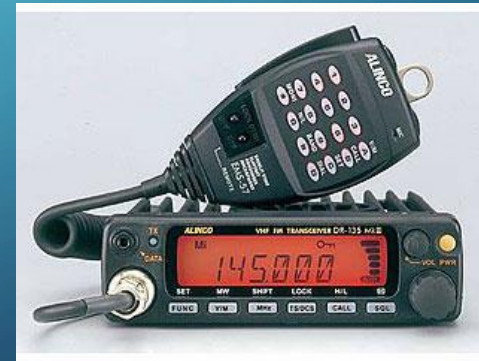
## YAESU

VX8/FT1DR/FT2DR  
FTM-100/350R/400DR



## ALINCO

DR-135 w/Internal TNC  
EJ-41U Or better T3-135



# INTEGRATED TRACKERS/IGATES

## SAINSONIC

AP510 – 1 Watt Tracker



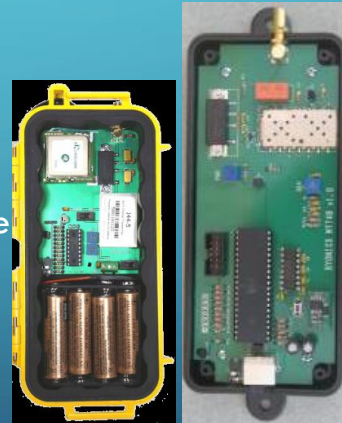
## BYONICS

MicroTrak Ready To Go (10 watt)



MicroTrak All In One  
10 watt Tracker

MTT4B/BT  
8 watt Transceiver



## MICROSAT

WX3IN1+/Mini

Fully Functional IGate



# AX.25 MODEMS (Modulator/Demodulator)

(not true TNCs)

## MOBILINKD

Direct BlueTooth-linked



## BYONICS

TinyTrak 3 (Deaf Tracker)



TinyTrak 4  
(w/TT4BT)



## ARGENT DATA SYSTEMS

OpenTracker+/USB



Tracker 3 Family



# TERMINAL NODE CONTROLLERS (TNCS)

## KANTRONICS

(Venerable) KPC-3+ & More



Standalone Operations

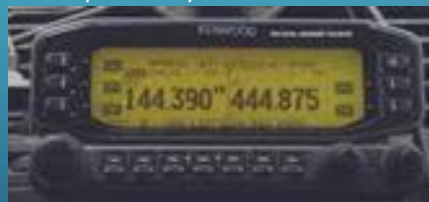
Provides Connected Packet & BBS too  
(NMEA-only Tracking, I think)

## KENWOOD

D7/D72

Not the new D74

D700/D710/D710G



## OTHERS?



# SOUND CARD MODEMS

## AGW Packet Engine Pro

<http://www.sv2agw.com/ham/pepro.htm>

Multi-Port, Multi-TNC w/shared access

Defined the "AGW" program interface

AGWPE free version

## UZ7HO's SoundModem

<http://uz7.ho.ua/packetradio.htm>

Dual Port

Mutli-Speed

Local monitor w/Waterfall

AGW-like TCP/IP interface

## DireWolf:

DECODED INFORMATION FROM RADIO  
EMISSIONS FOR WINDOWS OR LINUX FANS

<https://github.com/wb2osz/direwolf>

"Decoded Information from Radio  
Emissions for Windows Or Linux Fans"

