Automatic Packet Reporting System

CVARC

January, 17 2013

APRS Description

Automatic Packet Reporting System (APRS)

- APRS is a radio-based system of real time tactical data using the internet
- The data includes messages, alerts, announcements and bulletins to give situational awareness
- The display used is a map, which captures objects (that have GPS) and weather stations, alerts and activities

APRS Description

APRS in not a vehicle tracking system

But it is the most used function

History

- APRS was developed in the late 1980s by Bob Bruninga, WB6APR, He maintains the APRS website
- The acronym "APRS" was derived from his callsign

History

???????

History

- Bruninga developed a private duck locating system into the Connectionless Emergency Traffic System (CETS) used in a series of FEMA exercises
- In the early 1990s, CETS, became the Automatic Position Reporting System (APRS), and continued to evolve
- As GPS technology became widely available, 'Position' was replaced with 'Packet' to describe the more generic capabilities of the system

Functionality

- **Immediate local digital and graphical information exchange between all participants in a local area or event. This includes:**
  - Real time positions of all stations and objects
  - Status of all stations
  - Messages, Bulletins and Announcements (test and short e-mail)
  - Weather forecast 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 Freqs, IRLP, ECHOlink, Winlink, Nets, Meetings

Functionality

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

New Functionality

- **Global Email** - **Universal Text Messaging** (any device)
- **CQSRVR (Global APRS CQ's)**
- **APRStt (APRS touchtone) – APRS for Every Radio**
  - Simple DTMF memory for your Callsign – One Button Send
  - APRStt receiver converts to APRS Position, Time, Frequency and Status!
  - On IRLP nodes, Echolink nodes, some repeaters, anywhere on 146.58

New Functionality

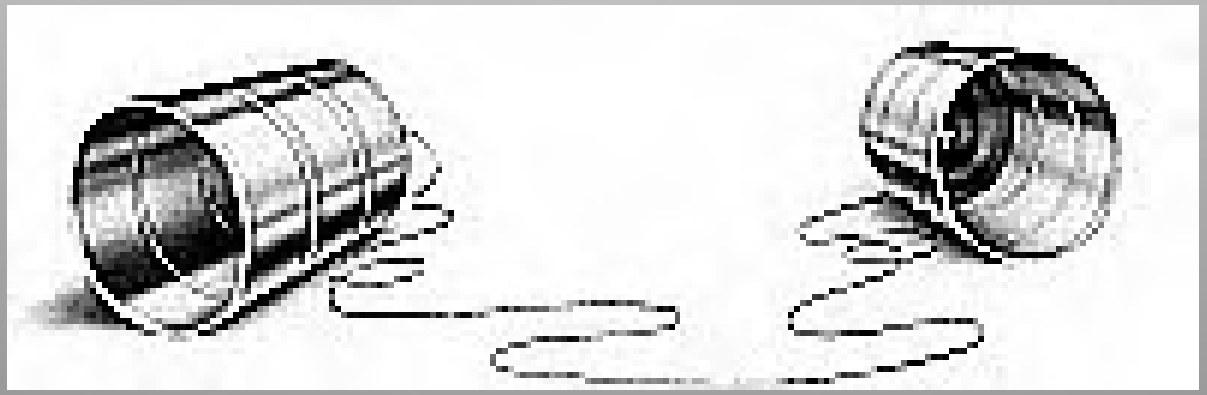
- **AVRS (Automatic Voice Relay System) Global Callsign-to-callsign VOIP**
  - Uses APRS message to set up call – it knows where you and callee are
  - Automatically links to Echolink or IRLP for nearest nod- sends to APRS
  - APRS Radio auto-QSY's to make link (= Ham Radio Cell phone from Mobile) (90% D710)
- **AI-FI** (APRS WIFI) in every laptop
  - OLPC message client (APRS-XO) and XASTIR (50% …)
  - Other Systems (View on OpenAPRS, APRS-fi, FINDU)
- **APRS RFID for ARRL name tags (event locating)**

