

# WHAT DOES THIS BUTTON DO?

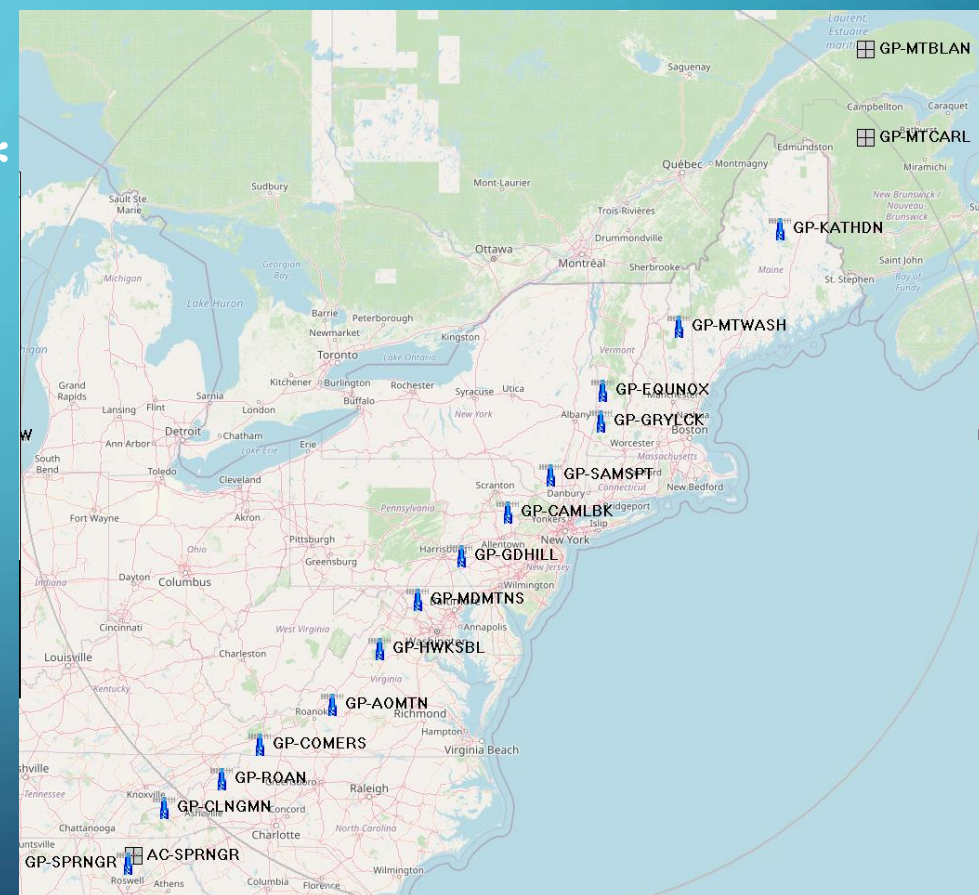
(OR WHY ATGP USES THE APRS\*  
SETTINGS THAT WE USE)

\*APRS is a registered trademark of Bob Bruninga, WB4APR

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KJ4ERJ

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# WHAT DOES THIS BUTTON DO?

- Anatomy of an APRS Packet
  - Path Selection
  - Digipeating 101+
  - ATGP Radio Settings (and WHY!)
  - ATGP Pre-Deployment Testing
  - ATGP Station Problem Diagnosis
- BUT FIRST!
    - WHO IS KJ4ERJ?
    - WHAT IS APRS?

