

Amateur Radio License

Radios, Power, RFI

Today's Topics

- Digital Radio
- Power
- Radio Frequency Interference

Digital Data Modes

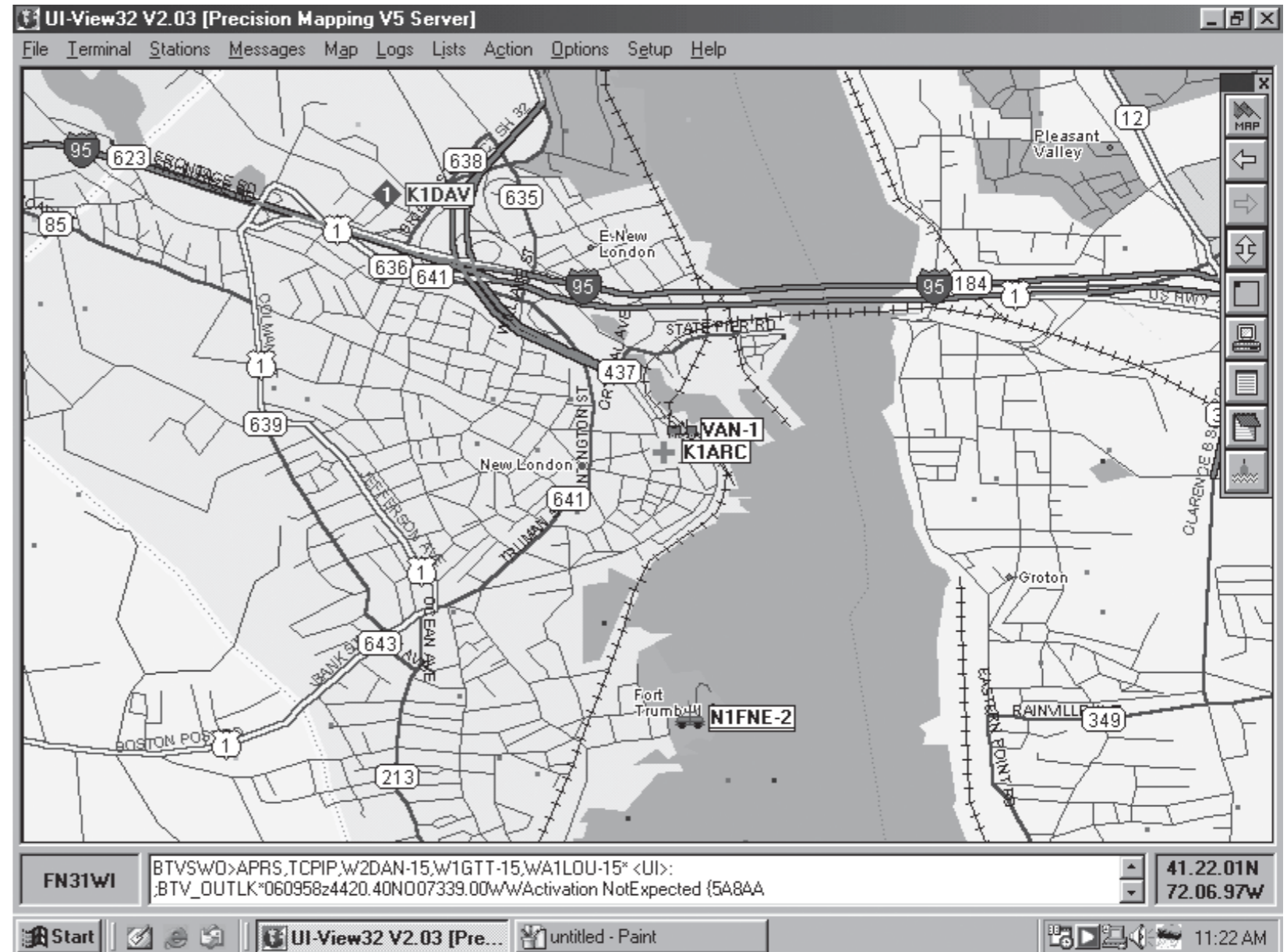
- Modem or sound card generates digital signals
Terminal Node Controller (TNC)
- Many different modes
 - Radioteletype (RTTY)
 - PSK31
 - Packet AX.25
 - APRS
 - Winlink

Packet Radio

- AX-25 : radio version of X-25, packet switched networks
- Packets have headers, checksums, and request for repeats (ARQ)
- Direct connections, or relayed through digipeaters (digital repeaters)
- Lots of packet repeaters around here, with connections to the internet (mail, ftp, etc)
- Your PC, radio, and packet modem software (Direwolf on Linux, for example).

APRS

- Radio + GPS
- Reports your position to internet servers
- Based on AX-25

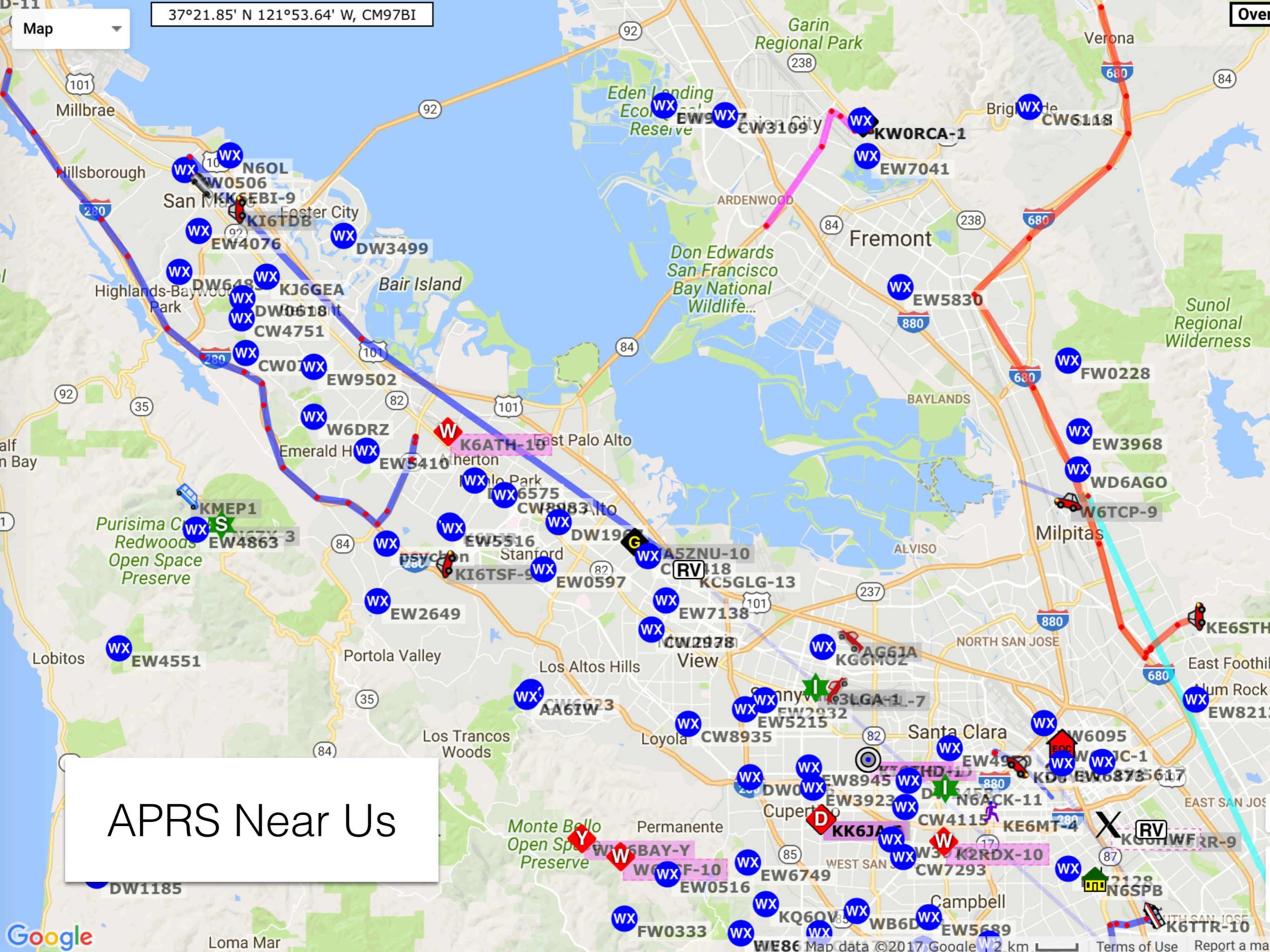


- APRS : Automatic Position Reporting System
- Also text, email, weather
- iPhone, Android apps (must have license)