Local monitor

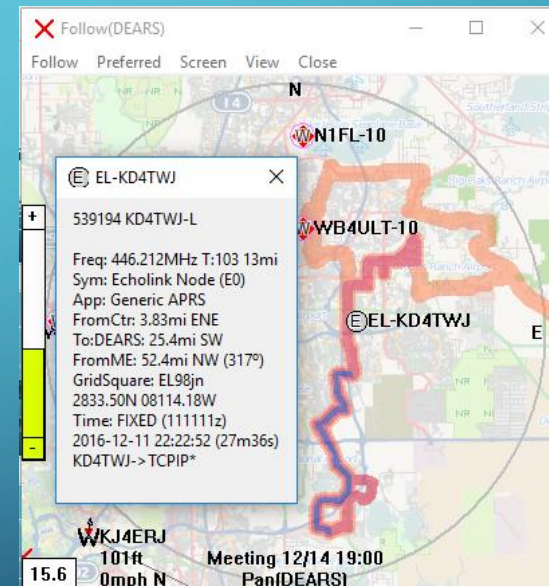
Digipeater, APRStt gateway, IGate

Virtual TNC for APRS clients

Multiple concurrent decoders w/offsets

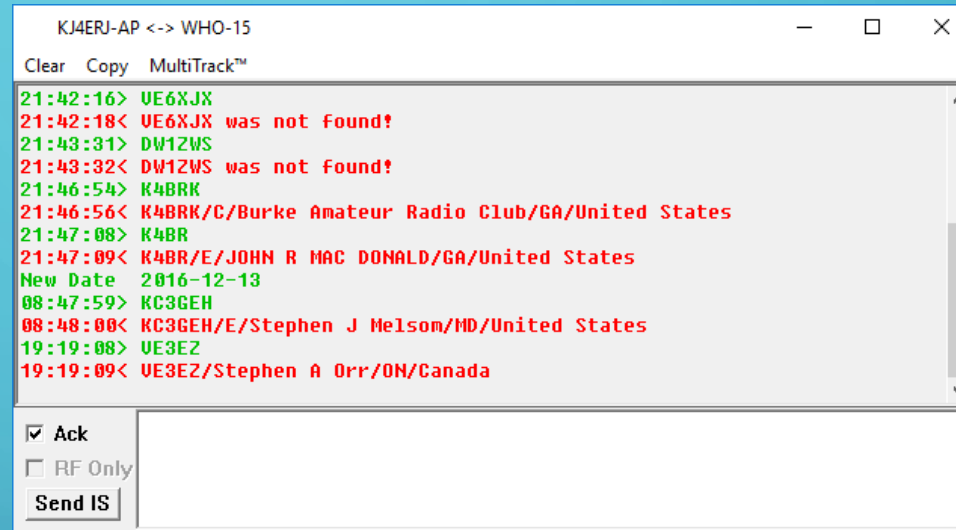
# APRS USES

- Tracking – Reduce voice traffic in public service events
  - Provide remote direction assistance
    - Off-roading in compound
    - Road-tripping to Dayton
    - Causing concern when out of range!
  - Meet spouse for dinner!
- Local Information Initiative
  - <http://www.aprs.org/localinfo.html>



# APRS USES

- Text Messaging
- Information Services
  - QRZ
  - WHO-IS/WHO-15
  - SATSRV - <http://aprsisce.wikidot.com/doc:satsrv>
- Satellite Tracking – ISS & PSAT objects w/footprints!

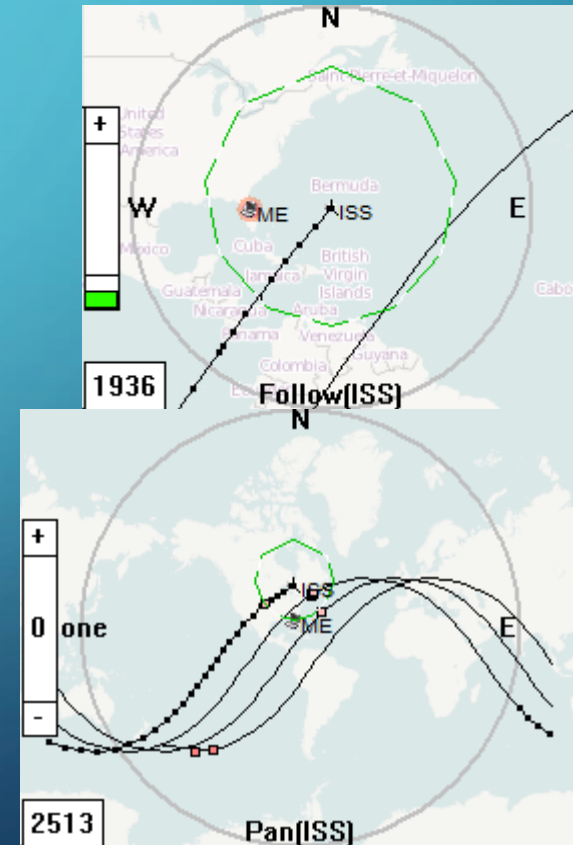


```
KJ4ERJ-AP <-> WHO-15
Clear Copy MultiTrack™
21:42:16> VE6XJX
21:42:18< VE6XJX was not found!
21:43:31> DW1ZWS
21:43:32< DW1ZWS was not found!
21:46:54> K4BRK
21:46:56< K4BRK/C/Burke Amateur Radio Club/GA/United States
21:47:08> K4BR
21:47:09< K4BR/E/JOHN R MAC DONALD/GA/United States
New Date 2016-12-13
08:47:59> KC3GEH
08:48:00< KC3GEH/E/Stephen J Melson/MD/United States
19:19:08> VE3EZ
19:19:09< VE3EZ/Stephen A Orr/ON/Canada

 Ack
 RF Only
Send IS
```