# 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 (TestHost) on Android – August 2013

# 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)
- Useful for both emergency operations and standard day-to-day operations
- An example of highly successful integration of RF and Internet technologies

# ATGP – WHAT'S SO SPECIAL?

- Point-to-point linear line of 13 digipeaters (plus north and south endpoints)
- Alternate frequency used (144.340)
- Custom path of HOP7-7,HOP7-7
- Zig Zag across the AT, no attempt to follow along the trail
- Test and validate use of linear APRS links for emergency communications

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

# AX.25 – FOUNDATION OF APRS PACKETS

- 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<sub>(suppressed)</sub> through -15, stored in 4 bits)
  - NOT WiFi's Service Set Identifier
- Checksum, not Error Correcting – all or nothing
- Address: Destination, Source, Repeaters – aka Path (7 bytes per entry)

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

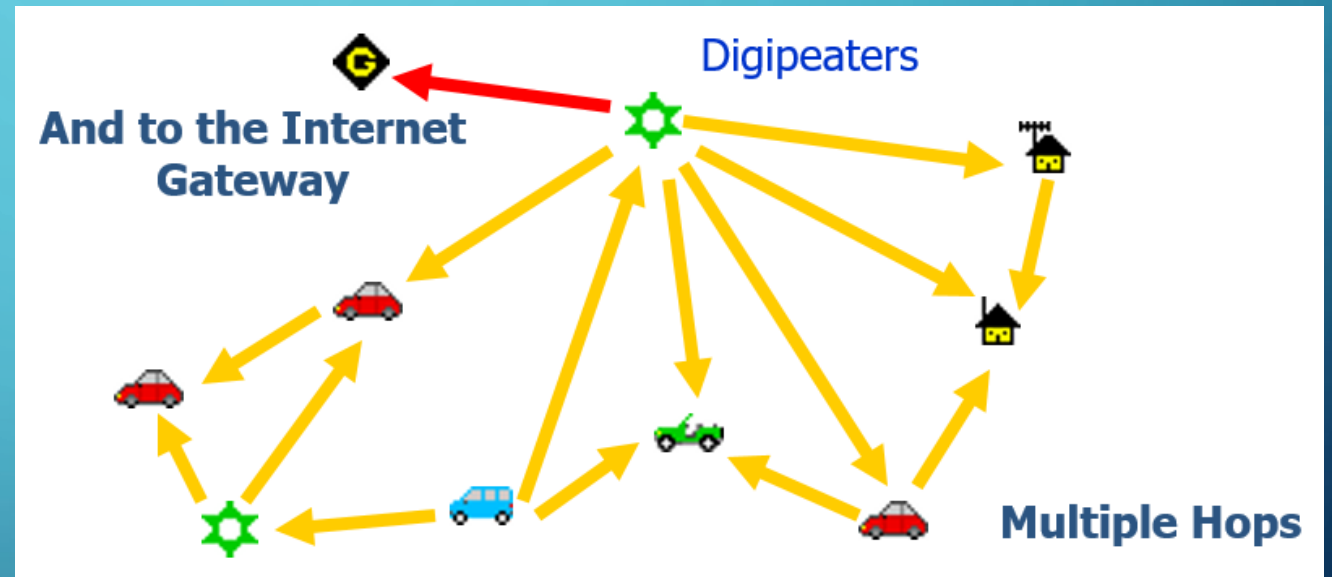
Figure 3.1b. Information frame construction.

# 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
- [https://github.com/wb2osz/direwolf/blob/dev/doc/AX25\\_plus\\_FEC\\_equals\\_FX25.pdf](https://github.com/wb2osz/direwolf/blob/dev/doc/AX25_plus_FEC_equals_FX25.pdf) - Direwolf's implementation of FX.25 wrapper for AX.25 packets