37°21.85' N 121°53.64' W, CM97BI

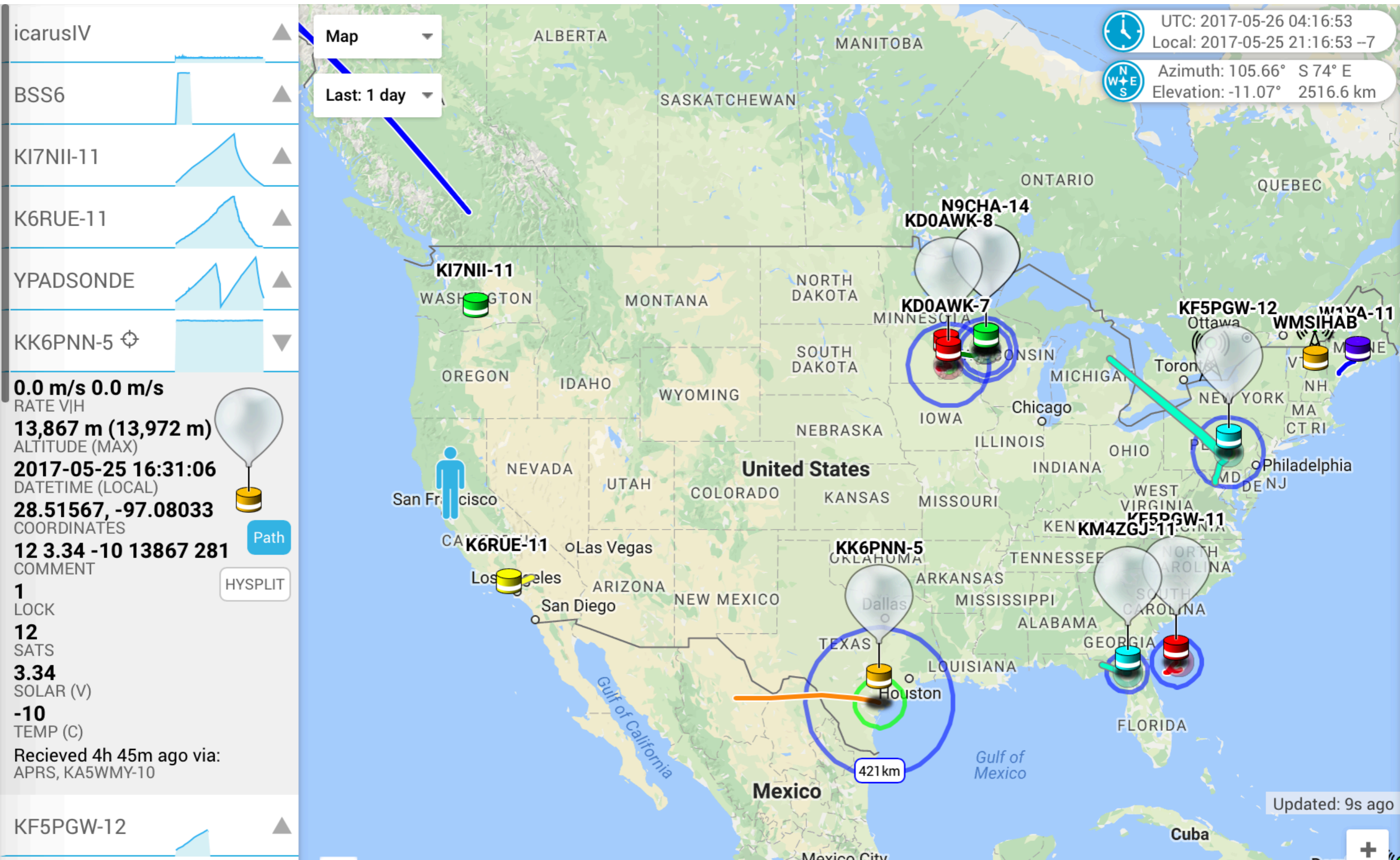
Map

Over

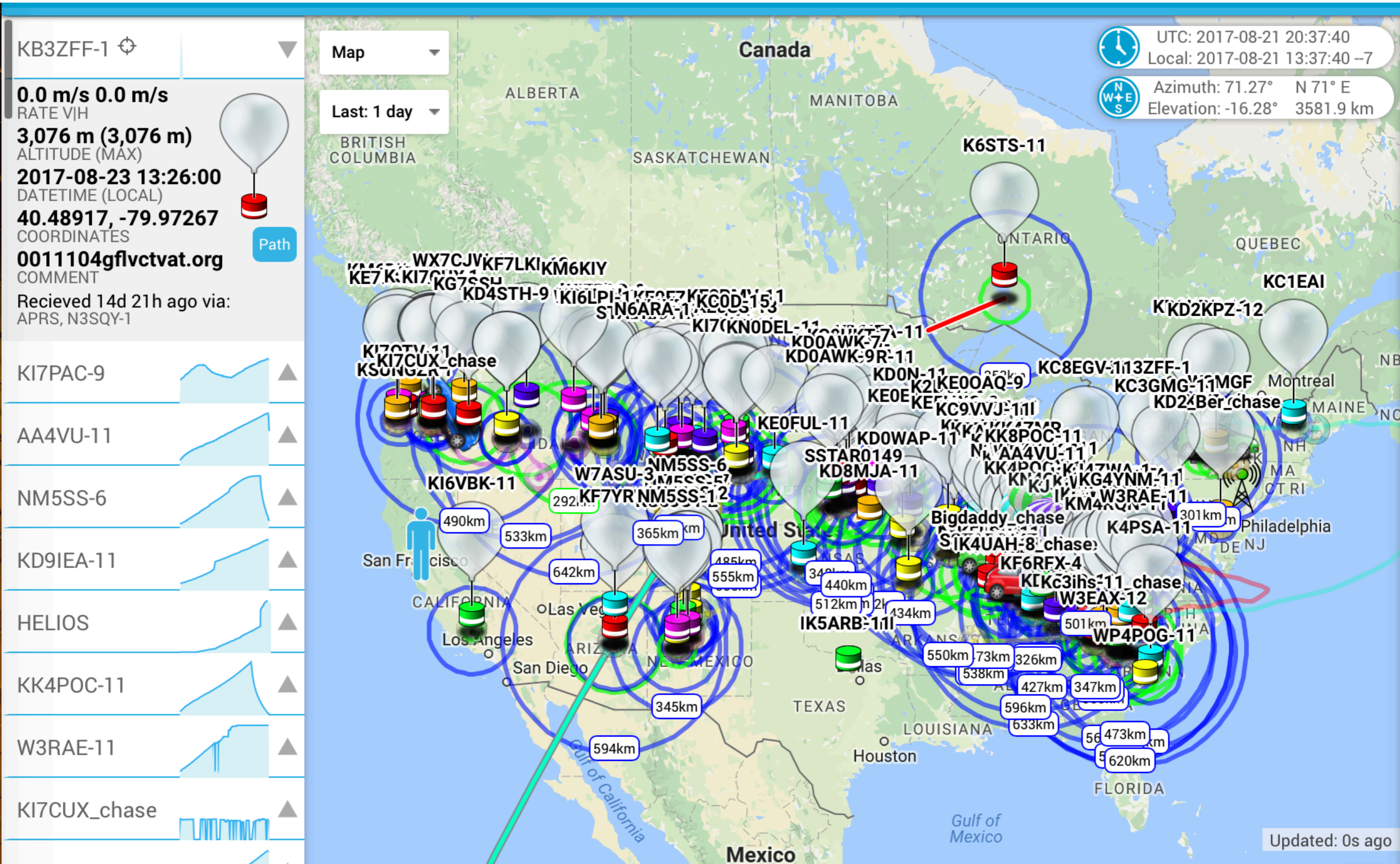


APRS Near Us

High Altitude Balloon Tracking



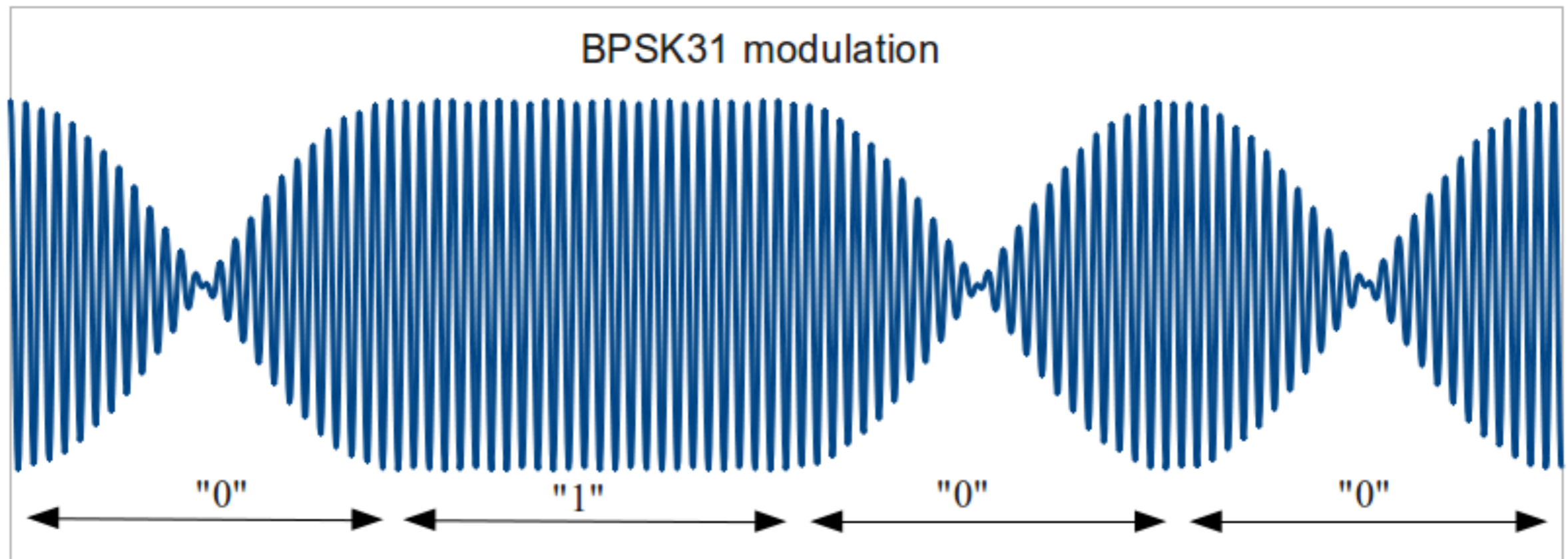
What Day Was This?