# ISS WITH FOOTPRINT

11:25:19 New Chat Between KJ4ERJ-AL and ISS on 2016-12-14  
11:25:20> x  
11:25:20< SE^17 SE^18 ENE LOS 5m11s (\*2-11:25:20)  
11:25:35> KJ4ERJ-12  
11:25:35< SE^15 SE^15 ENE LOS 4m47s @ KJ4ERJ-12 (\*2-11:25:35)  
11:29:00> Y  
11:29:00< ENE^5 ENE LOS 1m22s (\*2-11:29:00)  
11:29:08> KJ4ERJ-12  
11:29:08< ENE^4 ENE LOS 1m14s @ KJ4ERJ-12 (\*2-11:29:08)  
11:30:14> z  
11:30:15< ENE^0 ENE LOS 7s (\*2-11:30:15)  
11:30:22> x  
11:30:22< ENE^0 ENE LOS NOW! (\*2-11:30:22)  
11:30:29> t  
11:30:29< AOS 1h26m (1756z) NW^28 (\*2-11:30:29)  
14:42:52> u  
14:42:53< AOS 4h47m (15 0030z) NE^12 (\*2-14:42:53)



# APRS USES

- Contact/Announcement Services
  - CQSRVR/ANSRVR
    - <http://www.aprs-is.net/cqsrvr.aspx>
    - <http://aprsisce.wikidot.com/doc:ansrvr>
  - EMAIL-2 - <http://www.aprs-is.net/email.aspx>
  - Or just watch your APRS radio screen and QSY directly!
    - <http://www.aprs.org/info/freqspec.txt>
- National Weather Service alerts & locations
- Remote System Control via Authenticated Messaging