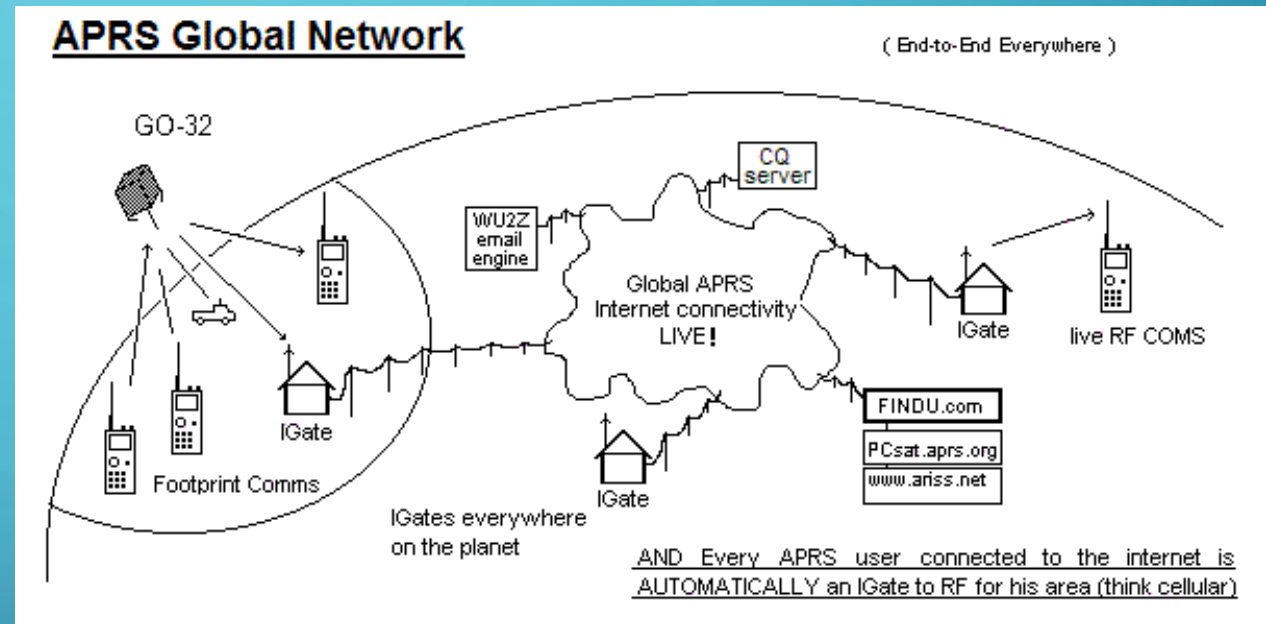
# APRS INFRASTRUCTURE – The RF Side

- 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!