Other Digital Modes

- RTTY : radio teletype, keyboard to keyboard
- PSK31 : low data rate digital mode, mostly HF
- JT65, JT9, FT8, FT4: very low data rate (73 bits/min!) but very sensitive.
- Winlink : radio email systems, used in emergency communications. Radio Message Servers (RMS) relay messages

BPSK31 Waveform



PSK 31 with fldigi

The screenshot shows the fldigi software interface for AG6WH. The main window displays the following information:

- Menu Bar:** File, Op Mode, Configure, View, Logbook, Help
- Control Panel:** Hamlib K3/KX3, Freq 14071.461, On, Off 2202, In, Out, Call, Op, Az, USB, Qth, St, Pr, Loc
- Frequency Display:** 14070.000 (highlighted in green)
- Text Window:** Report : 599 599KYLG DE WB7CYO WB7CYO K tte*etetemaw@et
hts otes ot
t
t v oet eg t e
n tK9ZJ K9ZJ CQ k k
e,... a ecte te Oq o>:il9~u kn
14071.46 teno3o'Aj tt%St Ĩ x1Dr1 e oi=0 ayee-S AF7ES
14071.26 CQ CQ CQ de AF7ES AF7ES AFE IS LEE IN SOUTH CENTRAL IDAHO TOWN OF TWIN FALLS. UR 559 559, 25 WATTS, ATTIC DIPOLE (N/
14070.51
CQ
3.0 Clear
- Waterfall Display:** Shows a strong signal at 14070.000 kHz. The x-axis represents frequency from 500 to 2500 kHz, and the y-axis represents time. The signal is centered around 14070.000 kHz.
- Bottom Panel:** TX, CQ, RX, TX, ANS, RX, TX, QSO, BTU, RX II, Close, RX II, Me/Qth, Brag, T/R, Tx, Rx, TX. Controls include WF, 0, 50, x2, NORM, 1461, QSY, Store, Lk, Rv, T/R, BPSK31, s/n 30 dB, imd -30 dB, -2.9, AFC, SQL.

JT65, JT9

JTAlert-X 2.4.10 - IU4APC on 20M [HRD] | Alerts | Settings | Sound ON | 160 80 60 40 30 20 17 15

UN7ID **PA3EUJ** **MWOMKG - B4** **RA4FAU**

WSJT-X v1.2, r3563 by K1JT

File Setup View Mode Decode Save Help

Band Activity					Rx Frequency				
UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
1613	-9	0.5	1434	# CQ MWOMKG IO81	1613	-1	0.3	1195	# IU4APC ON1AEY -09
1613	-1	0.3	1195	# IU4APC ON1AEY -09	1614	Tx		1195	# ON1AEY IU4APC R-01
1615	-1	0.3	1187	# IU4APC ON1AEY RRR	1615	-1	0.3	1187	# IU4APC ON1AEY RRR
1615	-7	0.5	1430	# CQ MWOMKG IO81	1616	Tx		1195	# ON1AEY IU4APC 73
1617	-1	0.8	1187	# IU4APC ON1AEY 73	1617	-1	0.8	1187	# IU4APC ON1AEY 73
1617	-9	0.5	1427	# CQ MWOMKG IO81	1617	-9	0.5	1427	# CQ MWOMKG IO81
1617	-13	0.5	1974	# CQ RA4FAU LO33	1618	Tx		1427	# MWOMKG IU4APC JN64
1617	-3	-0.1	2442	# CQ RD7P LN23	1619	-5	0.5	1426	# IU4APC MWOMKG -10
1619	-5	0.5	1426	# IU4APC MWOMKG -10	1620	Tx		1426	# MWOMKG IU4APC R-05
1619	-1	0.8	1186	# CQ ON1AEY JO11	1621	-11	0.4	1420	# IU4APC MWOMKG RRR
1619	-11	0.4	1973	# CQ RA4FAU LO33	1622	Tx		1426	# MWOMKG IU4APC 73
1619	-13	0.5	2000	# XV2M DH8BAO JO43	1623	-7	0.5	1420	# IU4APC MWOMKG 73
1619	7	0.2	3394	@ GP 60 W TKS O	1623	-1	0.1	1179	# CQ PA3EUJ JO32
1619	-15	0.2	3578	@ CQ EA7AH IM67	1624	Tx		1179	# PA3EUJ IU4APC JN64
1621	-11	0.4	1420	# IU4APC MWOMKG RRR					
1621	-1	0.2	1183	# CQ ON1AEY JO11					
1621	-8	0.3	1970	# CQ RA4FAU LO33					
1621	-10	0.1	1996	# XV2M DH8BAO JO43					
1623	-7	0.5	1420	# IU4APC MWOMKG 73					
1623	-10	0.5	752	# SQ5CZL UN7ID LO80					
1623	-1	0.1	1179	# CQ PA3EUJ JO32					
1623	-9	0.6	1964	# DG7EL RA4FAU -13					

Log QSO Stop Monitor Erase Decode **Enable Tx** Halt Tx Tune

20 m **14.076 000** Tx even

+2 kHz DX Call DX Grid

PA3EUJ JO32 Tx JT65 # Tx 1179 Hz Rx 1179 Hz

Az: 339 1009 km Tx=Rx Rx=Tx Lock Tx=Rx Report -1

Generate Std Msgs Next Now

PA3EUJ IU4APC JN64 Tx 1

PA3EUJ IU4APC -01 Tx 2

PA3EUJ IU4APC R-01 Tx 3

PA3EUJ IU4APC RRR Tx 4

PA3EUJ IU4APC 73 Tx 5

CQ IU4APC JN64 Tx 6

Tx: PA3EUJ IU4APC JN64 JT9+JT65 Last Tx: PA3EUJ IU4APC JN64

Wide Graph

16:23
16:22
16:21
16:20

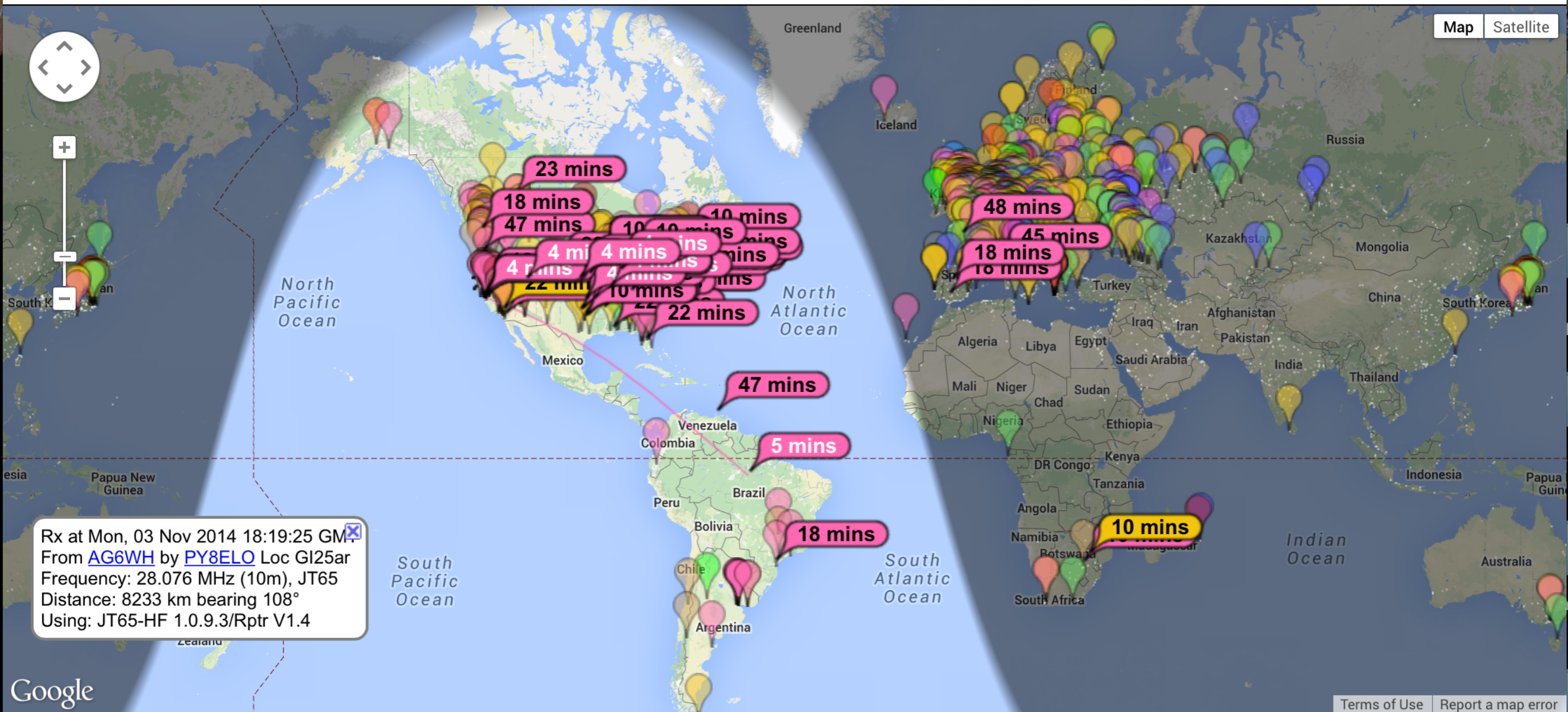
Bins/Pixel 7 Start 0 Hz Zero -23 N Avg 1 Palette
JT65 2500 JT9 Slope -0,0 Gain 0 Cumulative Default

