Amateur Radio License

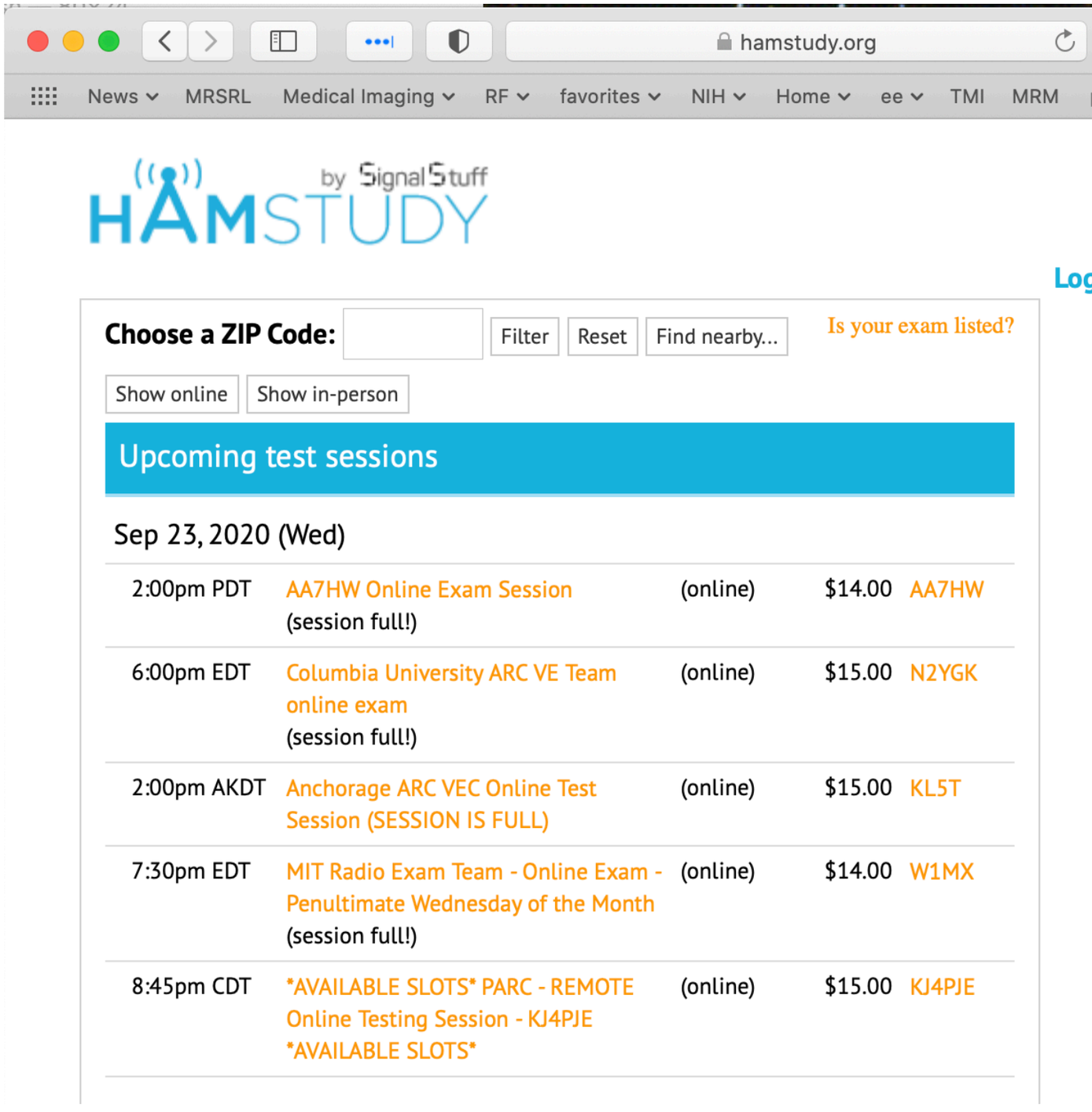
Safety

Test Format

- 35 questions from a pool of 300
- You need to get 26 right (74%)
- Multiple choice
- Calculators allowed (but you don’t really need one)
- You have to take this on-line

Test

- No Stanford test due to Covid
- Several online sites
- hamstudy.org has a list
- You schedule it yourself
- Not as much fun