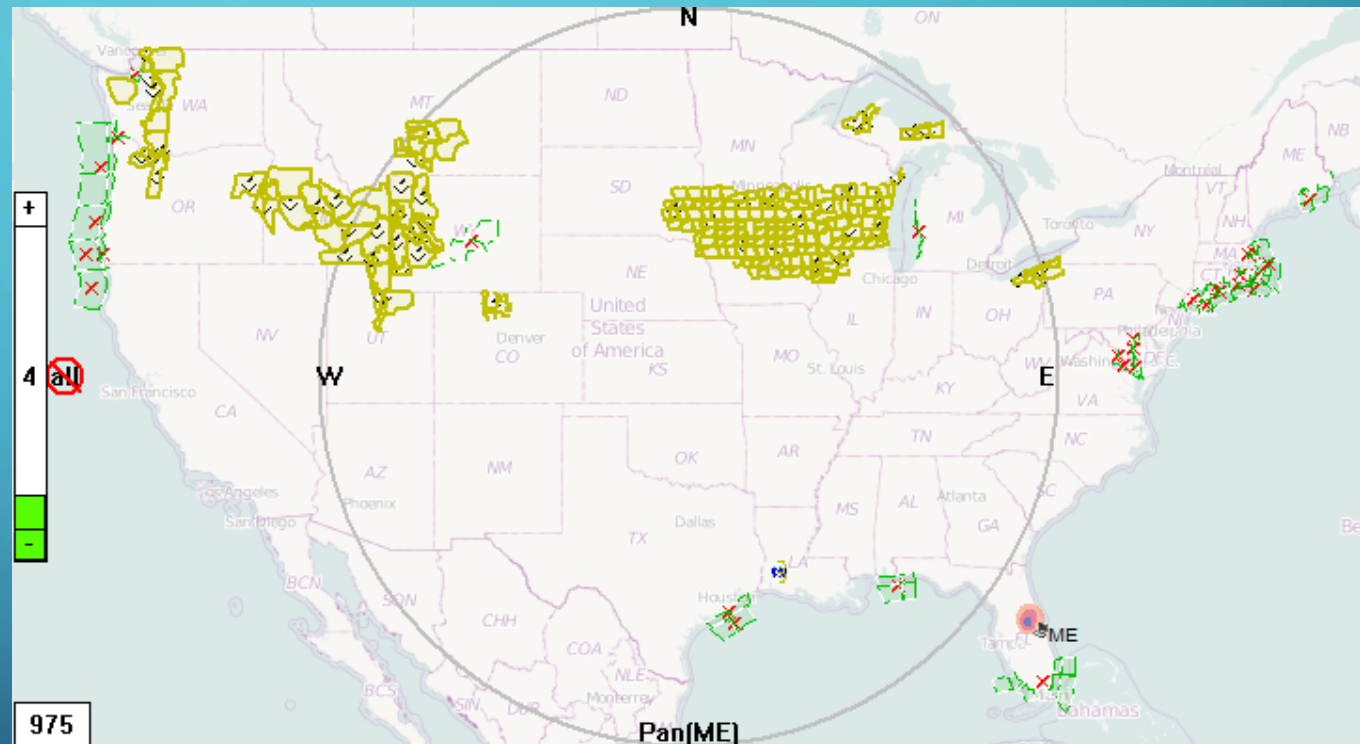
# NWS WEATHER ALERTS

- Weather on 12/9/2016

BOUWSWa8u via WE7U-WX

NWS-WARN WINTER\_WEATHER  
Winter Storm Warning  
Multi: 32/3464 Points 2 Parts  
Source: COZ31-33  
Issued: 09 16:53z  
Expire: 10 00:00z (5h27m)  
Duration: 7h07m

Sym: Snow Shwr (\G)  
App: Generic APRS  
FromCtr: 522mi WNW  
FromME: 1690mi NW (307°)  
GridSquare: DN60un92ap  
4033.1665N 10615.4908W  
2016-12-09 16:53:30 (1h39m)  
BOUWSW->



975

Pan[ME]

# NWS WARNINGS (POTENTIALLY LIFE THREATENING)

From [http://wa8lmf.net/aprs/get\\_nws\\_shapefiles.htm](http://wa8lmf.net/aprs/get_nws_shapefiles.htm)

- As of mid-July 2009, the original **WXSVR** that injected the NWS alerts into the APRS Internet System to make the NWS shape file feature work shut down. A replacement server, **AE5PL-WX**, is now online providing this service. Shapes and symbols for severe weather **WARNINGS** should appear on maps just as before, however the operator of the new weather server has opted to vastly reduce the volume of traffic inserted into the APRS Internet System. This is to reduce the local radio channel congestion when these bulletins are retransmitted on RF. AE5PL-WX only transmits **WARNINGS** (severe weather actually in progress) but not the **ALERTS** and **WATCHES** sent by the old server.
- As a result, you will never see the yellow **ALERT** areas and orange **WATCH** areas that formerly appeared on UI-View maps. Only the far less numerous red **WARNING** shapes will appear, and for shorter periods of time.

