

What's keeping Morse Code alive?

Considered a technology Dinosaur with several apparent 'replacement' communication technologies in existence, why is Morse code still used in so widely?

Foundations

- Whistle Language – Canary Islands – (Pre-history)



Foundations

- Whistle Language – Andulisa, Greece, Turkey, Ethiopia, Oaxaca, Mexico, etc..



Foundations of Electrical Communications

Electricity, Current, Magnetism, Fields



Michael Faraday
Basic electrical principles
1791 – 1867



Andre-Marie Ampere
Current flow & Magnetism
1775 – 1836



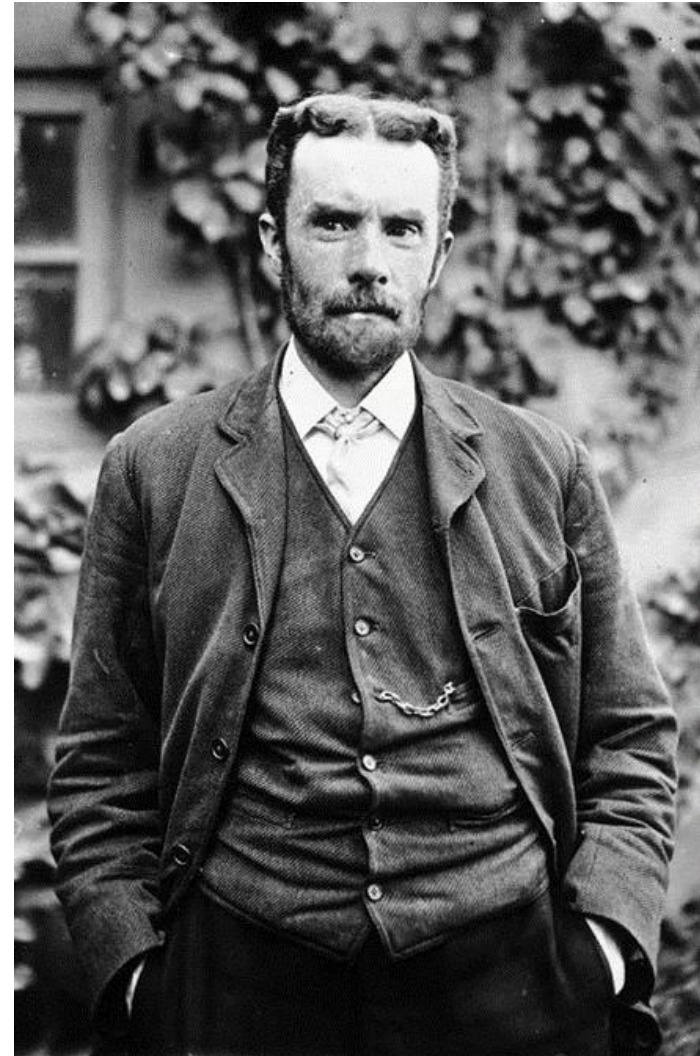
James Clerk Maxwell
Mathematical Realization
1831 - 1879

Foundations of Electrical Communications

Electricity, Current, Magnetism, Fields



James Clerk Maxwell
Mathematical Realization



Oliver Heaviside 1850 - 1925
'Simplified' Maxwell & 'Ionosphere'
Originally called 'The Heaviside Layer'

Foundation of Morse Code 1844

- First 'Code' and the 'Key'



Alfred Vail

Foundation of Morse Code

- Paper tape – (think “early ticker-tape machine”.)



Receiving Morse code 'by ear'.



Foundations of Morse Code

- 'International' Morse code

Friedrich Clemens Gerke was a German writer, journalist, musician and pioneer of telegraphy who revised the Morse code in 1848.

