

Why HF?

Cupertino Amateur Radio Emergency Service

June 3, 2021



Agenda

- Frequency Spectrum
- What is High Frequency (HF)?
- What modes of communications are used on HF
- Equipment to operate on HF
- How is HF relevant to Emergency Communications?



UNITED STATES FREQUENCY ALLOCATIONS

THE RADIO SPECTRUM

RADIO SERVICES COLOR LEGEND

AERONAUTICAL MOBILE	EARTH SATELLITES	RADIO ASTRONOMY
AERONAUTICAL MOBILE SATELLITES	LAND MOBILE AERONAUTICAL	RADIO TERRESTRIAL AERONAUTICAL
AERONAUTICAL RADIOLOCATION	LAND MOBILE SATELLITES	RADIO LOCATION
MOBILE	MARITIME MOBILE AERONAUTICAL	RADIO LOCATION SATELLITES
AMATEUR SATELLITES	MARITIME MOBILE SATELLITES	RADIO NAVIGATION
BROADCASTING	MARITIME RADIOLOCATION	RADIO NAVIGATION SATELLITES
BROADCASTING SATELLITES	NAVIGATION AERONAUTICAL	RADIO TERRESTRIAL SATELLITES
EARTH EXPLORATION SATELLITES	NAVIGATION RADIOLOCATION	RADIO TERRESTRIAL SATELLITES
EARTH EXPLORATION SATELLITES	NAVIGATION SATELLITES	RADIO TERRESTRIAL SATELLITES
EARTH EXPLORATION SATELLITES	NAVIGATION SATELLITES	RADIO TERRESTRIAL SATELLITES
EARTH EXPLORATION SATELLITES	NAVIGATION SATELLITES	RADIO TERRESTRIAL SATELLITES
EARTH EXPLORATION SATELLITES	NAVIGATION SATELLITES	RADIO TERRESTRIAL SATELLITES

