Pinellas ACS Training Introduction to APRS

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APRS is a registered trademark Bob Bruninga, WB4APR



Agenda



- Introduction
- APRS Capabilities
- APRS Architecture
- APRS Radio Configuration







Automatic *Packet* Reporting System

- Created by Bob Bruninga, W4APR (Silent Key)
- APRS is a real-time tactical digital communications protocol for exchanging information between a large number of stations covering a large (local) area.
 - Situational awareness and two-way information exchange
- A multi-user data network based on AX.25 packet radio specification
 - Simplex operation US and Canada: 144.390 MHz
 - Messages are broadcast sending station does not know if anyone heard the message
 - Does *not* implement Forward Error Correction (FEC) or Automatic Repeat Requests (ARQ)

Messages with detected errors are thrown away







Automatic *Packet* Reporting System

- APRS implements a wide array of capabilities in two broad categories
 - RF capabilities and protocols
 - Internet capabilities and protocols
- This presentation will focus on the RF capacities and protocols



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APRS Capabilities – Position Reports





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APRS Capabilities – Position Reports







APRS Capabilities – Weather Reports















APRS Capabilities – Text Messages



One to Many - Msg Groups PinCoACS



W7WMS-9



APRS Capabilities – General Bulletins







APRS Capabilities – Queries





- Request for information from a remote APRS station.
- Two Types Defined in APRS Specification.
 - General and *Direct*
 - Only Direct Queries (Station-to-Station) appear to be implemented.
- Receiving station:
 - Upon receipt, <u>No</u> acknowledgement sent.
 - If station holds the requested information, it will automatically send the data to the requesting station.
 - If the station does not recognize the query or does not have the requested information, it will not respond.





APRS Capabilities – Queries





| Туре | Query | Response |
|--------|---|---|
| ?APRS? | General — All stations query | Station's position and status |
| ?APRSD | Directed — Query an individual station for stations heard direct | List of stations heard direct |
| ?APRSH | Directed — Query if an individual station has heard a particular station | Position of heard station as an APRS Object, plus heard statistics for the last 8 hours |
| ?APRSM | Directed — Query an individual station for outstanding unacknowledged or undelivered messages | All outstanding messages for the querying station |
| ?APRSO | Directed — Query an individual station for its Objects | Station's Objects |
| ?APRSP | Directed — Query an individual station for its position | Station's position (Beacon) |
| ?APRSS | Directed — Query an individual station for its status | Station's status |
| ?APRST | Directed — Query an individual station for a trace (i.e., path by which the packet was heard) | Respond with the path over which the request was heard |
| ?IGATE | General — Query all Internet Gateways | IGate station capabilities |
| ?WX | General — Query all weather stations | Weather report (and the station's position if it is not included in the Weather Report) |

Note: Query types in Red implemented in TH-D74A

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WA1RYQ-7

Msg Groups: CQ, QST, NWS, PinCoACS



APRS Capabilities – Objects



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W4







- Create Initial DF Report
 - Create an DF object DF
 - DF Report Contents
 - Bearing
 - Quality
 - Beamwidth: 1°< up to 240°<
 - Range
 - Based on map scale







- Create Initial DF Report
 - Create an DF object
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Fix



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APRS Architecture System Architecture





- Hand Held Transceiver

ΗT





APRS Architecture AX.25 Packet Frame Format



Maximum Length – 332 Bytes (2,656 Bits)

| | AX.25 UI-FRAME FORMAT | | | | | | | | | |
|--------|-----------------------|------------------------|-------------------|----------------------------------|--------------------------|----------------|-------------------|----------------|--------|--|
| | Flag | Destination Address | Source Address | Digipeater Addresses (0-8) | Control Field (UI) | Protocol ID | INFORMATION FIELD | FCS | Flag | |
| Bytes: | 1 | 7 | 7 | 0–56 | 1 | 1 | 1–256 | 2 | 1 | |
| | 1 | | | | | ,) ↑ | | Î | Î | |
| | Start of | | | | Contro | ol Fields | | | End of | |
| | Frame | | | | (Fi> | ked) | | | Frame | |
| | | | | | | | c | Frame Check | | |