Additional Functionality

The APRS protocol has been adapted and extended to support additional projects, including:

- APRS FireNet uses the APRS protocol and the same client software to provide fire fighting, earthquake, and weather information in higher volume and detail than the traditional APRS system is capable of carrying
- PropNET uses the APRS protocol over AX.25 and PSK31 to study radio frequency propagation. PropNET 'probes' transmit position reports, along with information on transmitter power, elevation, and antenna gain, at various frequencies to allow monitoring stations to detect changes in propagation conditions
- APRS-RFID is now being used to locate personnel in emergency situations or on a public service event – uses a APRS HotSpot reader

TECHNOLOGY



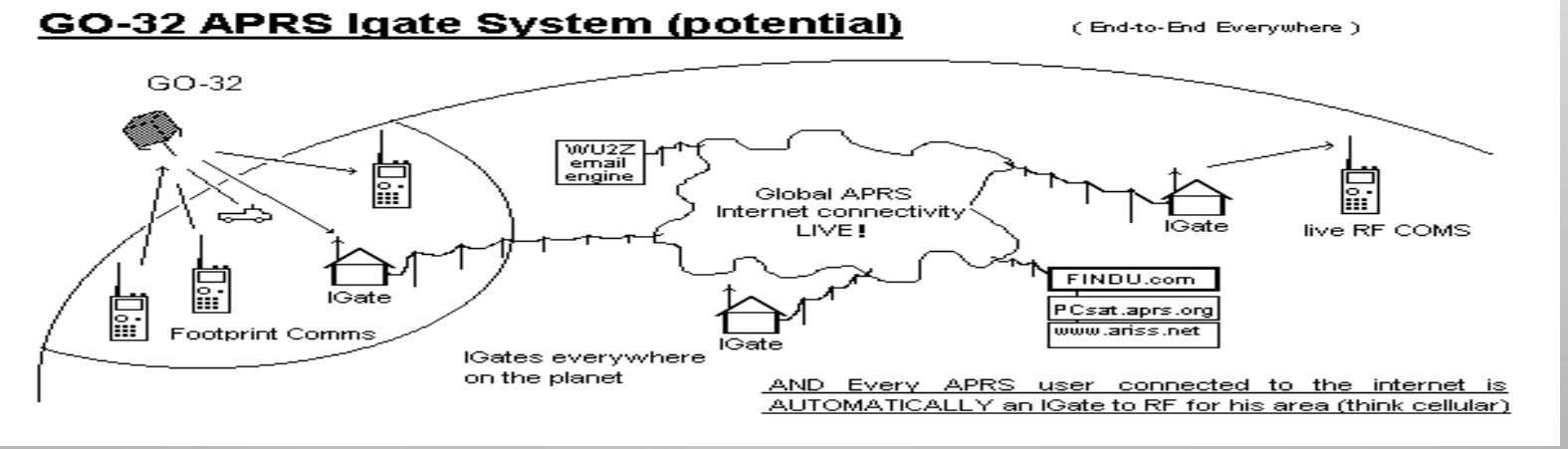
Network

- APRS is transported over the AX.25 protocol on 2 meters
- In North America the frequency is 144.390 Mhz
- The digipeater network provides the transport (every 30 m)
- Internet gateway stations (IGates) connect the on-air APRS network to the APRS Internet System (APRS-IS). There are 1500 throughout the world. Not all information is passed and available to other than local stations
- The APRS-IS system allows web-based access to the data

Digipeaters

- Packets are transmitted through repeaters, called digipeaters, to all stations on the same radio channel
- At each digipeater, the packet path is changed. The packet will only be repeated through a certain number of digipeaters -or hops- depending upon the "PATH" setting. Digipeaters keep track of the packets they forward to prevent packets from ending up in endless loops
- Packets are heard by an APRS Internet Gateway (Igate) and routed on to the Internet APRS backbone for display or analysis by other users connected to an APRS-IS server, or on a website
- Packets are transmitted (broadcast) to everyone, and multiplied many times over by each digipeater. All digipeaters and stations in range get a copy, and then proceed to broadcast it to all other digipeaters and stations within their range