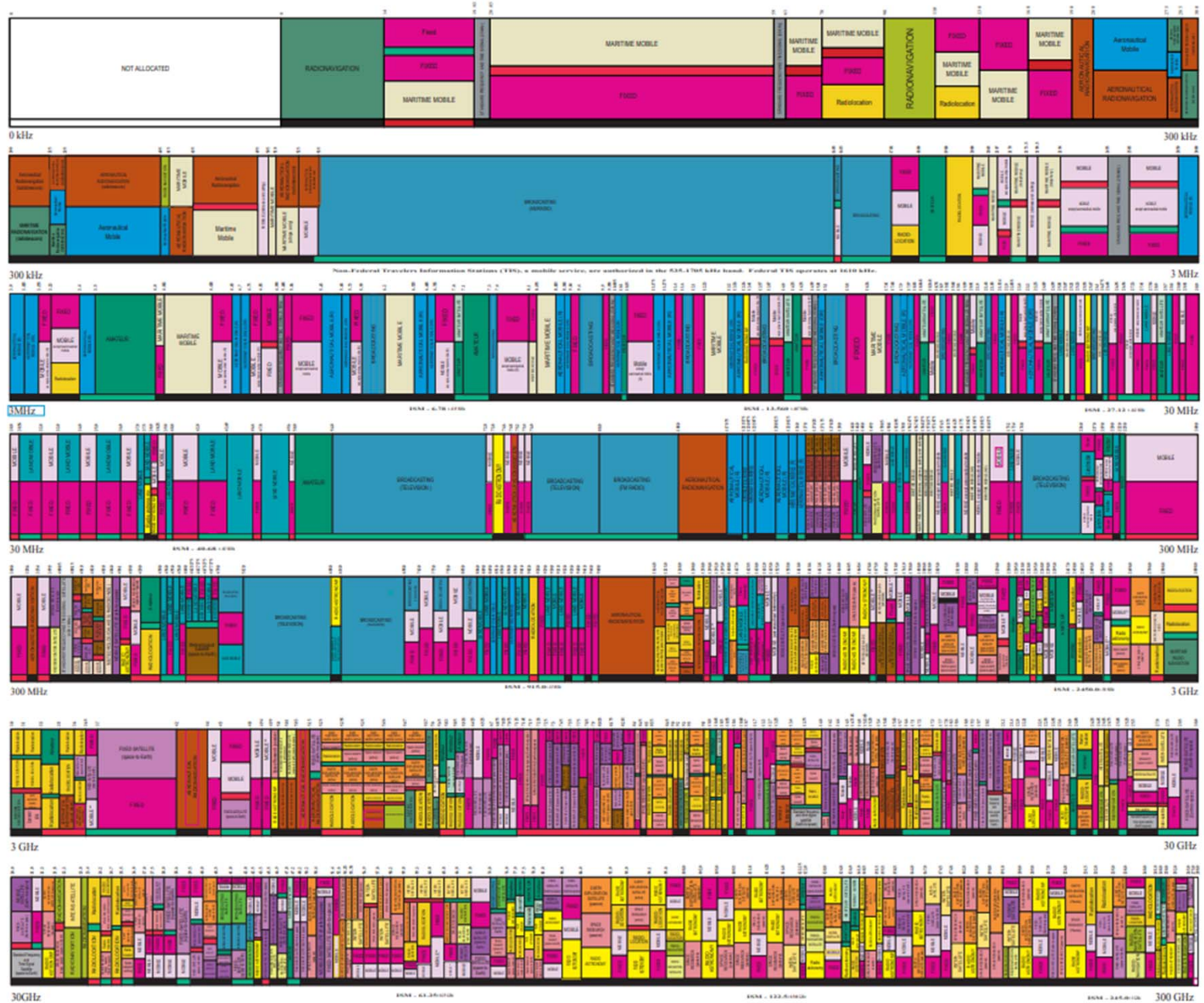
ACTIVITY CODE

FEDERAL EXCLUSIVE	FEDERAL-NON-FEDERAL SHARED
NON-FEDERAL EXCLUSIVE	

ALLOCATION USAGE DESIGNATION

SERVICE	EXAMPLE	HOW REPORTED
Primary	Fixed	Capital Letters
Secondary	Mobile	Not Capital with Intermediate Letters

U.S. DEPARTMENT OF COMMERCE National Telecommunications and Information Administration Office of Spectrum Management JANUARY 2018



Frequency Spectrum

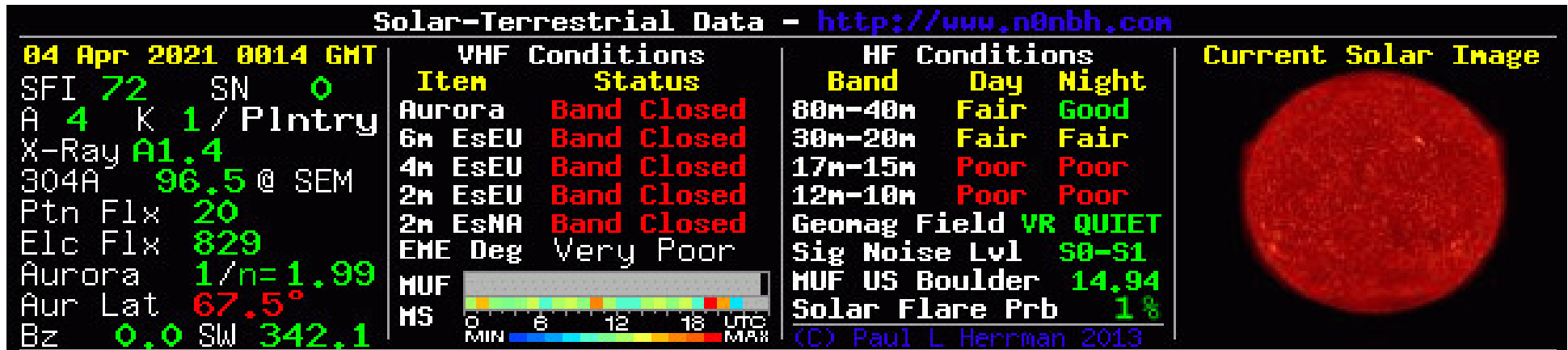
- **Remember the number 300 as in 300 million meters per second**
 - Planck's constant: $c = 299,792,458$ m/s
 - For computing bands, we use 300,000,000 meters/second

Spectrum	Frequency Range
VLF = Very Low Frequency	3KHz – 30KHz
LF = Low Frequency	30KHz – 300KHz
MF = Medium Frequency	300KHz – 3MHz
HF = High Frequency (Short Wave)	3MHz – 30MHz
VHF = Very High Frequency	30MHz – 300MHz
UHF = Ultra-High Frequency	300MHz – 3GHz



What is HF?

- High Frequency (HF) between 3MHz and 30MHz can be used for local and global communications depending on several factors
 - Maximum Usable Frequency (MUF)
 - Band conditions
 - Atmospheric, Ionosphere and Solar conditions



What is HF?