Todays Topics

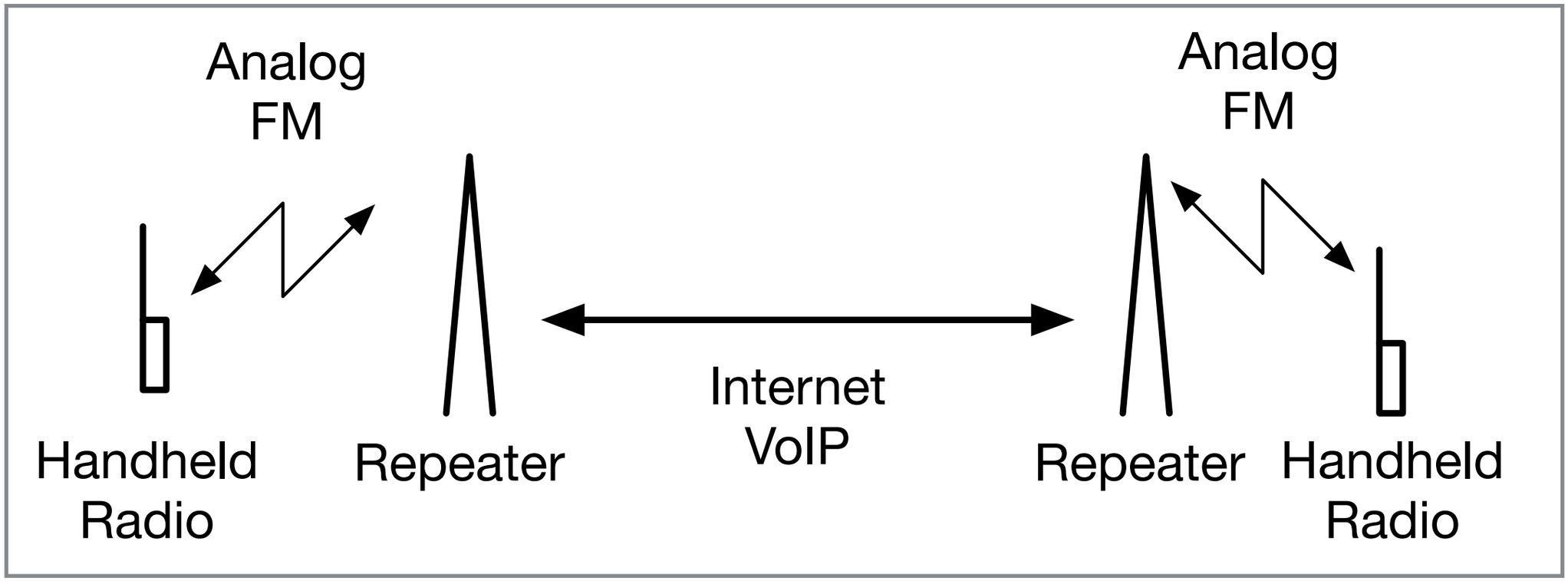
- Digital Radio
- Safety: Chapter 9
  - Electrical Safety
  - RF Exposure
  - Mechanical Safety