APRS IGates (Global APRS)



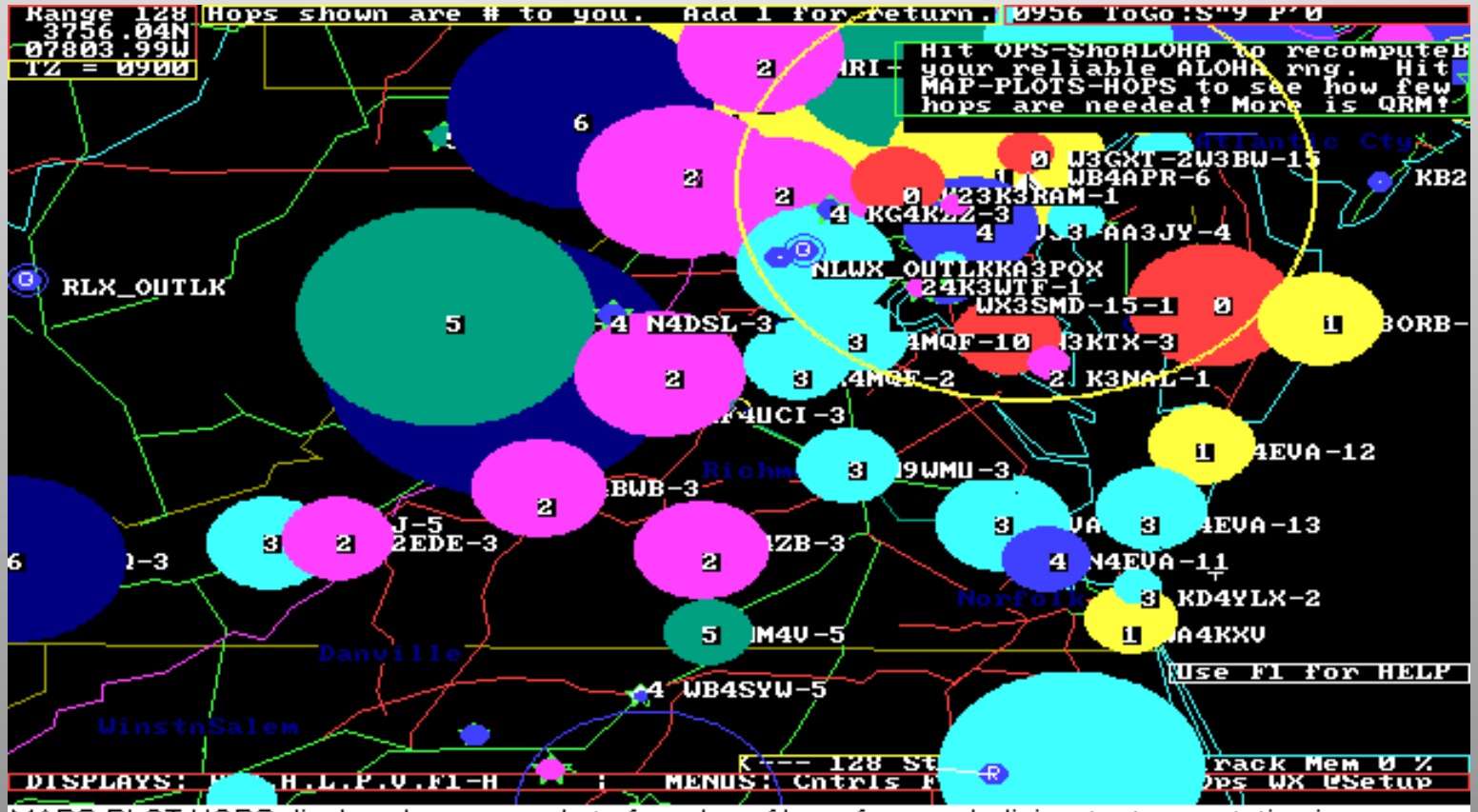
- An IGATE is a local APRS station that utilizes the APRS-Internet network to pass all packets heard on their local RF back to the Internet
- Also act as two-way gateways for ALL APRS MESSAGES worldwide (Internet ⇔ RF)