# ANATOMY OF AN APRS PACKET

- Humanly Readable TNC2 format
  - SrcCall>DstCall,Path:Payload
  - Payloads include:
    - See [APRS101.pdf](#)
  - Position reports, including Objects
  - Telemetry & Definitions
  - Messages (& acks) and Bulletins
  - 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
```

# 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 (ATGP)
- Explicit CALLSIGN-SSID (Packet)

# DIGIPEATING

- Digital Repeater
- Not concurrent (unlike voice), but store and repeat
- Can only repeat what is received and decoded
- Acts on first unused (not \*) path component
- Some support “preemptive” digipeat (WIDE1-1,WIDE2-1,PREMPT,WIDE2-1)
- Based on explicit callsign-SSID or configured Alias (WIDE, TEMP, or HOP)

# DIGIPEATING

- Explicit is easy, mark component used (\*) and retransmit
- New-N Paradigm (WIDEn-N), decrement N and mark used if 0 then retransmit
- What to do with previously used components (implicitly all before first unused)

DIGI1,WIDE1,DIGI2\*,WIDE2-1 vs  
DIGI1\*,WIDE1\*,DIGI2\*,WIDE2-1

- To identify myself or not

# DIGIPEATING - EXPLICIT

- Receive: SRC>DST,KJ4ERJ-5,WIDE2-1:PAYLOAD
- Add used bit to my callsign
- Transmit: SRC>DST,KJ4ERJ-5\*,WIDE2-1:PAYLOAD
  
- D710 menu 616 – DIGIPEAT (MY CALL)

# DIGIPEATING – UIDIGI FLAVOR

- Receive: SRC>DST,WIDE1-1,WIDE2-1:PAYLOAD
- Replace entire alias with MYCALL\*
- Transmit: SRC>DST,KJ4ERJ-5\*,WIDE2-1:PAYLOAD
  
- Hides the original path component
- D710 menu 618 – UIDIGI (Not used for ATGP)

# DIGIPEATING – UIFLOOD FLAVOR #1

- Receive: SRC>DST,WIDE1-1,WIDE2-1:PAYLOAD
- Decrement N, mark used if zero, insert MYCALL\*
- Transmit: SRC>DST,KJ4ERJ-5\*,WIDE1\*,WIDE2-1:PAYLOAD
  
- Receive: SRC>DST,KJ4ERJ-5\*,WIDE1\*,WIDE2-1:PAYLOAD
- Decrement N, mark used if zero, remove used components, insert MYCALL\*
- Transmit: SRC>DST,KJ4ERJ-6,WIDE2\*:PAYLOAD
  
- D710 menu 619 – UIFLOOD Substitution: ID – Used for SSn-N and ATGP w/HOP

# DIGIPEATING – UIFLOOD FLAVOR #2

- Receive: SRC>DST,WIDE1-1,WIDE2-1:PAYLOAD
  - Decrement N, mark used if zero
  - Transmit: SRC>DST, WIDE1\*,WIDE2-1:PAYLOAD
- 
- Receive: SRC>DST,KJ4ERJ-5\*,WIDE1\*,WIDE2-1:PAYLOAD
  - Decrement N, mark used if zero, remove used components
  - Transmit: SRC>DST, WIDE2\*:PAYLOAD
- 
- Completely hides everything that has gone before
  - D710 menu 619 – UIFLOOD Substitution: NOID

# DIGIPEATING – UITRACE

- Receive: SRC>DST,WIDE1-1,WIDE2-1:PAYLOAD
  - Decrement N, mark used if zero, insert MYCALL\*
  - Transmit: SRC>DST,KJ4ERJ-5\*,WIDE1\*,WIDE2-1:PAYLOAD