Digital Radio

Digital Radio

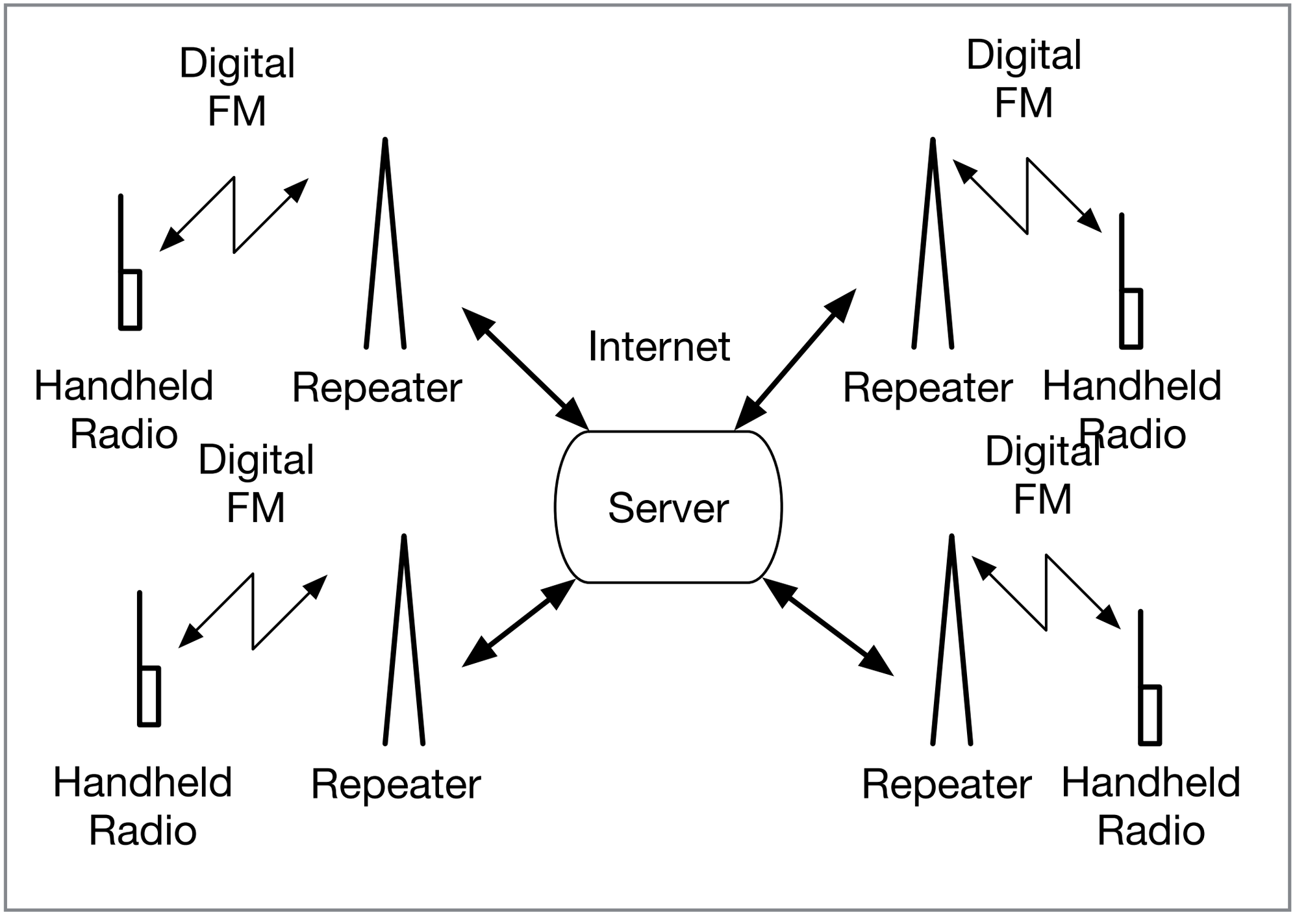
- Repeaters that use the internet (VoIP)
- DStar (ICom, Kenwood)
- C4FM, Wires (Yaesu)
- DMR — Digital Mobile Radio
  (Lots of companies)

Echo Link and IRLP



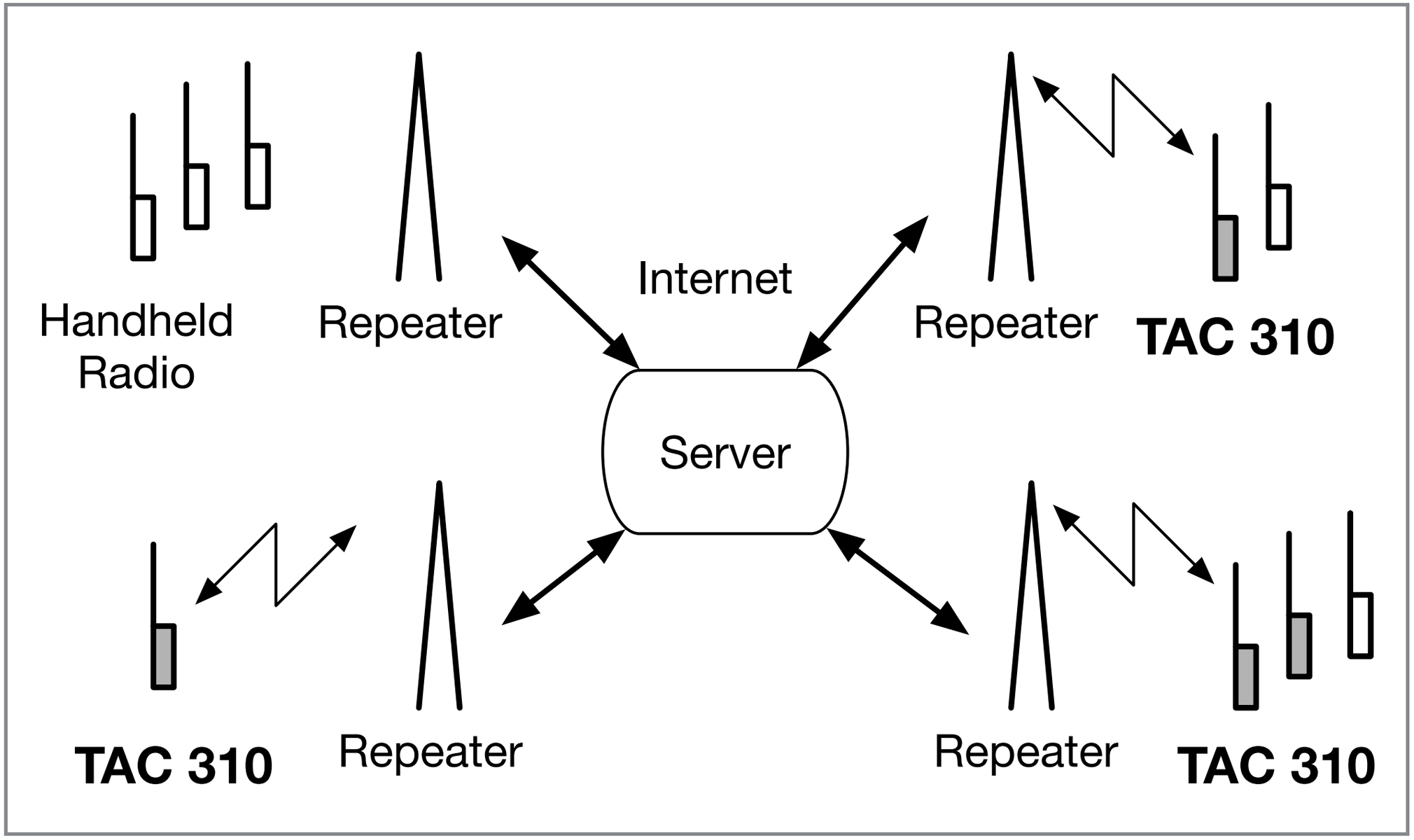
- Linked repeaters using “Voice over IP” (the internet)
- Type in access code, address of the repeater to link to using DTMF tones (same tones a phone uses)
- Acts like one big repeater, even though far apart
- IRLP is RF on both ends, Echo Link can use a computer