Network

- APRS is a random network based on random transmissions of data among many users trying to share a channel. This technique was well studied back in the 60's and is called an ALOHA network for where it was first developed at the University of Hawaii. It is the basis for most data networks which evolved into what we know of as the ARPANET and now the INTERNET and other protocols
- Basically the channel must be quiet most of the time, so that a sender will have a good chance of a successful transmission. By adding more users, eventually you get to the point that adding more users only adds more collisions, and the net reliability goes down drastically. . If you add up the statistical load of about 60 or so APRS users, their packets equal a 100% busy channel.If your digi hears too much then its reliability for local users is poor
- In this context, LOWER is BETTER (just like CELL phones have grown, by going to smaller and smaller cells

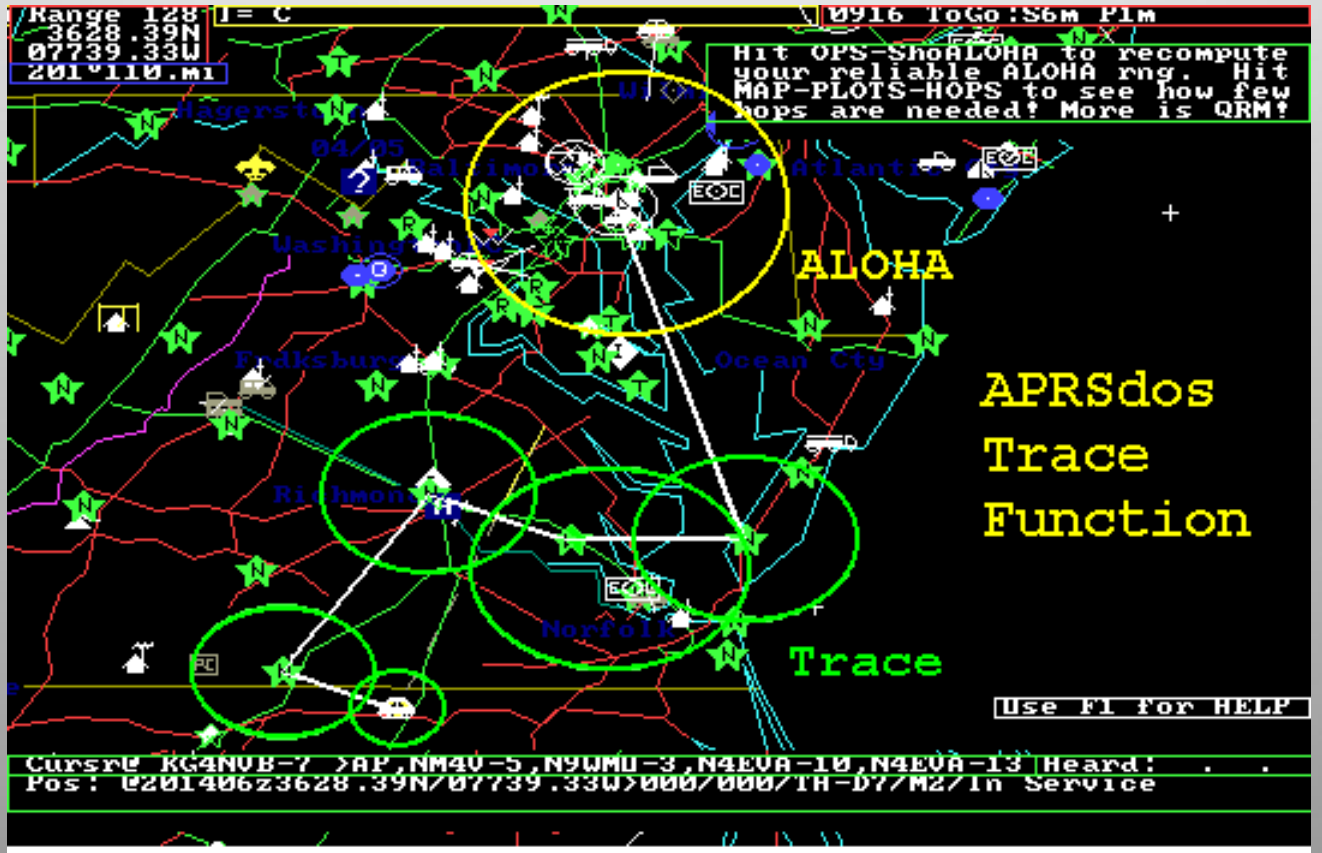
APRS (ALOHA circle and digipeater hops)