PSK Reporter

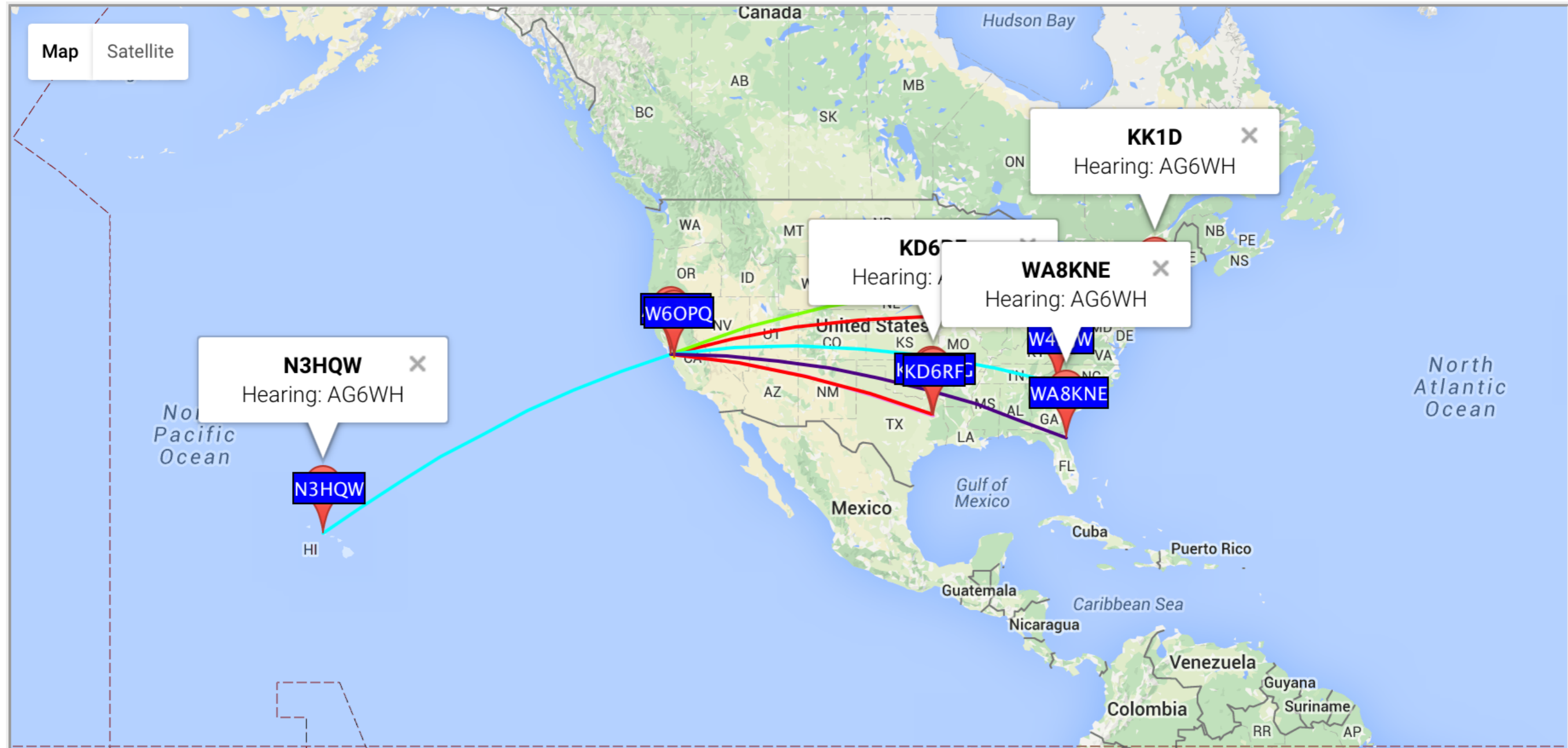
On , show sent by using over the last [Display options](#)

Monitoring AG6WH (last heard 4 mins ago). Automatic refresh in 5 minutes. Reception reports for AG6WH are shown as times ([show logbook](#)).

There are **875 active monitors**: **286 on 20m**, **194 on 10m**, **83 on 40m**, **79 on 15m**, **72 on 30m**, **26 on 80m**, **23 on 12m**, **19 on 2200m**, 14 on unknown, **12 on 11m**, **8 on 600m**, **6 on 160m**, **5 on 2m**, **2 on 6m**, **2 on 17m**. [Legend](#)

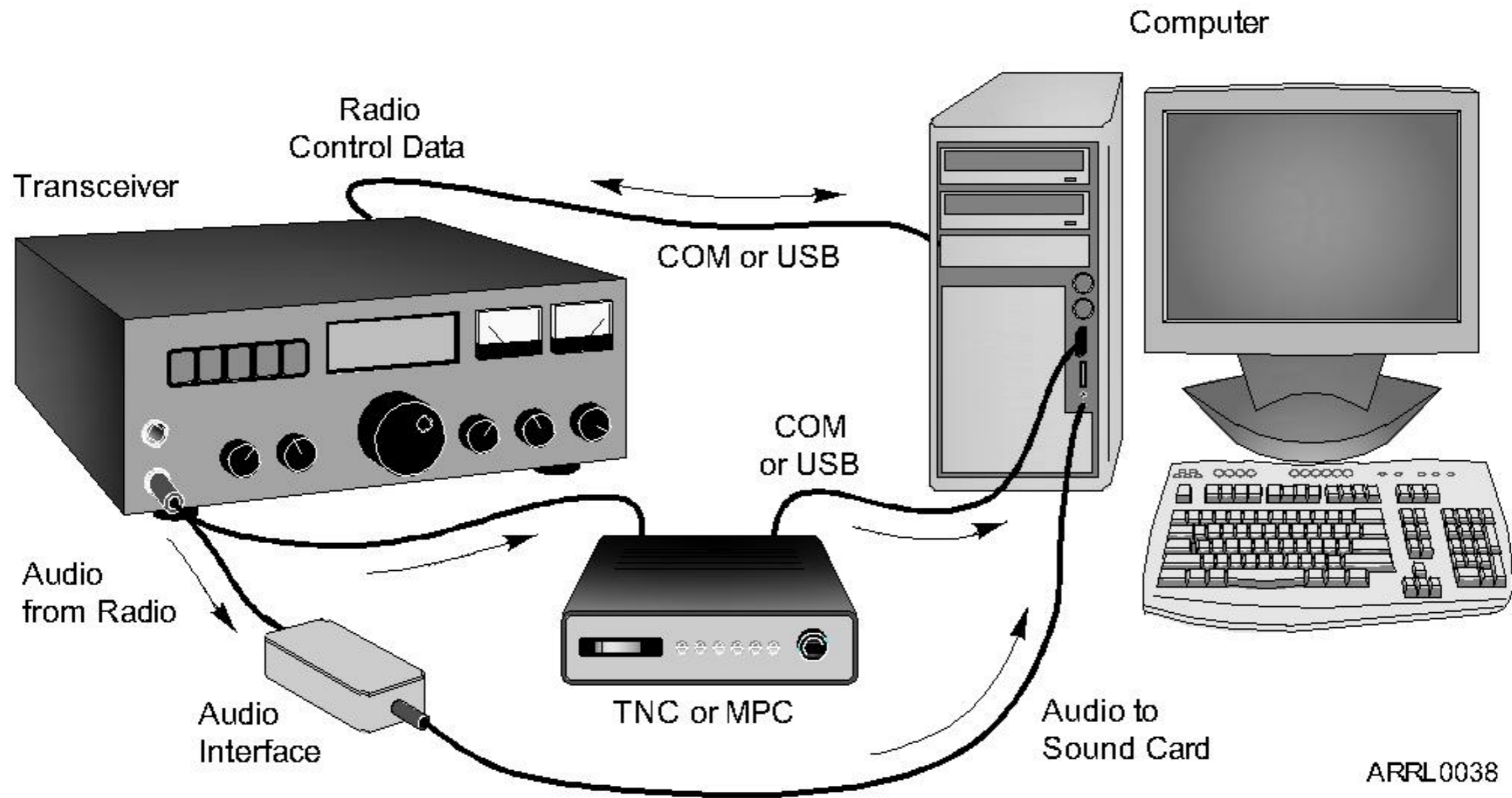


WSPR

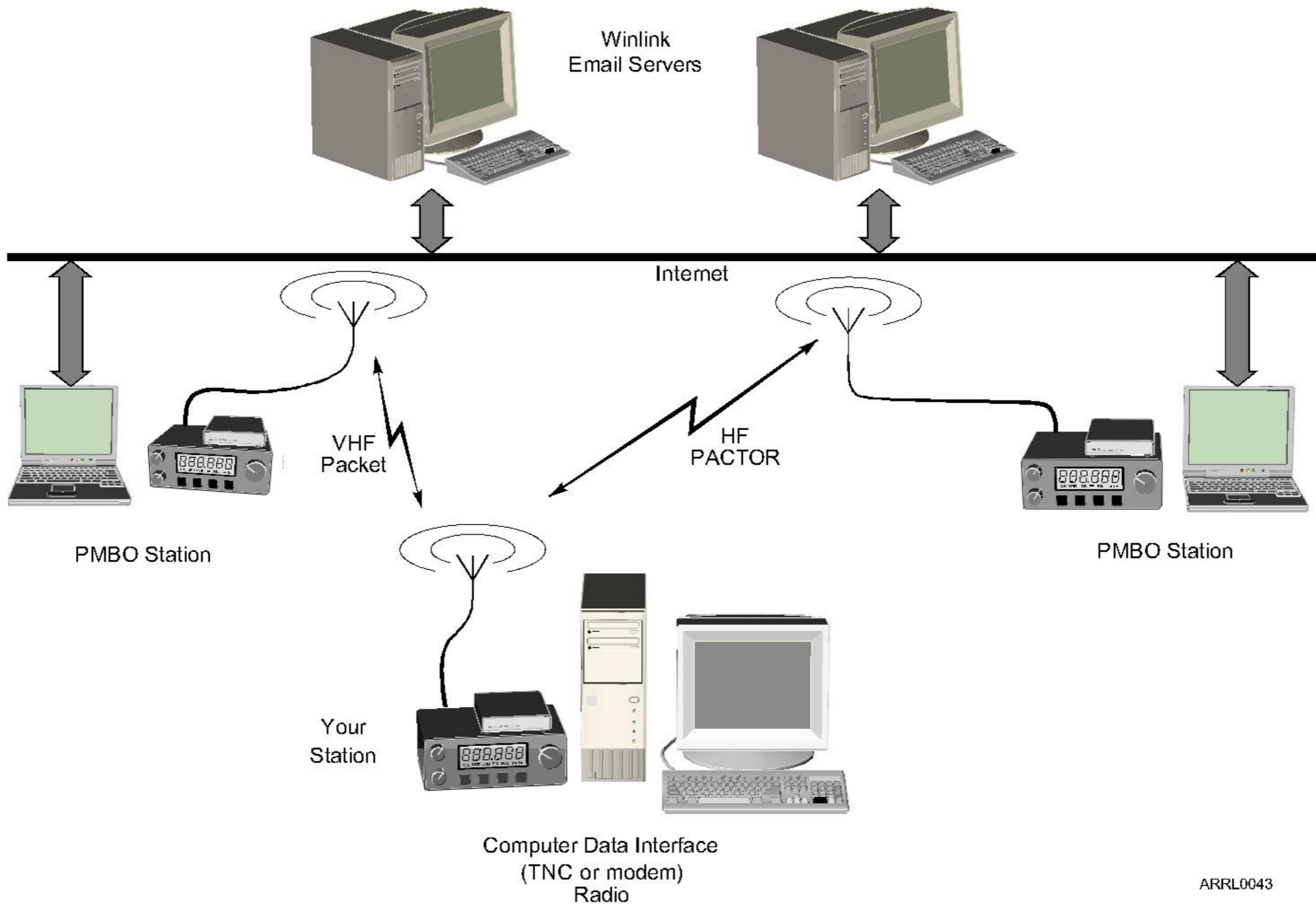


200 mW on 40 m
100 mW on 20 m

Digital Radio Connections



Internet Gateway



Which of the following is an example of a digital communications method? (T8D01)