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

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

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..

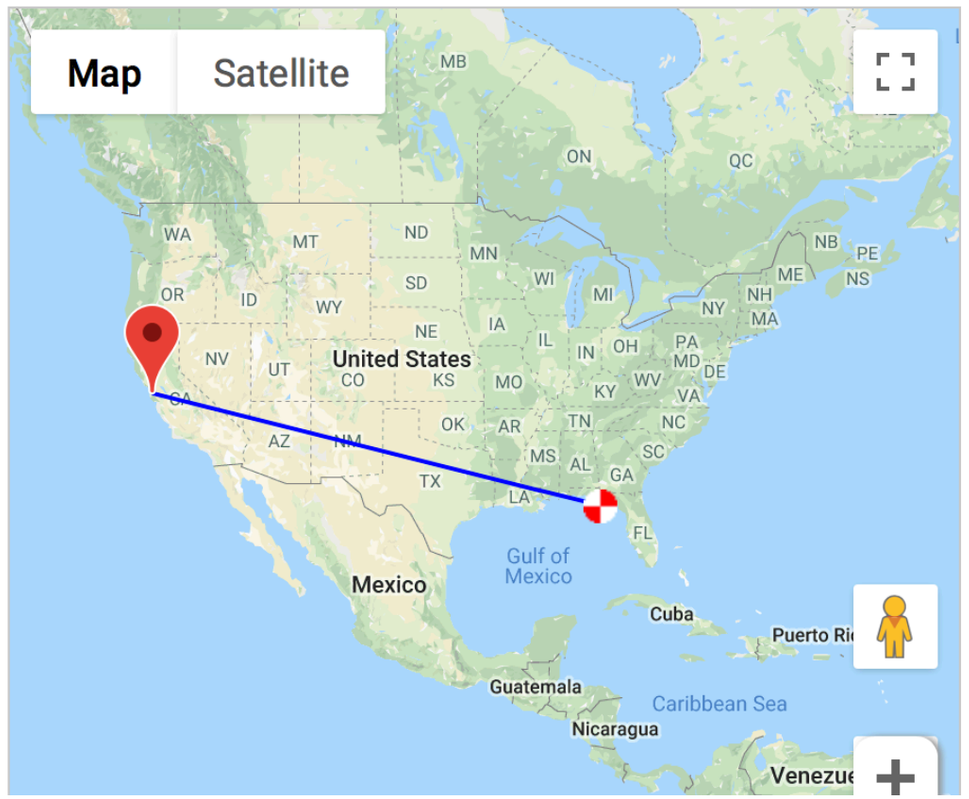
XML Subscriber **Lookups: 12062** Label

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 AC6WH)



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

Current (1 Second Contact)	*Effect*
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

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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

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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)

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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

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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

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RF Exposure

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- 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