[Your ALOHA circle is your 100% saturated channel range]



MAPS-PLOT-HOPS display shows snapshot of number of hops from each digipeater to my station in Baltimore (at center of my ALOHA circle). Data is plotted from last-packet-received, so needs to be observed several times to average out circuitous packets and lucky shots.

APRS Range circles and Path tracing



The TRACE function shows the path through the digipeaters it took to get to your station. This is a 5 hop mobile well outside of my ALOHA circle that got a lucky hop over water up the Bay from Norfolk to Baltimore. The fixed PHG RF range of each digi is also shown

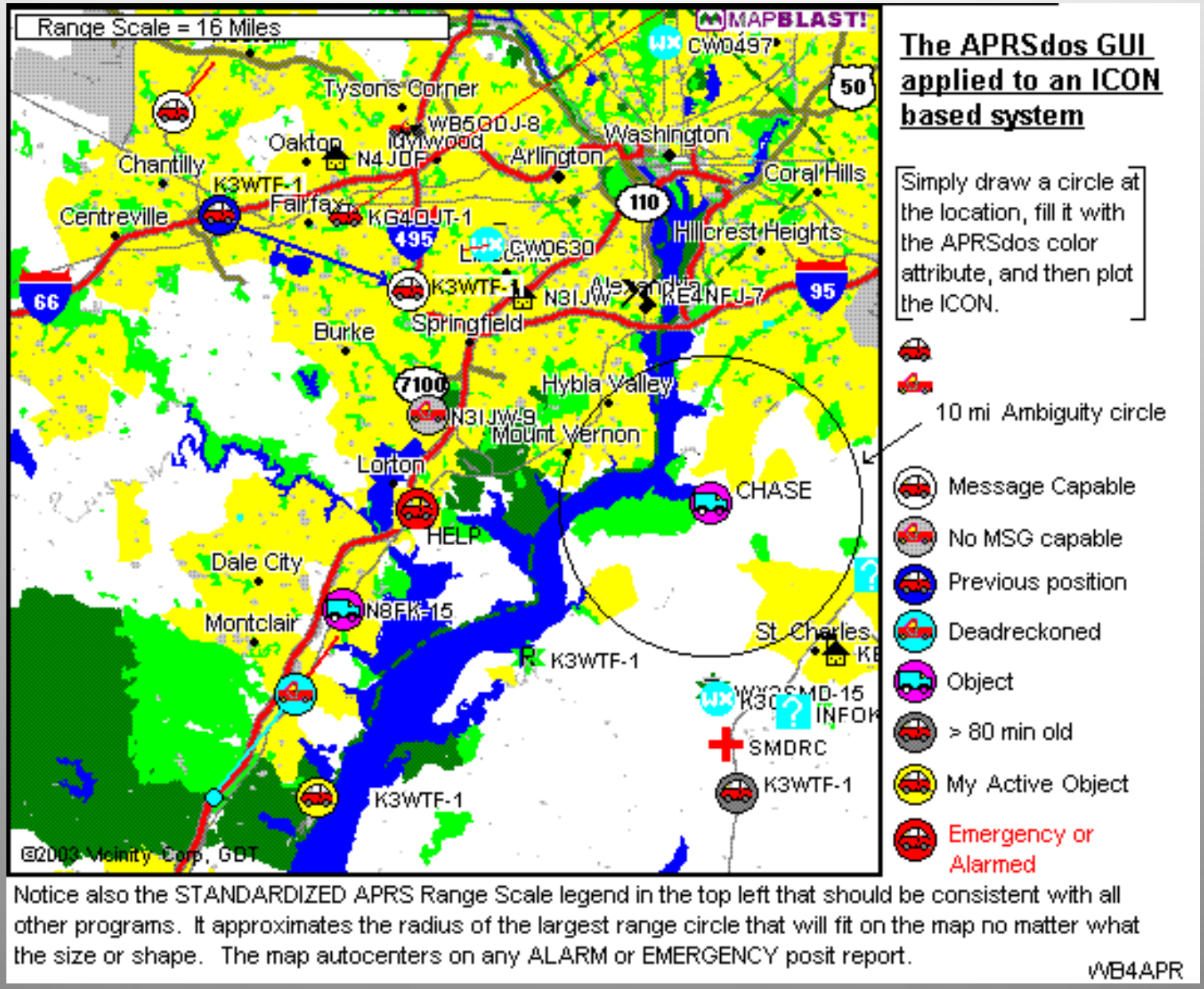
Packet Types

APRS contains only four packet types:

- Position/objects
  - The latitude and longitude, and a symbol to be displayed on the map
  - Optional fields for altitude, course, speed, radiated power, antenna height above average terrain, antenna gain, and voice operating frequency
- Status
- Messages
- Queries