A. Packet radio

B. IEEE 802.11

C. JT65

D. All of these choices are correct

Which of the following is an example of a digital communications method? (T8D01)

A. Packet radio

B. IEEE 802.11

C. JT65

D. All of these choices are correct

What does the abbreviation
PSK mean? (T8D06)

- A. Pulse Shift Keying
- B. Phase Shift Keying
- C. Packet Short Keying
- D. Phased Slide Keying

What does the abbreviation
PSK mean? (T8D06)

A. Pulse Shift Keying

B. Phase Shift Keying

C. Packet Short Keying

D. Phased Slide Keying

Which of the following may be included in packet transmissions? (T8D08)

- A. A check sum which permits error corrections
- B. A header which contains the call sign of the station to which the information is being sent
- C. Automatic repeat request in case of error
- D. All of these choices are correct

Which of the following may be included in packet transmissions? (T8D08)

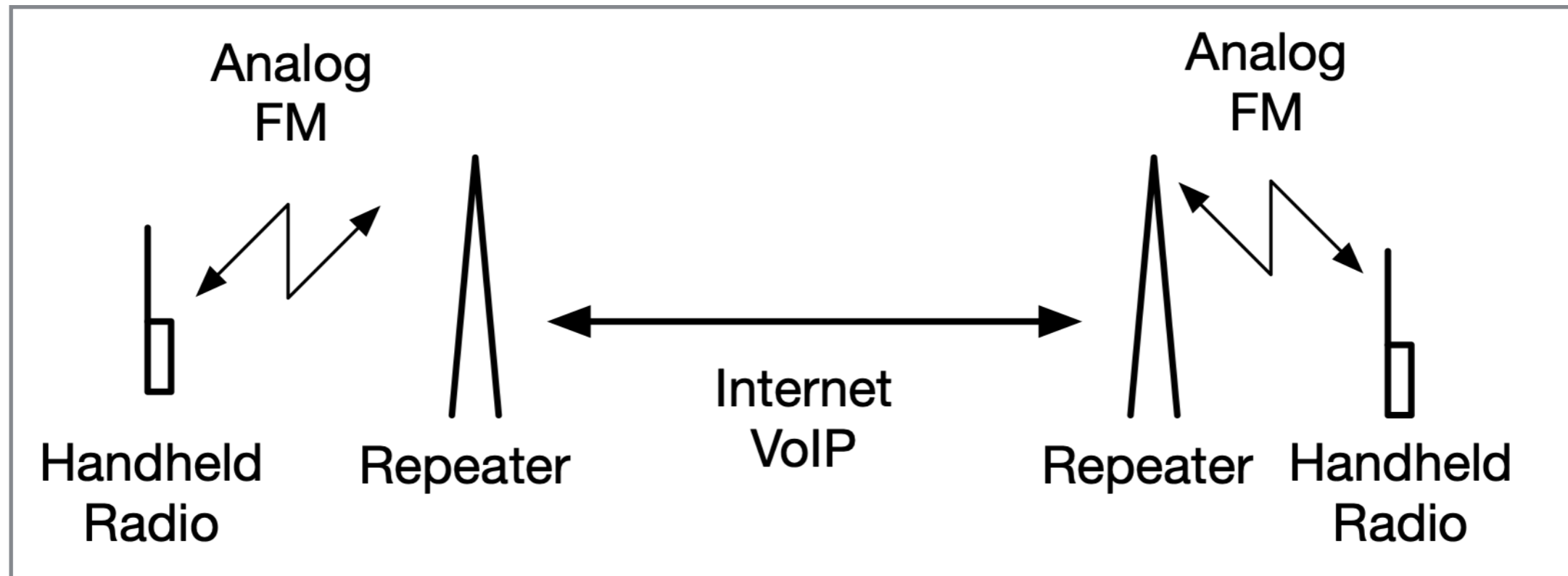
- A. A check sum which permits error corrections
- B. A header which contains the call sign of the station to which the information is being sent
- C. Automatic repeat request in case of error
- D. All of these choices are correct**

Digital Handheld Radios

- Repeaters that use the internet (VoIP)
- DStar (ICom, Kenwood)
- C4FM, Wires (Yaesu)
- DMR — Digital Mobile Radio
(Lots of companies)