- 
- Receive: SRC>DST,KJ4ERJ-5\*,WIDE1\*,WIDE2-1:PAYLOAD
  - Decrement N, mark used if zero, insert MYCALL\*
  - Transmit: SRC>DST,KJ4ERJ-5\*,WIDE1\*,KJ4ERJ-6\*,WIDE2\*:PAYLOAD
- 
- Completely traceable (except for WIDE2-1)
  - Notice how the packet gets longer with each digipeat
  - D710 menu 619 – UITRACE – Used for WIDEn-N and ATGP w/TEMPn-N

# DIGIPEATING – ATGP STYLE

AOMTN-5>APK102,HOP7-7,HOP7-7::BLN0AOMTN:HEAR 3-9

## SOUTH

COMERS-4\*,HOP7-6,HOP7-7

ROAN-3\*,HOP7-5,HOP7-7

CLNGMN-2\*,HOP7-4,HOP7-7

SPRNGR-1\*,HOP7-3,HOP7-7

### Without UIFLOOD:

COMERS-4\*,ROAN-3\*,CLNGMN-2\*,SPRNGR-1\*,HOP7-3,HOP7-7

HWKSBL-6\*,MDMTN-7\*,GDHILL-8\*,CAMLBK-9\*,SAMSPT-10\*,BOVINA-11\*,GRYLCK-12\*,HOP7\*,EQUINOX-13\*,HOP7-6

## AOMTN-5

HOP7-7,HOP7-7

AOMTN-5\*,HOP7-5,HOP7-7

(This is the D700/D710 Digipeater bust)

## NORTH

HWKSBL-6\*,HOP7-6,HOP7-7

MDMTN-7\*,HOP7-5,HOP7-7

GDHILL-8\*,HOP7-4,HOP7-7

CAMLBK-9\*,HOP7-3,HOP7-7

SAMSPT-10\*,HOP7-2,HOP7-7

BOVINA-11\*,HOP7-1,HOP7-7

GRYLCK-12\*,HOP7\*,HOP7-7

EQUINOX-13\*,HOP7-6

# ATGP RADIO SETTINGS

- MYCALL – Who you are
- Data band – Which band to set the 144.340 frequency
- Location – Where you are
- Comment – Use to show current status
- Symbol – Set to Tent (or be different)
- TX Timing – Depending on where you are in the chain
- PATH – HOP7-7,HOP7-7
- DIGIPEAT – The whole point of the station!

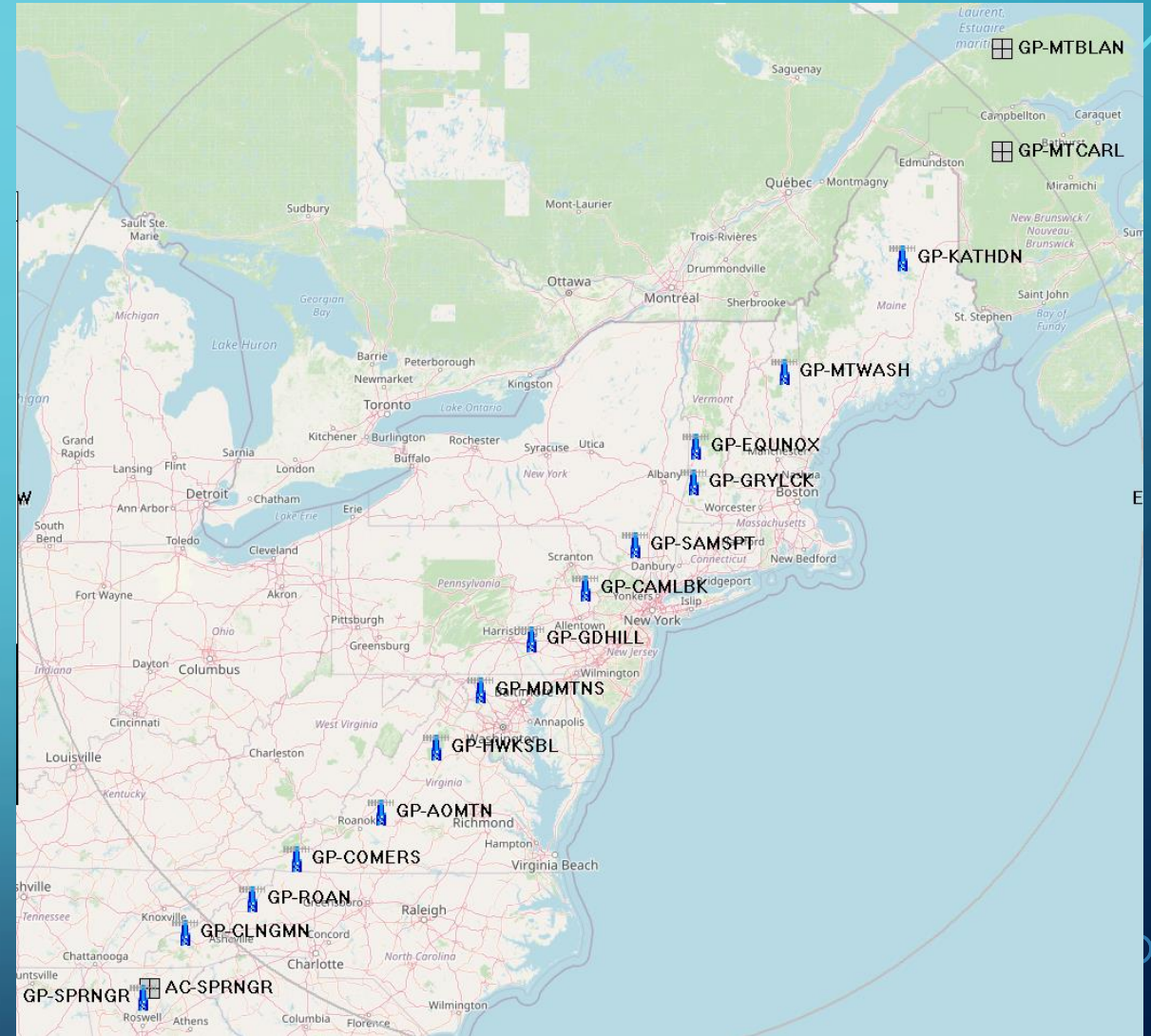
# MYCALL – WHO YOU ARE

## SOUTH HOP7-7

- GDHILL-8
- MDMTNS-7
- HWKSBL-6
- AOMTN-5
- COMERS-4
- ROAN-3
- CLNGMN-2
- SPRNGR-1

## NORTH HOP7-7

- KATHDN-15
- MTWASH-14
- EQUINOX-13
- GRYLCK-12
- BOVINA-11
- SAMSPT-10
- CAMLBK-9
- GDHILL-8



# MYCALL – WHO YOU ARE

INTENT: IDENTIFY STATION AND POSITION IN CHAIN

## D72

Menu 300 Basic Settings MYCALL

## D710

Menu 600 Basic Settings MYCALL

## D710G

Menu 600 Basic Settings MYCALL

# DATA BAND – WHERE TO SET 144.340

INTENT: USE APRS ON BAND A, KEEP BAND B FOR UHF VOICE

## D72

Menu 310

Data to A-Band

1200 baud

Menu 320

DCD Sense: D or RxD Band

TX Delay: 200msec

## D710

Menu 601

Data to A-Band

1200 baud

DCD Sense [D or RxD BAND]

200msec

## D710G

Menu 601

Data to A-Band

1200 baud

(later 9600)

DCD Sense [D or RxD BAND]

# LOCATION – WHERE YOU ARE

INTENT: STATIC LOCATION, NO GPS REQUIRED (OR WANTED)

## D72

Menu 360 MY POSITION

Enter lat/lon

Get Asterisk (\*) by pressing USE

Menu 370 Turn off Speed, Altitude, and Ambiguity

## D710

Menu 602 GPS port

INPUT OFF

Menu 605 MY POSITION

Enter lat/lon