# NWS WATCHES

From [http://wa8lmf.net/aprs/get\\_nws\\_shapefiles.htm](http://wa8lmf.net/aprs/get_nws_shapefiles.htm)

- **UPDATE AS OF SPRING 2011:** Another source of the NWS alerts, that duplicates the full feed of the original WXSVR is now available. "FireNet" is a separate server system operating in parallel with the standard APRS-IS. It provides the full APRS-IS feed, plus hundreds of other objects of interest to SAR groups, disaster incident commanders, EOC managers and others. FireNet includes earthquake epicenters, forest fires, stream and river water gauges, and the full NWS weather feed.

Just insert **firenet.us** port **14580** into your APRS software server login setup, instead of a "normal" APRS server. In Ulview, this would be added to the APRS server list in the "APRS Server Setup" dialog by using the keyboard "Ins" (Insert) key and entering **firenet.us:14580** and then checking the box to enable the new entry.. The standard port 14580 **user-defined filter commands** work on FireNet . More details on FireNet are here: <http://info.aprs.net/index.php/FireNet>

- **Ed Note:** firenet.us should **NOT** be used on an IGate as the primary APRS-IS connection!
- Enough with the details already!
- How do I get started to use APRS?

# GETTING STARTED

- CALLSIGN-SSID
- SSID Recommendations
- Path Recommendations

# STATION IDs – CALLSIGN-SSID

- Up to 6 Character Call Sign
- 2 (Alpha)Numeric –SSID
  - -00 should be expressed as just CALLSIGN
  - -00 through -15 inclusive required for RF (AX.25) usage
  - -XX or Anything goes on the APRS-IS (or non-AX.25 RF)
  - Yaesu APRS Radios cannot message with non-AX.25 –SSIDs
- Each concurrently operating “thing” needs a unique –SSID!
  - No matter if hardware or software or anything in between

# -SSID RECOMMENDATIONS

|    |                                                             |
|----|-------------------------------------------------------------|
| -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 networks (Dstar, Iphones, Androids, Blackberry's etc) |
| -6 | Special activity, Satellite ops, camping or 6 meters, etc   |
| -7 | Walkie talkies, HT's or other human portable                |

|     |                                                                  |
|-----|------------------------------------------------------------------|
| -8  | Boats, sailboats, RV's or second main mobile                     |
| -9  | Primary Mobile (usually message capable)                         |
| -10 | Internet, I gates, echolink, winlink, AVRS, APRN, etc            |
| -11 | Balloons, aircraft, spacecraft, etc                              |
| -12 | APRS <sup>tt</sup> , 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                |

# ADDITIONAL -SSIDS

- INTERNET-ONLY Recommendations
- Some APRS-IS Servers don't pass SSIDs > 2 characters
  - javAPRSSrvr per Pete Lovell, AE5PL

|        |                                           |
|--------|-------------------------------------------|
| -63    | PSK63 HF stations                         |
| -tt    | APRS TouchTone users (DTMF)               |
| -ID    | RFID                                      |
| - A- Z | D-Star (That's <space>A through <space>Z) |

# KJ4ERJ-\*

- AX.25 Compatible

- -0 APRSISCE/32 Version Monitor
- -1 APRSIS32 IGate (w/-7)
- -7 OT2m w/HT
- -11 D700 Mobile
- -12 APRSISMO on Cell Phone
- -14 APRSISMO IGate (w/TH-D74)
- -15 APRSIS32 ANSRVR/SATSRVR  
ISS/PSAT Object injector

- APRS-IS Stations

- -AP APRSIS32 Usage Monitor
- -AL APRSIS32 Full Feed
- -TS APRSISMO Test Instance
- -LS Lightning Strike Object injector
- -TD The Energy Detective
- -F1 APRSISMO on FreedomPop Phone
- -E1/E2/E3/E4 ESP8266 IoT Instances
- S1 ESP8266 Server Remote Reset
- -HW/MB HotWater/MasterBath!