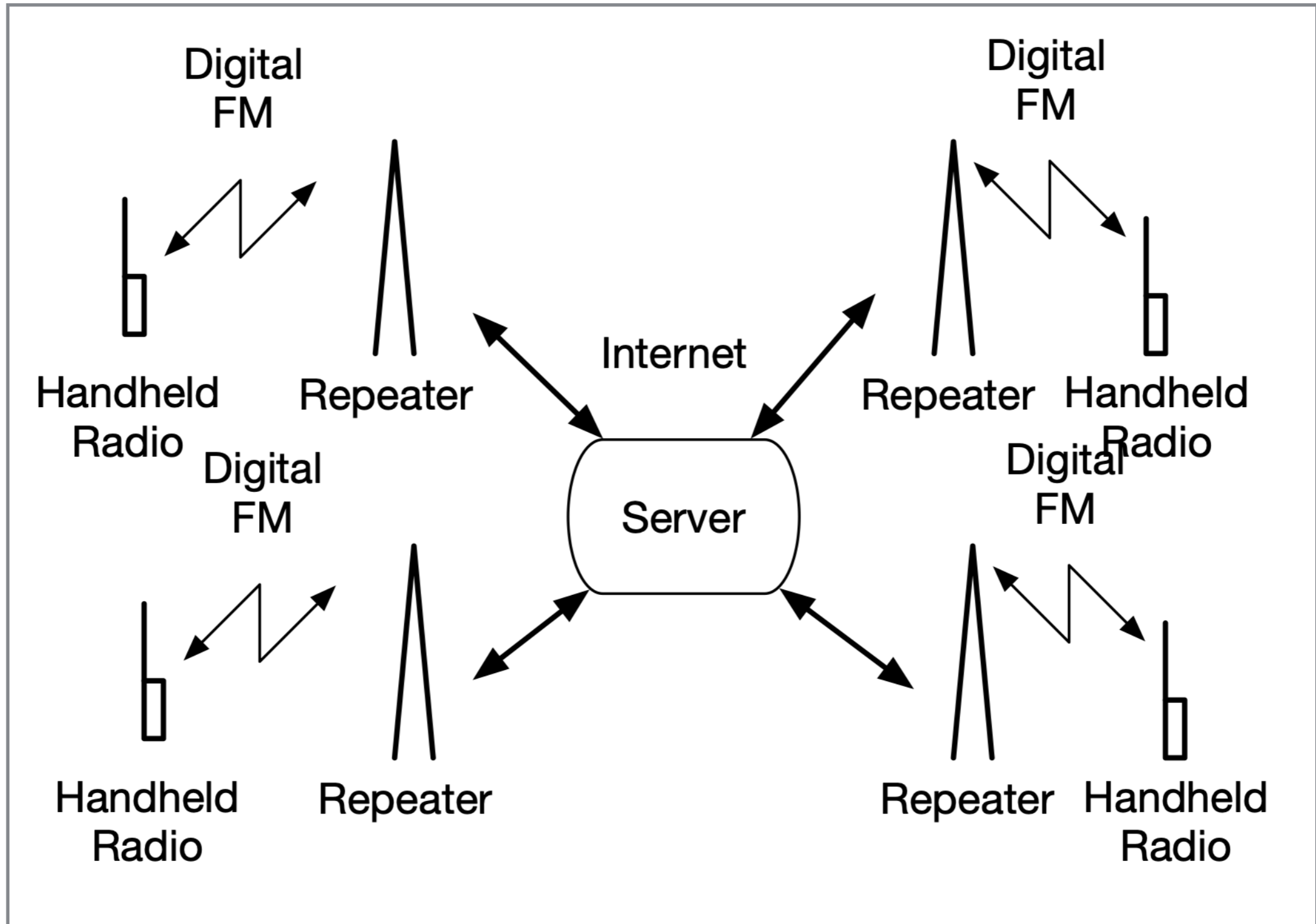


Echo Link and IRLP



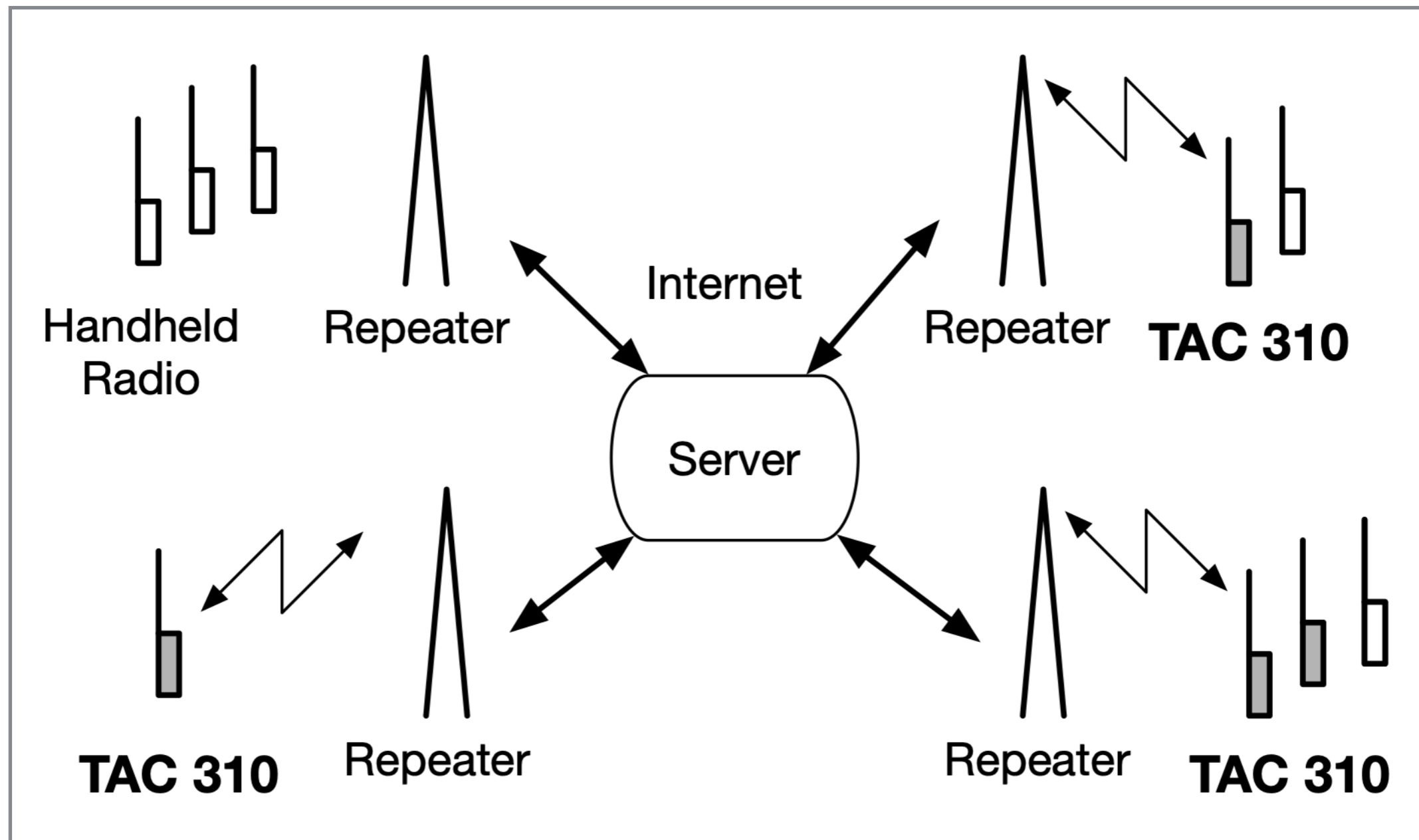
- Linked repeaters using “Voice over IP” (the internet)
- Type in access code, address of the repeater to link to using DTMF tones (same tones a phone uses)
- Acts like one big repeater, even though far apart
- IRLP is RF on both ends, Echo Link can use a computer

Digital Mobil Radio (DMR)



DMR

- Each user has an ID
- Your repeater tells the network you are there
- You can connect to an individual user directly (rare)
- You can connect to a “talk group” (most common)



- TAC 310 is a talk group
- I tell my repeater I want to access TAC 310 by selecting it on the radio, and hitting the PTT button momentarily
- Other people do the same for their repeaters.
- We all hear all the traffic on the talk group, all over the world.

DMR

- Lots of talk groups, can be based on geography, interest, or organization
- Your local repeater may be transmitting several talk groups at the same time, but you'll only hear the one you selected. You can also listen to everything
- You can send text to specific users, as well as SMS messages to/from phones

DMR Radios

- Looks just like the UV-5R
- Radioddity DMR internals
- \$65
- A real challenge to program
- Don't get the DM-5R! It costs about the same, but doesn't work on DMR networks
- Many other DMR options now



DMR Hotspots



Zumspot

- Raspberry Pi-Zero and RF daughter card
- Acts like a DMR repeater (100 mW)
- It connects to the DMR servers over WiFi
- Also does DStar, C4FM, P25 ...
- \$110
- Non-trivial to program

Zumspot

Hostname: pi-star

Pi-Star:3.4.13 / Dashboard: 20181230

Pi-Star Digital Voice Dashboard for AG6WH

Dashboard | Admin | Configuration

Modes Enabled

D-Star	DMR
YSF	P25
YSF XMode	NXDN
DMR XMode	POCSAG

Network Status

D-Star Net	DMR Net
YSF Net	P25 Net
YSF2DMR	NXDN Net
YSF2NXDN	YSF2P25
DMR2NXDN	DMR2YSF

Radio Info

Trx	TX DMR Slot 2
Tx	438.760000 MHz
Rx	438.760000 MHz
FW	ZUMspot:v1.3.3

Gateway Activity

Time (PST)	Mode	Callsign	Target	Src	Dur(s)	Loss	BER
15:49:46 Feb 20th	DMR Slot 2	KM4UJP	TG 310	Net	TX		
15:49:33 Feb 20th	DMR Slot 2	K9DWO	TG 310	Net	9.8	0%	0.0%
15:47:53 Feb 20th	DMR Slot 2	KG5DGG	TG 310	Net	2.6	0%	0.0%
15:46:55 Feb 20th	DMR Slot 2	N5JOJ	TG 310	Net	2.0	54%	0.0%
15:46:38 Feb 20th	DMR Slot 2	3128509	TG 310	Net	0.8	0%	0.0%
15:45:52 Feb 20th	DMR Slot 2	N3HFB	TG 310	Net	1.7	0%	0.0%
15:45:28 Feb 20th	DMR Slot 2	KD2DRL	TG 310	Net	1.4	75%	0.0%
15:43:31 Feb 20th	DMR Slot 2	KL4HX	TG 310	Net	3.0	14%	0.0%
15:42:24 Feb 20th	DMR Slot 2	AG6WH	TG 310	RF	0.4	0%	0.9%

Local RF Activity

Time (PST)	Mode	Callsign	Target	Src	Dur(s)	BER	RSSI
15:42:24 Feb 20th	DMR Slot 2	AG6WH	TG 310	RF	0.4	0.9%	S9+46dB

QRZ

KM4UJP



USA

Jonathan Goodson
849 EAST BEACH DRIVE
SAINT GEORGE ISLAND, FL 32328
USA

QSL: eQSL

Email: Use mouse to view..

XML Subscriber Lookups: 12062

Label



No picture available

Biography

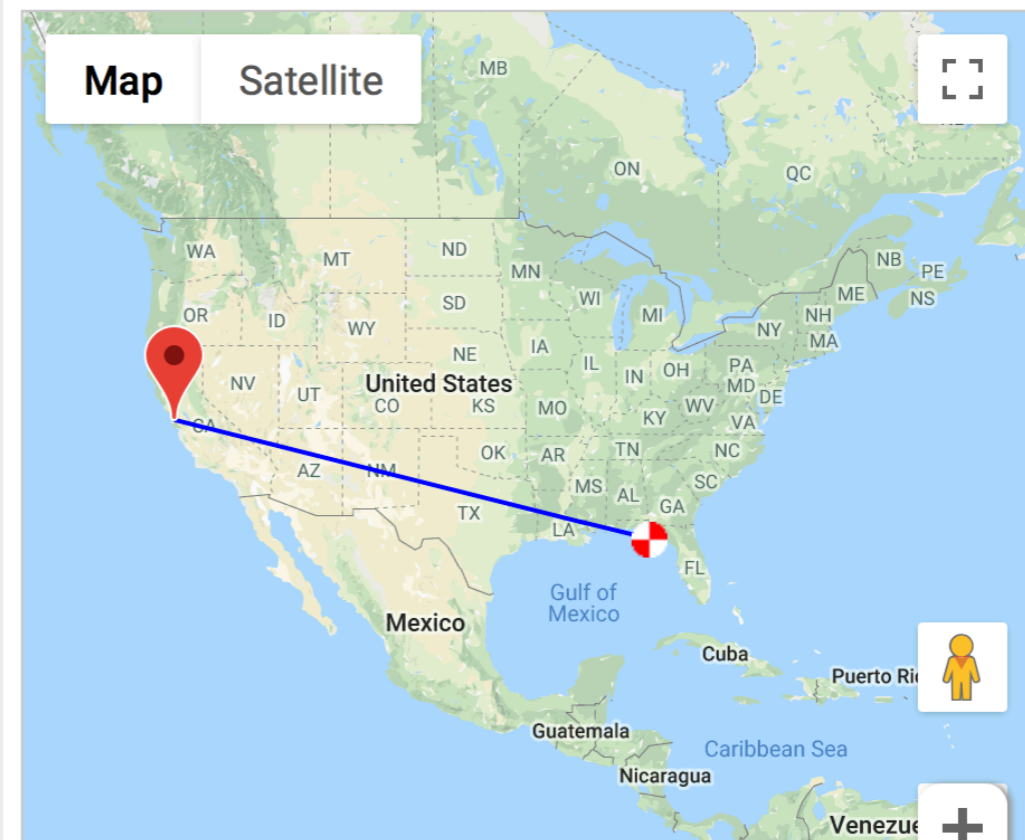
Detail

Logbook 167

Web 32

Log a NEW contact with KM4UJP...

Lookups	12062 (13476)
QRZ Record#	2088217
QRZ Admin	KM4UJP
Last Update	2018-11-30 21:22:43
Class	General Codes: HAI
Effective	2018-10-22
Expires	2026-06-02
Latitude	29.670877 (29° 40' 15" N)
Longitude	-84.841779 (84° 50' 30" W)
Grid Square	EL79nq
Geo Source	User supplied
US State	Florida
US County	Franklin
Bearing	92 9° E (from AG6WH)



Power

- Most radios use 12 Volts
 - DC power supplies
 - Batteries

12 V DC Power Supplies

- Linear : big transformers
 - Heavy : iron core transformers
 - Expensive
 - Very clean power
- Switchers : small transformers
 - High frequency switching before transformer
 - Lightweight, small, inexpensive
 - Often very noisy

Batteries

- Disposable, rechargable, and storage
- Power storage measured in amps X hours
- Storage batters (car batteries) have a whole set of potential issues.