Get Asterisk (\*) by pressing USE

Menu 606 Set Speed/Alt/Amb to OFF

## D710G

Menu 602 GPS port

INPUT OFF

Menu 605 MY POSITION

Enter lat/lon

Get Asterisk (\*) by pressing USE

Menu 606 Set Speed/Alt/Amb to OFF

# COMMENT – SHOW CURRENT STATUS

INTENT: PROVIDE STATUS INSIDE NORMAL BEACON PACKETS

## D72

Menu 380 Set comment to SPECIAL

Menu 390

Select \*1

TX rate: 1/1

TEXT updated frequently with status

Menu 3A0 Set QSY in Status to ON

Set Tone and Shift to OFF

## D710

Menu 607 Set comment to SPECIAL

Menu 608

\*1 and enter text

Update frequently with current status

TX Rate: 1/1

## D710G

Menu 607 Set comment to SPECIAL

Menu 608

\*1 and enter text

Update frequently with current status

TX Rate: 1/1

# SYMBOL – TENT (OR...)

INTENT: STANDARDIZED SYMBOL FOR OUTSIDE OBSERVERS

## D72

Menu 3C0 Set station Icon to DIGIPEATER  
Otherwise use Human or Tent

## D710

Menu 610 Station Icon  
Select the TENT (Portable)

## D710G

Menu 610 Station Icon  
Select the TENT (Portable)

# TX TIMING – VARIES BY LOCATION

INTENT: BEACON AT A FIXED INTERVAL

## D72

Menu 3D0 TX Beacon to AUTO

Interval to 10 minutes

Springer and Katahdin use 5

Menu 3E0 Algorithm

Decay: OFF

Proportional: OFF

## D710

Menu 611 Beacon TX algorithm

METHOD: Auto

Initial interval: 10 minutes

Springer and Katahdin use 5 minutes

Decay: OFF

Proportional: OFF

## D710G

Menu 611 Beacon TX algorithm

METHOD: Auto

Initial interval: 10 minutes

Springer and Katahdin use 5 minutes

Decay: OFF

Proportional: OFF

# TX TIMING – VARIES BY LOCATION

## 2020 SUGGESTION FOR BETTER PERFORMANCE

### SOUTH

- GDHILL-8 10 minutes
- MDMTNS-7 10 minutes
- HWKSBL-6 5 minutes
- AOMTN-5 5 minutes
- COMERS-4 5 minutes
- ROAN-3 3 minutes
- CLNGMN-2 3 minutes
- SPRNGR-1 1 minute

### NORTH

- KATHDN-15 1 minute
- SUGRLF-14 3 minutes
- MTWASH-13 3 minutes
- EQUINOX-12 5 minutes
- GRYLCK-11 5 minutes
- SAMSPT-10 5 minutes
- CAMLBK-9 10 minutes
- GDHILL-8 10 minutes

<http://www.aprs.org/hamtrails/2020/2020-ATGP-plan-a.txt>

NOTE: Tactical callsigns above were current as of 2020 but several have changed starting with ATGP 21

# MISCELLANEOUS SETTINGS

## INTENT: STANDARDIZED SETTINGS

### D72

Menu 370 Turn OFF  
Speed, Altitude, Ambiguity

Menu 380 Comment to SPECIAL

Menu 3B0 Position Limit Off

Menu 3Q0 Auto Reply OFF

Menu 3U0 Display Area  
Entire-Always  
Interrupt Time: 10 seconds

### D710

Menu 606 Speed/Alt/Amb OFF

Menu 607 Comment to SPECIAL

Menu 609 Position Limit OFF (or 0)

Menu 613 Select APRS