APRS Architecture AX.25 Packet Frame Format



Maximum Length – 332 Bytes (2,656 Bits)





APRS Architecture AX.25 Packet Frame Format – APRS



Maximum Length – 332 Bytes (2,656 Bits)

| | AX.25 UI-FRAME FORMAT | | | | | | | |
|--------|-----------------------|------------------------|-------------------|----------------------------------|--|-------------------|--|--|
| | | Destination Address | Source Address | Digipeater Addresses (0-8) | | INFORMATION FIELD | | |
| Bytes: | | 7 | 7 | 0–56 | | 1–256 | | |

•

SSID Recommendations

<u>Source Address</u> — This field contains the callsign and Secondary Station Identifier (SSID) of the transmitting station.

- -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, Igates, 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



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| s: | | 7 | 7 | 0–56 | | 1–256 | | | | |

Bytes

Question: What is the destination call sign of an APRS message?

Answer: APRS does not use the destination address for packet routing.

Destination Address field is repurposed as a data field



APRS Architecture AX.25 Packet Frame Format – APRS



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Question: How does APRS know the digipeater call signs within an area?

APRS Architecture Digipeaters

APRS Architecture Digipeaters

APRS Architecture Digipeaters

Question: How many digipeaters will retransmit this message?

Result: CONGESTION

- APRS is a simplex network
- Single APRS Beacon transmitted 6 times

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Basic Settings

• User call sign and SSID

SSID Recommendations

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Basic Settings

- User call sign and SSID
- APRS Icon

Basic Settings

- User call sign and SSID
- APRS Icon
- Network APRS
- Mic-E Position Comment
 - Off Duty, En Route, In Service, Returning, Special, Priority, Emergency
- Status Text
 - Up to 42 characters
 - Interval
 - Off, 1/1, 1/2, 1,4...

Do Not use EMERGENCY!

- Packet Path (Recommendations)
 - HT and mobile stations in urban areas: WIDE1-1, WIDE2-1
 - HT and mobile stations in rural areas: WIDE1-1, WIDE2-2
 - Home Stations: WIDE2-1

- Beacon Control Method
 - Manual Beacon only send upon user command
 - PTT Sent at beginning or end of transmission. May also depend on Beacon Interval
 - Auto Beacon automatically transmitted at interval selected
 - Decay algorithm setting may change interval
 - SmartBeaconing This option optimized beacon transmission based on driving direction and speed.
 - Overrides beacon interval, decay algorithm and proportional path settings.

- Beacon Interval
 - Interval for automatically transmitting APRS packets
 - Radio dependent
 - Kenwood TH-D74A: Range 0.2 seconds to 60 minutes
- Decay Algorithm
 - On/Off
 - When station position data does not change, the data is transmitted based on a Decay Algorithm

- Decay Algorithm
 - Next Transmission = Double interval between transmissions until station position changes; then revert back to defined beacon interval.
 - Example:
 - Interval = 1 Minutes
 - Next Beacon 2 minutes
 - Third Beacon 4 minutes
 - Forth Beacon 8 minutes
 - Fifth Beacon 16 minutes
 - Sixth Beacon 30 minutes
 - Beacon interval remains at 30 minutes until station position changes.

Setting designed to minimize Network Congestion

- Proportional Pathing
 - On/Off
 - Does not impact transmission interval
 - Packet Path changes for each transmission
 - Initial Beacon WIDE1-1, WIDE2-1
 - Next Beacon Direct (no digipeater address included)
 - Third Beacon WIDE1-1
 - Forth Beacon WIDE1-1, WIDE2-1
 - Fifth Beacon Direct
 - Sixth Beacon WIDE1-1

Closest stations always receive beacon