Battery Types

Style	Chemistry	Rechargeable	Voltage	Energy
AAA	Alkaline	No	1.5 V	1000 mAh
AA	Alkaline	No	1.5 V	3000 mAh
AA	Carbon-Zinc	No	1.5 V	600 mAh
AA	Nickel-Cadmium	Yes	1.2 V	700 mAh
AA	Nickel-Metal Hydride	Yes	1.2 V	2000 mAh
C	Alkaline	No	1.5 V	7500 mAh
D	Alkaline	No	1.5 V	14000 mAh
9 V	Alkaline	No	9 V	580 mAh
9 V	Nickel-Cadmium	Yes	9 V	110 mAh
9 V	Nickel-Metal Hydride	Yes	9V	150 mAh

Mobile, Storage Batteries

- Large amounts of stored energy
- If shorted, can overheat, produce hydrogen gas, and explode
- Should be well fused (both leads), and well ventilated

Radios in Cars

- Where do you get power, how do you connect
- Where does all the interference come from?
- Where do you put your antenna?
- Are you even allowed to use a radio in a car?

Where should the negative return connection of a mobile transceiver's power cable be connected? (T4A11)

- A. At the battery or engine block ground strap
- B. At the antenna mount
- C. To any metal part of the vehicle
- D. Through the transceiver's mounting bracket

Where should the negative return connection of a mobile transceiver's power cable be connected? (T4A11)

- A. At the battery or engine block ground strap**
- B. At the antenna mount
- C. To any metal part of the vehicle
- D. Through the transceiver's mounting bracket

Radio Frequency Interference (RFI)

- Two situations:
 - Your radio interfering with other devices
 - Other devices interfering with you
- Many unlicensed RF devices (Part 15)
 - Must not cause interference with licensed users (you)
 - Must accept interference from users of properly operating equipment (you)
- Be diplomatic, first make sure your equipment is working, and then try to help them solve their problems

Types of RFI

- Direct detection – offending signals get into the electronics circuits to cause interference.
- Overload – strong signal that overwhelms the weaker, wanted signal.
- Harmonics – multiples of the offending signal that coincide with the wanted signal

RFI Mitigation

- Filters
 - Highpass : receive
 - Lowpass : transmit, eliminates harmonics
 - Notch : suppress particular signals to reduce overload
- Ferrites
 - RF chokes

RFI Sources

- Electrical arcs (motors, thermostats, electric fences, neon signs).
- Power lines.
- Motor vehicle ignitions or alternators.
- Switching power supplies.
- Computers, networks, and TV sets.

What should you do if something in your neighbor's home is causing harmful interference to your amateur station? (T7B08)

A. Work with you neighbor to identify the offending device

B. Politely inform your neighbor about the rules that require him to stop using the device if it causes interference

C. Check your station and make sure it meets the standards of good amateur practice

D. All of these choices are correct

What should you do if something in your neighbor's home is causing harmful interference to your amateur station? (T7B08)

A. Work with you neighbor to identify the offending device

B. Politely inform your neighbor about the rules that require him to stop using the device if it causes interference

C. Check your station and make sure it meets the standards of good amateur practice

D. All of these choices are correct

Which of the following actions should you take if a neighbor tells you that your station's transmissions are interfering with their radio or TV reception? (T7B06)

- A. Make sure that your station is functioning properly and that it does not cause interference to your own television
- B. Immediately turn off your transmitter and contact the nearest FCC office for assistance
- C. Tell them that your license gives you the right to transmit and nothing can be done to reduce the interference
- D. Install a harmonic doubler on the output of your transmitter and tune it until the interference is eliminated.

Which of the following actions should you take if a neighbor tells you that your station's transmissions are interfering with their radio or TV reception? (T7B06)

A. Make sure that your station is functioning properly and that it does not cause interference to your own television

B. Immediately turn off your transmitter and contact the nearest FCC office for assistance

C. Tell them that your license gives you the right to transmit and nothing can be done to reduce the interference

D. Install a harmonic doubler on the output of your transmitter and tune it until the interference is eliminated.

Electrical Grounding and Circuit Protection (in the home)

- Make sure your home is “up to code.”
- Most ham equipment does not require special wiring or circuits.
- Use 3-wire power cords.
- Use circuit breakers, circuit breaker outlets, or Ground Fault Interrupter (GFI) circuit breakers.
- Use proper fuse or circuit breaker size.
- Don't overload single outlets.

Electrical Hazards

Electrical Hazards

- Shocks
- Burns
- Even small currents can cause problems

Table 7-1

Effects of Electric Current Through the Body of an Average Person

<i>Current (1 Second Contact)</i>	<i>Effect</i>
1 mA	Just Perceptible.
5 mA	Maximum harmless current.
10 - 20 mA	Lower limit for sustained muscular contractions.
30 - 50 mA	Pain
50 mA	Pain, possible fainting. "Can't let go" current.
100 - 300 mA	Normal heart rhythm disrupted. Electrocution if sustained current.
6 A	Sustained heart contractions. Burns if current density is high.

Electrical Safety

- Avoid contact
- Most modern equipment is low voltage, low hazard
- Old equipment (tube amps for example) can be high voltage, quite hazardous

Mitigating Electrical Hazards

- If power is required:
 - Remove jewelry.
 - Avoid unintentional touching of circuitry.
 - Never bypass safety interlocks.
 - Capacitors hold a charge even when power is off.
 - Storage batteries are dangerous when shorted

Mitigating Electrical Hazards

- Turn off power when working inside equipment!
- Make sure equipment is properly grounded and circuit protected!
- Keep one hand in pocket when working around high voltage circuits.

Responding to Electrical Injury

- REMOVE POWER!
 - Have ON/OFF switches and circuit breakers clearly marked.
- Call for help.
- Learn CPR and first aid.

Lightning Safety

- Antennas are not struck any more frequently than trees or tall structures.
- Ground all antennas.
- Use lightning arrestors.
- Disconnect antenna cables and power cords during storms.
- Disconnect telephone lines from computer modems.

What health hazard is presented by current flowing through the body? (T0A02)

- A. By heating tissue
- B. It disrupts the electrical functions of cells
- C. It causes involuntary muscle contractions
- D. All of these choices are correct

What health hazard is presented by current flowing through the body? (T0A02)

- A. By heating tissue
- B. It disrupts the electrical functions of cells
- C. It causes involuntary muscle contractions
- D. All of these choices are correct**

In the US, what is connected to the green wire in a three-wire electrical AC plug?
(T0A03)

- A. Neutral
- B. Hot
- C. Safety ground
- D. The white wire

In the US, what is connected to the green wire in a three-wire electrical AC plug?
(T0A03)

A. Neutral

B. Hot

C. Safety ground

D. The white wire

White is neutral, black or red is hot

Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feedline? (T0A07)

- A. Include a parallel bypass switch for each protector so that it can be switched out of the circuit when running high power
- B. Include a series switch in the ground line of each protector to prevent RF overload from inadvertently damaging the protector
- C. Keep the ground wires from each protector separate and connected to station ground
- D. Ground all of the protectors to a common plate which is in turn connected to an external ground

Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feedline? (T0A07)

- A. Include a parallel bypass switch for each protector so that it can be switched out of the circuit when running high power
- B. Include a series switch in the ground line of each protector to prevent RF overload from inadvertently damaging the protector
- C. Keep the ground wires from each protector separate and connected to station ground
- D. Ground all of the protectors to a common plate which is in turn connected to an external ground**

What kind of hazard might exist in a power supply when it is turned off and disconnected? T0A11

- A. Static electricity could damage the grounding system
- B. Circulating currents inside the transformer might cause damage
- C. The fuse might blow if you remove the cover
- D. You might receive a shock from the charge stored in large capacitors

What kind of hazard might exist in a power supply when it is turned off and disconnected? T0A11

- A. Static electricity could damage the grounding system
- B. Circulating currents inside the transformer might cause damage
- C. The fuse might blow if you remove the cover
- D. You might receive a shock from the charge stored in large capacitors**

Which of the following establishes grounding requirements for an amateur radio tower or antenna? (T0B11)

- A. FCC Part 97 Rules
- B. Local electrical codes
- C. FAA tower lighting regulations
- D. Underwriters Laboratories' recommended practices

Which of the following establishes grounding requirements for an amateur radio tower or antenna? (T0B11)

A. FCC Part 97 Rules

B. Local electrical codes

C. FAA tower lighting regulations

D. Underwriters Laboratories' recommended practices

RF Exposure

RF Exposure

- Exposure to high levels of RF can cause problems.
- If precautions are taken, RF exposure is minimal and not dangerous.
- RF energy can heat body tissues.
- Heating depends on the RF intensity and frequency.

RF Power Density

- Actual transmitter power.
 - Higher power, higher risk.
- Antenna gain and proximity.
 - Beam antennas focus available energy.
 - Physical proximity or standing in the beam increases risk.
- Mode duty cycle.
 - More time at high power level, higher risk.