Menu 614 Voice Alert OFF

### D710G

Menu 606 Speed/Alt/Amb OFF

Menu 607 Comment to SPECIAL

Menu 609 Position Limit OFF (or 0)

Menu 613 Select APRS

Menu 614 Voice Alert OFF

Menu 622 Auto Reply OFF

Menu 625 Interrupt ALWAYS

# PATH – HOP7-7,HOP7-7

INTENT: ONLY TRIGGER ATGP DIGIPEATERS

## D72

Menu 3H0 PATH

Type: \*Others

Press the \* key to activate

Path: HOP7-7,HOP7-7

Note that there are NO spaces in the path and the separator is a comma

## D710

Menu 612 PATH

Type: \*Others

Press the USE button to set \*

Path: HOP7-7,HOP7-7

Note that there are NO spaces in the path and the separator is a comma

## D710G

Menu 612 PATH

Type: \*Others

Press the USE button to set \*

Path: HOP7-7,HOP7-7

Note that there are NO spaces in the path and the separator is a comma

# DIGIPEAT – MAGIC HAPPENS HERE!

INTENT: RESPOND ONLY TO CUSTOM ATGP HOP ALIAS  
HOP ALIAS USING UIFLOOD TO KEEP PACKETS SHORTER  
TEMP ALIAS USING UITRACE FOR LOCALIZED TESTING

## D72

Menu 3K0 DIGIPEAT (MYCALL) ON

Menu 3L0 UICHECK TIME 10 seconds  
(Note: Default is 20 seconds)

Menu 3M0 UIDIGI OFF

Menu 3N0 UIFLOOD ON  
ALIAS HOP  
SUBSTITUTION ID

Menu 3O0 UITRACE ON  
ALIAS TEMP

## D710

Menu 616 DIGIPEAT (MY CALL) ON

Menu 617 UICHECK TIME 10 seconds  
(Note: Default is 20 seconds)

Menu 618 UIDIGI OFF

Menu 619 UIFLOOD ON  
ALIAS HOP  
SUBSTITUTION ID

Menu 620 UITRACE ON  
ALIAS TEMP

## D710G

Menu 616 DIGIPEAT (MY CALL) ON

Menu 617 UICHECK TIME 10 seconds  
(Note: Default is 20 seconds)

Menu 618 UIDIGI OFF

Menu 619 UIFLOOD ON  
ALIAS HOP  
SUBSTITUTION ID

Menu 620 UITRACE ON  
ALIAS TEMP

# PRE-EVENT CHECKOUT

- Tune to 144.390 and beacon – Station should show up if simplex to iGate
- Monitor 144.390 on another radio – Beacon and learn sound of packet
- On a 2<sup>nd</sup> APRS radio, set path to HOP7-7 and beacon
  - Watch and listen for digipeat
  - Should see transmit immediately after reception
- Try TEMP2-2 as well on 2<sup>nd</sup> APRS radio
- Alter your Status Text (Menu 608) and view on second radio or aprs.fi
- Compose and send a BLNnXXXXX message  
<https://aprs.fi/bulletin/>

# WHEN THINGS GO WORNG (SIC)

- Station isn't Transmitting APRS
- Nothing is being received/decoded
- Station isn't Digipeating
- Only seeing one adjacent station
- Only seeing adjacent station, nothing beyond
- Not receiving messages
- Shack potato contact

# WHEN THINGS GO WRONG

## STATION ISN'T TRANSMITTING APRS

- Make sure Squelch is closed on the APRS channel  
Won't transmit if squelch is open