- **HF is used by a variety of radio services**
 - **Marine Mobile**
 - **Land Mobile**
 - **Aeronautical**
 - **Satellite**
 - **Amateur**

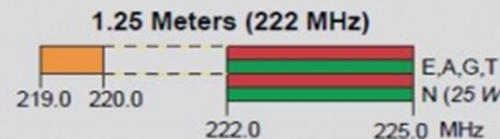
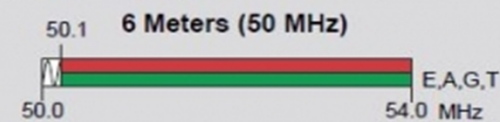
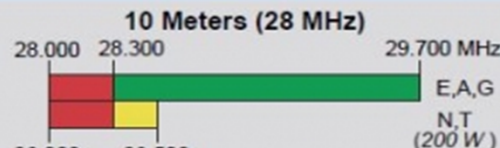
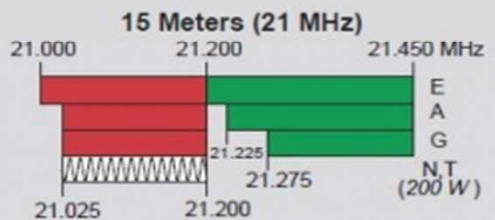
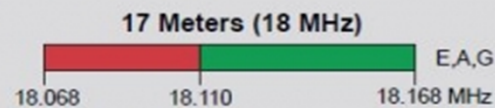
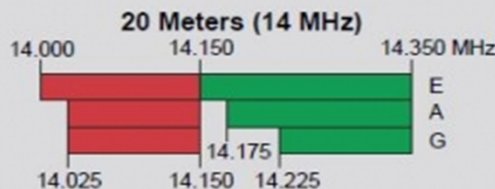
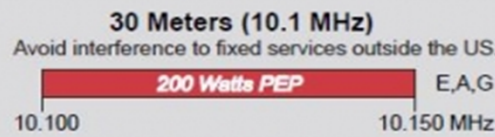
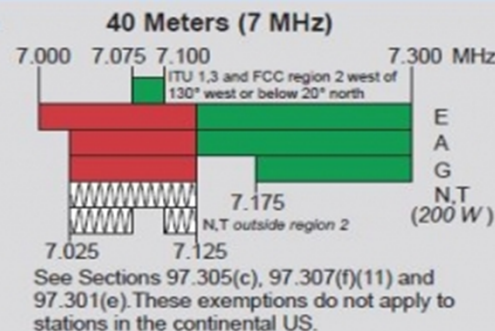
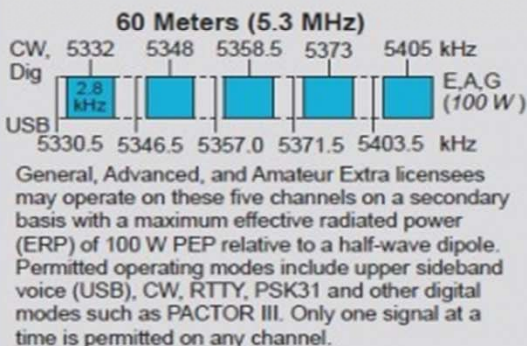
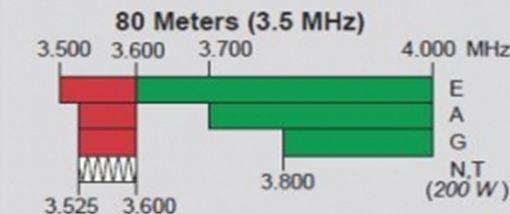
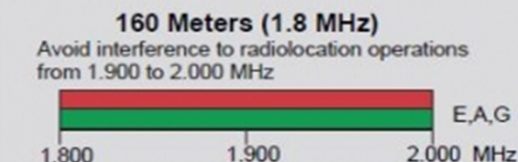
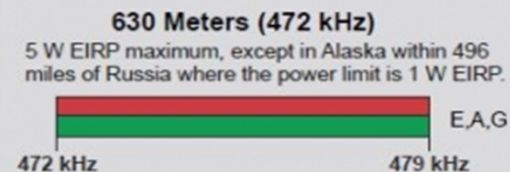


US Amateur Radio Bands

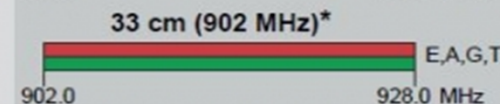
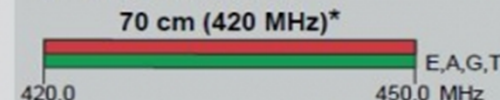
US AMATEUR POWER LIMITS — FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.



Amateurs wishing to operate on either 2,200 or 630 meters must first register with the Utilities Technology Council online at <https://utc.org/plc-database-amateur-notification-process/>. You need only register once for each band.



*Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.



All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz ‡	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

‡ No pulse emissions

KEY

Note: CW operation is permitted throughout all amateur bands.