Antenna Proximity

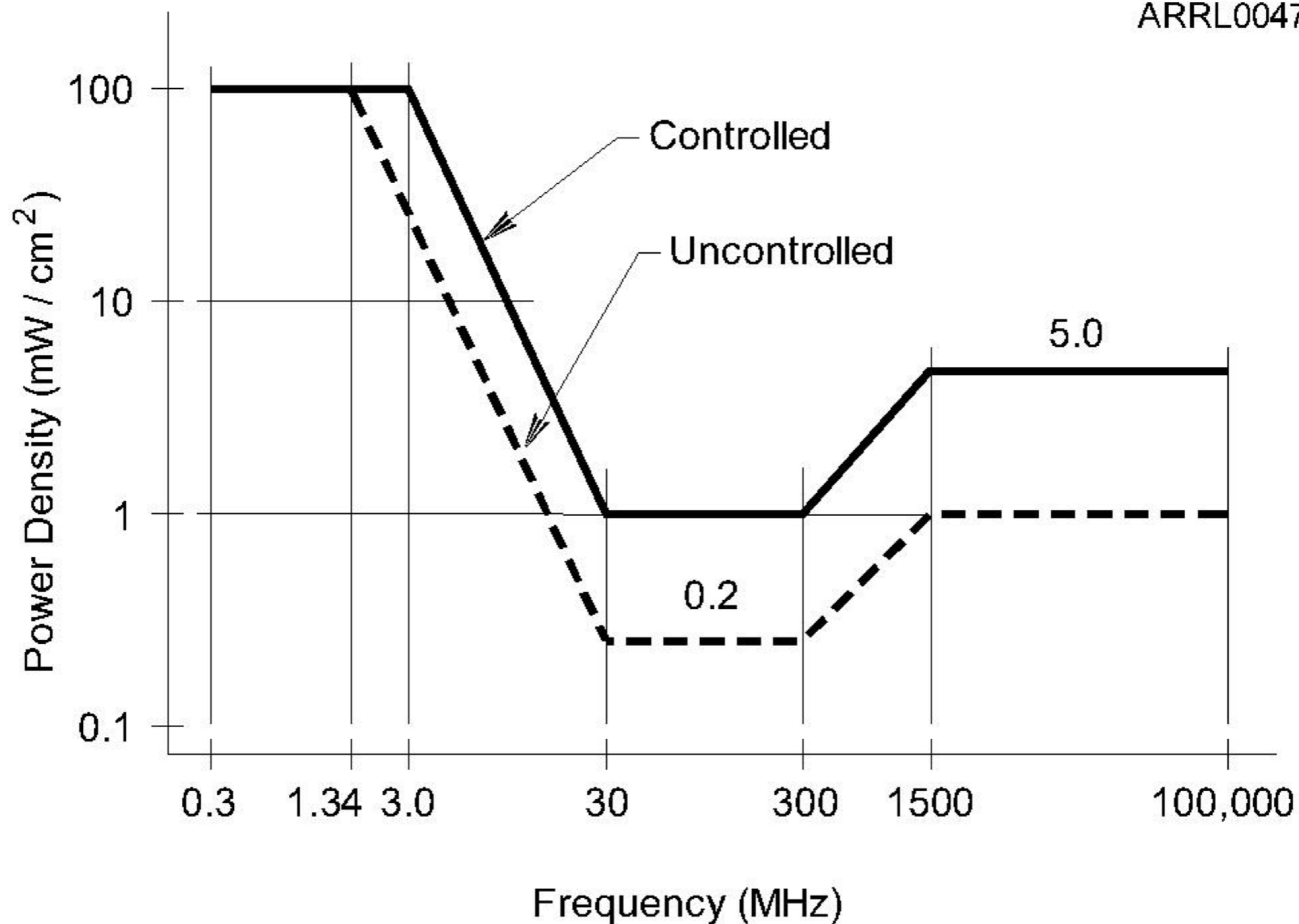
- Controlled Environment:
 - You know where people are standing in relation to your antenna and you can do something about it.
 - More power is allowed because you can make adjustments if needed.
- Uncontrolled Environment:
 - You have no idea, or have no control of people near your antenna.
 - Less power is allowed because you have to assume the worse case scenario.

RF Exposure and Frequency

- When body parts act like antennas, those parts absorb RF energy at certain frequencies (wavelengths) more efficiently and increase risk.
- RF exposure risk varies with frequency.
- More caution is dictated at some frequencies more than other frequencies.

RF Exposure and Frequency

ARRL0047



Mode Duty Cycle

- Higher duty cycle, greater RF exposure

Operating Duty Factor of Modes Common

<i>Mode</i>	<i>Duty Cycle</i>
Conversational SSB	20%
Conversational SSB	40%
SSB AFSK	100%
SSB SSTV	100%
Voice AM, 50% modulation	50%
Voice AM, 100% modulation	25%
Voice AM, no modulation	100%
Voice FM	100%
Digital FM	100%
ATV, video portion, image	60%
ATV, video portion, black screen	80%
Conversational CW	40%
Carrier	100%

RF Exposure Evaluation

- All fixed stations must perform an exposure evaluation. Several methods are available to do this.
- Until last year no evaluation was required if power was low enough. Varies with frequency – example: below 50 W at VHF. Now you need to check with a web site.
- Relocating antennas is one way to reduce RF exposure
- Also, regardless of the exposure evaluation results, make sure that people cannot come into contact with your antennas – RF burns are painful

Evaluation Thresholds

Band (m)	Power (W)
80, lower	500
40	500
20	225
10	50
2	50
1.25	50
0.7	70
0.23	200
0.13, higher	250

Which of the following frequencies has the lowest Maximum Permissible Exposure limit? (TOC02)

A. 3.5 MHz

B. 50 MHz

C. 440 MHz

D. 1296 MHz

Which of the following frequencies has the lowest Maximum Permissible Exposure limit? (TOC02)

A. 3.5 MHz

B. 50 MHz

C. 440 MHz

D. 1296 MHz

What factors affect the RF exposure of people near an amateur radio antenna?
(T0C04)

- A. Frequency and power level of the RF field
- B. Distance from the antenna to the person
- C. Radiation pattern of the antenna
- D. All of these choices are correct

What factors affect the RF exposure of people near an amateur radio antenna?
(T0C04)

- A. Frequency and power level of the RF field
- B. Distance from the antenna to the person
- C. Radiation pattern of the antenna
- D. All of these choices are correct**

Why do exposure limits vary with frequency? (TOC05)

- A. Lower frequency RF fields have more energy than higher frequency fields
- B. Lower frequency RF fields do not penetrate the human body
- C. Higher frequency RF fields are transient in nature
- D. The human body absorbs more RF energy at some frequencies than at others

Why do exposure limits vary with frequency? (TOC05)

- A. Lower frequency RF fields have more energy than higher frequency fields
- B. Lower frequency RF fields do not penetrate the human body
- C. Higher frequency RF fields are transient in nature
- D. The human body absorbs more RF energy at some frequencies than at others**

Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations? (TOC06)

- A. By calculation based on FCC OET Bulletin 65
- B. By calculation based on computer modeling
- C. By measurement of field strength using calibrated equipment
- D. All of these choices are correct

Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations? (TOC06)

- A. By calculation based on FCC OET Bulletin 65
- B. By calculation based on computer modeling
- C. By measurement of field strength using calibrated equipment
- D. All of these choices are correct**

Why is duty cycle one of the factors used to determine safe RF radiation exposure levels? (TOC10)

- A. It affects the average exposure of people to radiation
- B. It affects the peak exposure of people to radiation
- C. It takes into account the antenna feedline loss
- D. It takes into account the thermal effects of the final amplifier

Why is duty cycle one of the factors used to determine safe RF radiation exposure levels? (TOC10)

- A. It affects the average exposure of people to radiation**
- B. It affects the peak exposure of people to radiation
- C. It takes into account the antenna feedline loss
- D. It takes into account the thermal effects of the final amplifier

Physical Safety

Driving

- Amateur radio exempt from CA cell phone law
 - Doesn't cover two way radios
 - People still get tickets
- Make sure equipment is secure, that you can operate it safely

Antenna Towers

- Power lines and trees
- Lightning and grounding
- Climbing towers

Tower Installation

- Clear of trees and power lines.
- If it falls it won't hit anyone or cross power lines

No closer than 10 feet from power line if the tower falls over.

- Towers should use proper grounding techniques.

Tower Work

- Proper clothing, hard hat and eye protection.
- Climbing harness.
- Gin pole: used for lifting tower sections and antennas.
- Don't climb a crank-up tower supported by its cable.
- Don't work alone.

Under what circumstances is it safe to climb a tower without a helper or observer? (T0B03)

- A. When no electrical work is being performed
- B. When no mechanical work is being performed
- C. When the work being done is not more than 20 feet above ground
- D. Never

Under what circumstances is it safe to climb a tower without a helper or observer? (TOB03)

- A. When no electrical work is being performed
- B. When no mechanical work is being performed
- C. When the work being done is not more than 20 feet above ground
- D. Never**

Which of the following is an important safety precaution to observe when putting up an antenna tower? (T0B04)

- A. Wear a ground strap connected to your wrist at all times
- B. Insulate the base of the tower to avoid lightning strikes
- C. Look for and stay clear of any overhead electrical wires
- D. All of these choices are correct

Which of the following is an important safety precaution to observe when putting up an antenna tower? (T0B04)

- A. Wear a ground strap connected to your wrist at all times
- B. Insulate the base of the tower to avoid lightning strikes
- C. Look for and stay clear of any overhead electrical wires**
- D. All of these choices are correct

What is the minimum safe distance from a power line to allow when installing an antenna? (T0B06)

- A. Half the width of your property
- B. The height of the power line above ground
- C. $\frac{1}{2}$ wavelength at the operating frequency
- D. So that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power lines

What is the minimum safe distance from a power line to allow when installing an antenna? (T0B06)

- A. Half the width of your property
- B. The height of the power line above ground
- C. $\frac{1}{2}$ wavelength at the operating frequency
- D. So that if the antenna falls unexpectedly, no part of it can come closer than 10 feet to the power lines**

What is considered to be a proper grounding method for a tower? (T0B08)

- A. A single four-foot ground rod, driven into the ground no more than 12 inches from the base
- B. A ferrite-core RF choke connected between the tower and ground
- C. Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other
- D. A connection between the tower base and a cold water pipe

What is considered to be a proper grounding method for a tower? (T0B08)

- A. A single four-foot ground rod, driven into the ground no more than 12 inches from the base
- B. A ferrite-core RF choke connected between the tower and ground
- C. Separate eight-foot long ground rods for each tower leg, bonded to the tower and each other**
- D. A connection between the tower base and a cold water pipe

Why should you avoid attaching an antenna to a utility pole? (T0B09)

- A. The antenna will not work properly because of induced voltages
- B. The utility company will charge you an extra monthly fee
- C. The antenna could contact high-voltage power wires
- D. All of these choices are correct

Why should you avoid attaching an antenna to a utility pole? (T0B09)

- A. The antenna will not work properly because of induced voltages
- B. The utility company will charge you an extra monthly fee
- C. The antenna could contact high-voltage power wires**
- D. All of these choices are correct

That's It!

- Good luck with the exam!