# PATHS AND ALIASES

- Service request for digipeaters
- Between Src>Dst and :Payload
- Can be empty for simplex only!
- NOGATE or RFONLY
- TCPIP\* or TCPXX\* (obsolete)
- RELAY,WIDE – Obsolete
- WIDEn-N (New Paradigm)
  - WIDE1-1,WIDE2-1
  - WIDE1-1,WIDE2-2
  - WIDE2-1
- SSn-N (State-wide Coverage)
- HOP7-7
- Explicit CALLSIGN-SSID

# KJ4ERJ-AUTHORED APRS CLIENTS

- APRSISCE/32 – Windows and Windows Mobile Client (APWWxx APWMxx)
- APRSISMO – Android MOAI Client (APWAxx)
- ESP8266 NodeMCU/Lua (APZESP)
- When all you have is a hammer...

# APRS EXPERIMENTAL – APZXXX

- APZTED – The Energy Detective – KJ4ERJ-TD
- APZLUA – ESP8266 – KJ4ERJ-E\*, KJ4ERJ-S1, KJ4ERJ-HP
- APZMOW – KJ4ERJ-RB

# APRSISMO (currently)

- MOAI Cross-platform development environment
  - Android – KJ4ERJ-12
  - Windows – KJ4ERJ-LS, KJ4ERJ-TS
  - Linux (untested)
  - iOS (untested)
- Coded in Lua, a scripting language
- <http://tinyurl.com/Get-APRSISMO>



100% 10:31 PM

**KJ4ERJ-12(349)(75)**

19+13=32MB(88/952MB) 58fps 1(172)=73%  
 MOBILE 1 Packets in 0.32ms(0.04+0.26) Idle 0  
 Commands Complete

QSOs

0.7

KJ4UJW-1

WD4WDW-B

N1WDW-B

ME4ERJ-11

DEARS

Zoom:11

true GPS 28 21.827N 081 30.695W -8m 0.6@139 7  
 true 0.44  
 0:00:00. Time 0:24:05 11.3mi

100% 10:31 PM

**APRSISMO 20161209 07:10**

21+14=35MB(93/952MB) 58fps 1(131)=61%  
 MOBILE 1 Packets in 0.58ms(0.04+0.53) Idle 0  
 Commands Complete

Config Debug

Pulse

KJ4UJW-1

WD4WDW-B

N1WDW-B

Xmit ME ISS-11

DEARS

ME

BT!

Labels Temps

GPS Syslog

Dim Radar

2x 3x 6x 3

100 75 50 25

All One

true GPS 28 21.825N 081 30.697W -9m 0.07  
 true 0.4  
 0:00:00. Time 0:23:59 5.64mi

90% 10:49 PM

**APRS QSOs**

Back Refresh

Active QSOs

New

ME<>JO4GDA (1 msg)

ME<>KJ4DXK-AC (12 msgs 9 NEW!)

ME<>KJ4ERJ (1 msg 1 NEW!)

Back Refresh

2016-12-13 22:32:25 06)=22:32:27

**KJ4ERJ**

M5)06=22:32:27 22:32:27

**KJ4ERJ/E/Lynn W Deffenbaugh/FL/United States**

22:49:09 07)=22:49:10+22:49:10(3)

**f wd4wdw**

M6)07=22:49:10 22:49:10

**WD4WDW:DISNEY EMERGENCY AMATEUR RADIO SERVICE/C**

M7)07=22:49:10

**WD4WDW:PO BOX 690905**

M8)07=22:49:10

**WD4WDW:Orlando, FL United States**

Back Compose Refresh

ME<>WHO-15 (2 msgs 1 NEW!)

ANSRVR (Announcements) New

ME<>ANSRVR:APRSISCE (2 msgs)

Saved QSOs (Future)

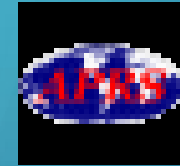
Back Refresh

# QUESTIONS?

- There's no such thing as a stupid question unless you've asked it before and are expecting a different answer.

# A QUESTION FOR YOU! NAMING CHALLENGE...

- APRSISMO
- APRSISDR/WN/LX/IO depending on platform
- lynxa or LynXA
- lynxac or LynXAC
- aprslync or aprslynx
- Hydra



# THANK YOU!