- Verify DCD Sense (menu 301)  
[BOTH BAND] will not transmit when receiving on either band
- Verify that Beacon is on display
- Check that GPS is off (Menu 602) and My Position (Menu 605) is set

# WHEN THINGS GO WRONG

## NOTHING BEING RECEIVED/DECODED

- Open squelch and listen for packets  
Remember to close or transmit will be disabled!
- Double-check APRS band frequency  
Try 144.390 to get a bunch of packets at most sites
- Double-check Position Limit is OFF (Menu 609)
- Confirm by voice that adjacent station is transmitting packets
- D710 filter crystal deafness (<https://www.youtube.com/watch?v=3Y8U4BWac3w>)  
Try switch APRS band (Menu 601) (or NFM vs FM Menu 102)

# WHEN THINGS GO WRONG

## STATION ISN'T DIGIPEATING

- You should see transmit immediately after receiving a packet
  - You may need to change Display Area to see transmit bar (Menu 625)
- First ensure that it can both transmit and receive packets
- Can the D710 show the path of a received packet?
  - If so, ensure that first unused component is a HOP7-n or TEMPn-N
  - If not, then get other station to fix their path (Menu 612)

# WHEN THINGS GO WRONG

## ONLY SEEING ONE ADJACENT STATION

- Other adjacent station isn't transmitting
- Coordinate by voice and listen for packets by opening squelch

Antenna placement at one or both sites

# WHEN THINGS GO WRONG

ONLY SEEING ADJACENT STATION, NOTHING BEYOND

- Verify the adjacent station is digipeating  
Especially if they are seeing further along the chain

# WHEN THINGS GO WRONG

## NOT RECEIVING MESSAGES OR BULLETINS

- Clear your received messages
  - D710 has a fixed-length (100) message list
- Bulletins are just specially-addressed messages
  - They transmit not expecting an acknowledgement

# WHEN THINGS GO WRONG

## SHACK POTATO CONTACT

- If you have cell coverage, call the shack
- If have voice to adjacent station with cell coverage, arrange a relay
- If you have any contact outside the event, arrange a relay
- If you have 144.390 APRS access, send an APRS message  
Even in RO iGate coverage, you can still send TO the APRS-IS
- Use APRS messaging to your adjacent station(s)  
Temporarily change Path to TEMPn-N (Menu 612)  
Or empty Path to only reach adjacent stations

I have POTS land line with Call Waiting (Deluxe)/3-Way Calling that rolls to Cell with Voicemail beyond that. Some of you have experienced my impromptu conferences when fielding simultaneous calls.

## QUESTIONS?

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

THANK  
YOU!