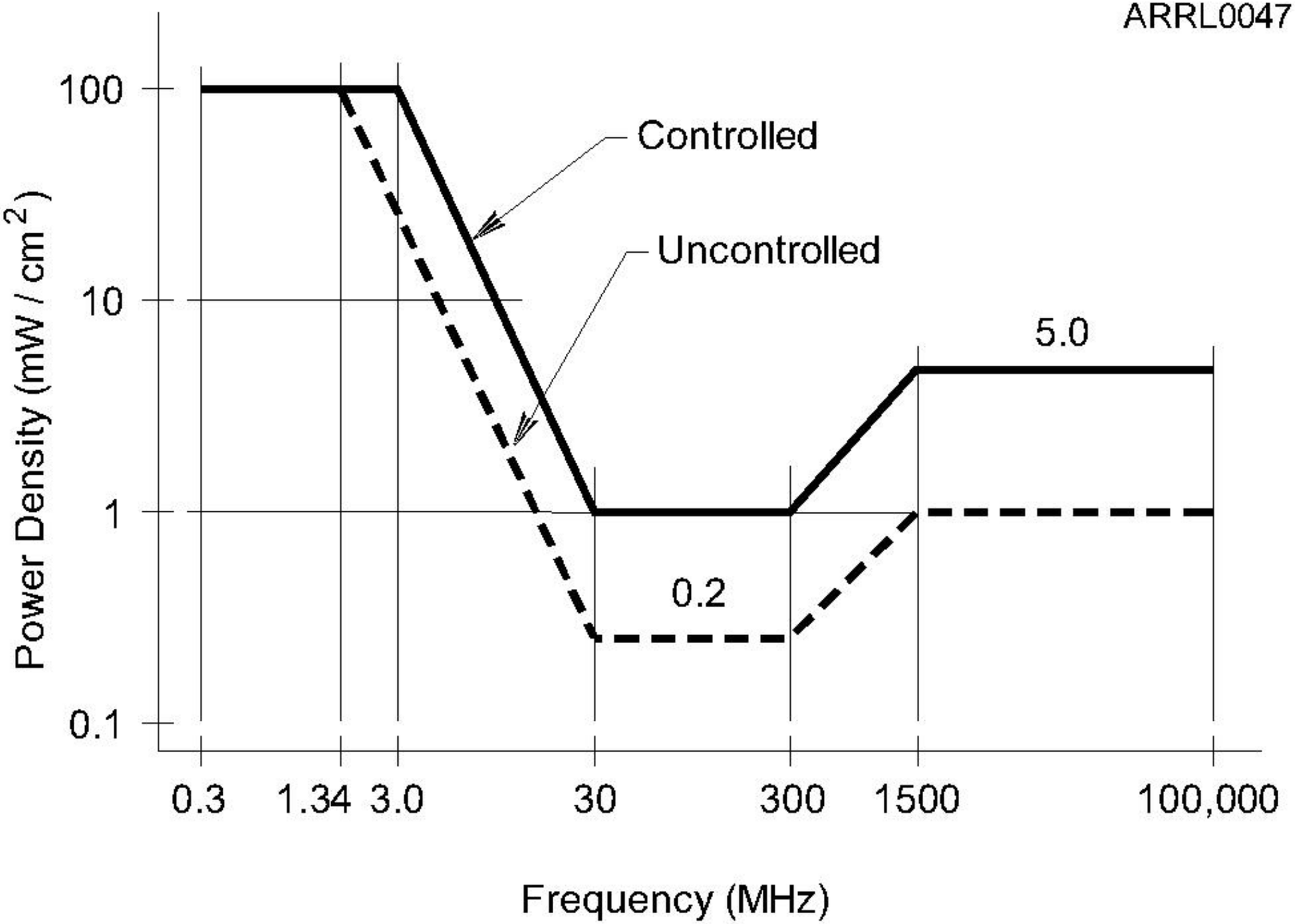
- When body parts act like antennas, those parts absorb RF energy at certain frequencies (wavelengths) more efficiently and increase risk.

- 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

Mode	*Duty Cycle*
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.

- At lower power levels, no evaluation is required. Varies with frequency – example: below 50 W at VHF.

- 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? (T0C02)

A. 3.5 MHz

B. 50 MHz

C. 440 MHz

D. 1296 MHz

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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

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Why do exposure limits vary with frequency? (T0C05)

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

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Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations? (T0C06)

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

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Why is duty cycle one of the factors used to determine safe RF radiation exposure levels? (T0C10)

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

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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

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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

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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. ½ 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

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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

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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

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That’s It!

- Good luck with the exam!