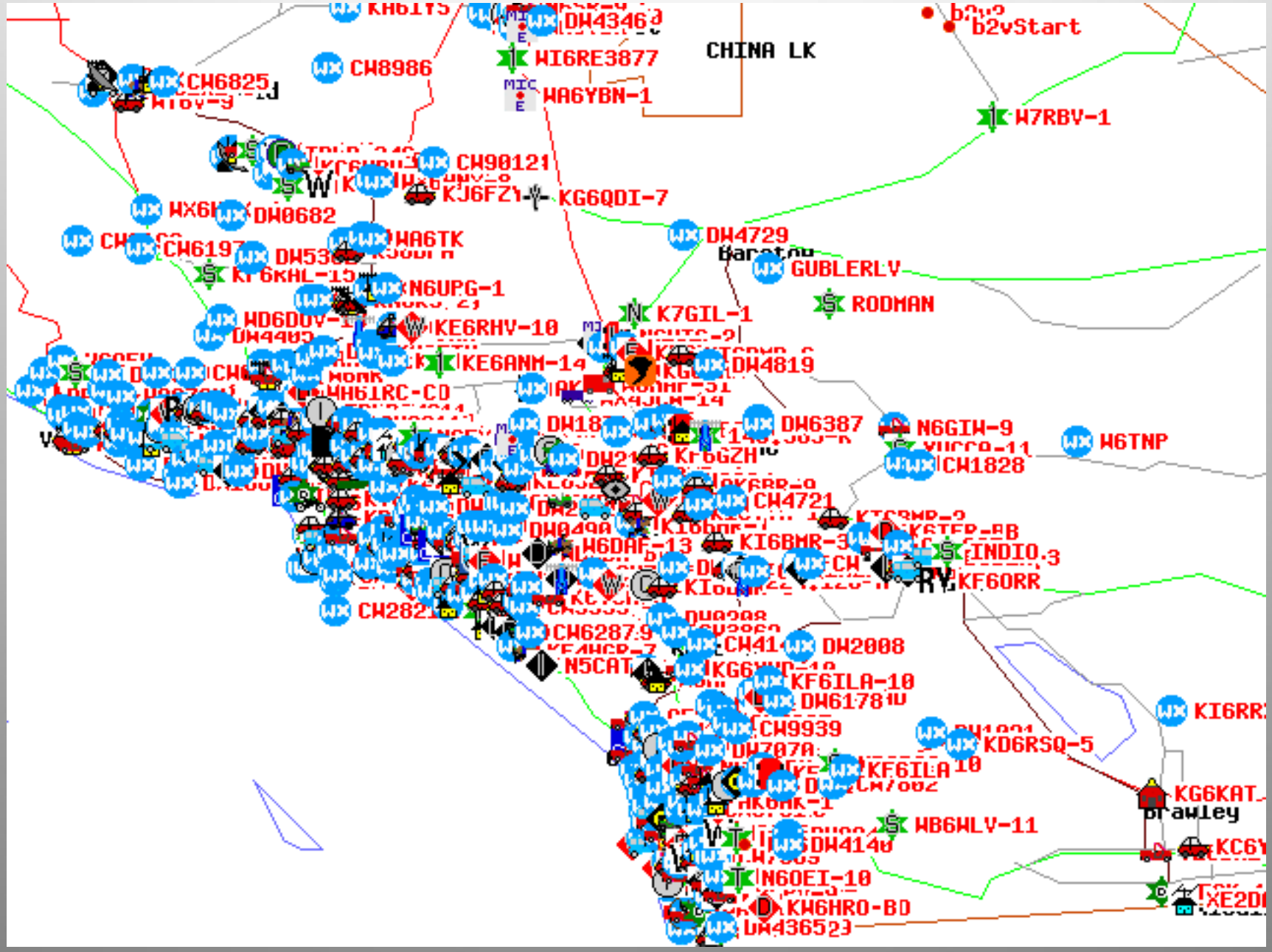
APRS Display

- The map display fields to plot the communication range of all participants and facilitate the ability to contact users
- Each position/object packet can use any of several hundred different symbols. And can contain weather information
- Each symbol on an APRS map can display many attributes discriminated either by color or other technique
- These attributes are:Moving (thru GPS) or fixed Dead-Reckoned (thru SW) positions or oldMessage capable or notStation or objectOwn object or other station objectEmergency, priority, etc.



Notice also the STANDARDIZED APRS Range Scale legend in the top left that should be consistent with all other programs. It approximates the radius of the largest range circle that will fit on the map no matter what the size or shape. The map autocenters on any ALARM or EMERGENCY posit report.

WB4APR


CHINA LK
b2vStart
WI6RE3877
WA6YBN-1
W7RBV-1
CW8986
CW6825
CW90121
KG6QDI-7
DW0682
WA6TK
CW6197
N6UPG-1
DW4729
GUBLERLV
RODMAN
K7GIL-1
KE6RHV-10
KE6ANM-14
DW4819
DW6387
N6GIW-9
W6TNP
CW1828
CW4721
KI6BMR-3
INDIO,3
KF6ORR
W6DAF-13
CW2821
CW6287.9
N5CAT
CW41
DW2008
KF6ILA-10
CW9939
KD6RSQ-5
KG6KAT
WB6WLV-11
DW4140
N6OEI-10
KW6HRO-BD
DW4365.23

End Device Equipment

- APRS client equipment consists of a variety of Terminal Node Controller (TNC) equipment which includes soundcards interfacing a radio to a computer
- “Smart" TNCs can prevent redundant packet repeating within the network. Reporting stations use a method of routing called a "path" to broadcast the information through a network

Equipment Availability

Radios which include a built-in AX.25 Terminal Node Controller and APRS software, and are capable of working with or without the need for an external GPS device include:

- Kenwood TM-D700A and its replacement, the Kenwood TM-D710A. The handheld Kenwood TH-D7A(G)and its replacement, the Kenwood TH-D72
- Yaesu has recently entered the APRS market with their VX-8R(G) handheld and FTM-350R mobile radio

More Information

- See www.aprs.org
- View various Iphone Aps