MCW is authorized above 50.1 MHz, except for 144.0-144.1 and 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz

- = RTTY and data
- = phone and image
- = CW only
- = SSB phone
- = USB phone, CW, RTTY, and data
- = Fixed digital message forwarding systems only

- E = Amateur Extra
- A = Advanced
- G = General
- T = Technician
- N = Novice

See *ARRLWeb* at www.arrl.org for detailed band plans.

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What is HF?

- **The Amateur Radio Service has the following HF frequency allocations:**

Band	Frequencies	When to Use
80 / 75 Meters	3.5MHz – 4.0MHz	Evenings, night and early morning
40 Meters	7.2MHz – 7.3MHz	Day time is best, but nighttime can be good
30 Meters	10.1MHz – 10.15MHz	Day time, evenings (Data only)
20 Meters	14.0MHz – 14.35MHz	Day time and into the evening
17 Meters	18.68MHz – 18.168MHz	Day time
15 Meters	21.0MHz – 21.45MHz	Day time
12 Meters	24.89MHz – 24.98MHz	Day time
10 Meters	28.0MHz – 29.7MHz	Day time / Night for local communications

- **When is the best time to use a particular band? When the band is open.**



Modes of Communication on HF

CW – Continuous Wave (Morse Code)

- **CW is alive and well**

Digital Modes

- **ALE, Slow Scan TV, Olivia, PSK31, RTTY, WinLink**
- **Weak Signal: WSPR, WSJT (FT8, FT4)**

Phone:

- **AM, SSB, FM on 10 meters**



Equipment for Operating on HF

- Radio capable of operating on HF
- Power Supply
- Antenna Tuner
- Coax cable
- Antenna



- HF stations can be fixed or portable



Equipment for Operating on HF

- **Modern HF radios now come in 3 architectures**
 - **Superheterodyne – Yeasu FTdx 101D, Icom IC-756**
 - **Software Define Radios – Icom IC-7300, IC-7610, IC-705**
 - **Hybrid – Elecraft K4 (K4 SDR + K3s add-on)**
- **Antenna Tuners are devices that match the transceiver's antenna port impedance to the antenna (50 ohms)**
 - **Some radios have internal antenna tuners but with limited reach: 3:1 SWR matching**
 - **External antenna tuners have much higher reach: 10:1 SWR matching**



Equipment for Operating on HF

- **Coax cable examples**
 - **RG-8, RG-8s, LMR-400**
- **Antennas come in all shapes and sizes**
 - **Monoband vs. multi-band**
 - **Physical vs. Electrical wave lengths**
 - **Fixed mounted vs. portable**
 - **Verticals, horizontal, inverted “V”, etc.**
 - **Di-poles, beams**
- **Placement depends on many factors**
 - **Space limitations, obstacles, applicable restrictions (CC&Rs)**



How is HF relevant to Emergency Communications?

- **Puerto Rico**
 - **Use of Winlink over HF after Hurricane Maria on 20m and 40m**
- **California wildfires**
- **Earthquakes**
 - **Use of Near Vertical Incidence Skywave (NVIS) on 40m and 80m for local and regional communications**



How is HF relevant to Emergency Communications?

- **Without power:**
 - You cannot charge your cell phone
 - You cannot power your cordless phone
 - Batteries for cell towers may have 8 – 12 hours of service with no generator backup
 - WI-FI routers may be down
 - Telecommunications back-hauls may be impacted
 - Standard POT lines have been moved to digital services with little to no backup power (You get no dial-tone)
- **October 2019 PG&E PSPS demonstrated clearly commercial service decay over a 14-hour power outage period**



How is HF relevant to Emergency Communications?

- All modern HF and VHF/UHF radios run on standard 12v DC power to support point-to-point and net communications
- 40m and 80m HF bands can be used for cross-county and regional (CA operational area) communications
- Satellite phones can do this also but how many people have satellite phones?
- Standard ARES/RACES nets can be formed quickly following standard procedures
- VHF/UHF is used for local city/county communications



How is HF relevant to Emergency Communications?

Nets (not an exhaustive list)

- Marine Mobile nets (14.300MHz)
- Hurricane Watch (14.325MHz)
- CAL-OES Net 3922 KHz at 2000 hours local
- Western Public System Net 3952 KHz at 1800 hours local
- Local informal HF net 3878KHz each Tuesday at 2030 hours local



How can I Listen to HF Communications?

- If you do not have an HF transceiver or short wave receiver, you can use WebSDR and select an SDR receiving station:
 - <http://www.websdr.org/>
 - KFS Half Moon Bay: <http://69.27.184.62:8901/>
 - Northern Utah: <http://www.sdrutah.org/>



Thank you

Any Questions?