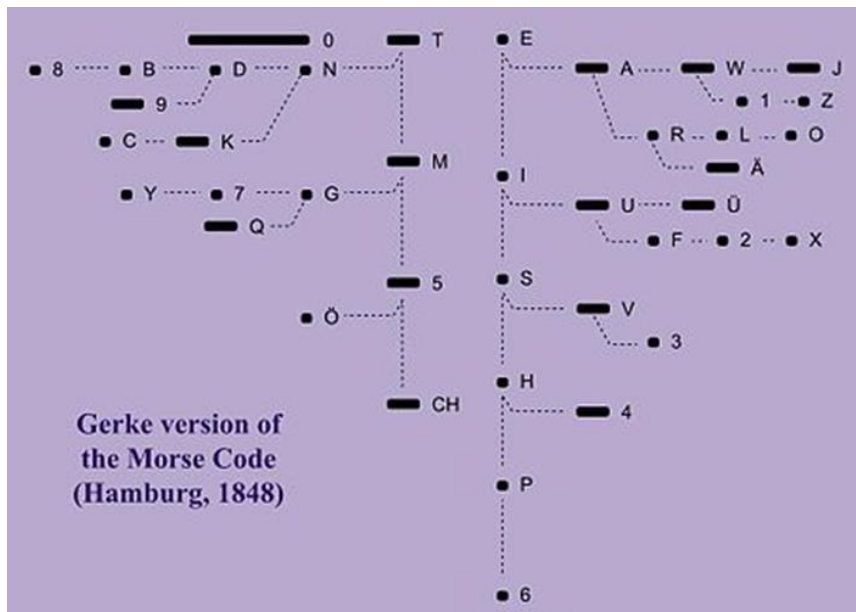
It is Gerke's version of the original (American) Morse code. called 'Contential' code now known as the **International Morse code**, was standardized by the **ITU** and still used today.



Friedrich Gerke
'Contential' Morse

Steps to ITU Morse:

- 1837 First Test
- 1938 Alfred Vail – Paper Tape
- 1840 ‘American’ Morse
- 184- Copy by ear!
- 1848 Greke – Revises Morse code
- 1851 Germany adopts ‘Continental’ Morse
- 1865 ITU – ‘International’ Morse



	American (Morse)	Continental (Gerke)	International (ITU)
A	• —	• — — —	• —
Ä		• — — — • —	
B	— • • •	— • • • •	— • • •
C	• • •	— • — — •	— • — — •
CH		— • — — — —	
D	— • •	— • • •	— • • •
E	•	•	•
F	• — • •	• • — • •	• • — • •
G	— • — •	— • — • •	— • — • •
H	• • • •	• • • •	• • • •
I	• •	• •	• •
J	— • — — •	• • — — —	• • — — —
K	— • — •	— • — • —	— • — • —
L	— • — —	• — • • •	• — • • •
M	— • —	— • — —	— • — —
N	— • •	— • • •	— • • •
O	• •	• — • — •	• — • — •
Ö		— • — — • •	
P	• • • • •	• • • • •	• • — • •
Q	• • — • •	— • — • • —	— • — • • —
R	• • • •	• — • • •	• — • • •
S	• • •	• • • •	• • • •
T	—	—	—
U	• • •	• • — •	• • — •
Ü		• • — • —	
V	• • — •	• • — • —	• • — • —
W	• • — —	• • — —	• • — —
X	• • • •	• • — • •	• • — • •
Y	• • • •	— • — • •	— • — • •
Z	• • • •	— • — • •	— • — • •
1	• — • — •	• — • — •	• — • — • —
2	• • — • •	• • — • •	• • — • • —
3	• • — • •	• • — • •	• • — • • —
4	• • — • •	• • — • •	• • — • • —
5	• — • — •	• — • — •	• — • — •
6	• • — • •	• • — • •	• • — • •
7	• • — • •	• • — • •	• • — • •
8	• • — • •	• • — • •	• • — • •
9	• • — • •	• • — • •	• • — • •
0	— — — — —	— — — — —	— — — — —
0 (alt)	—	—	—

The Civil War & Telegraphy 1861 - 1865



The Civil War & Telegraphy



Post Civil War & Telegraphy

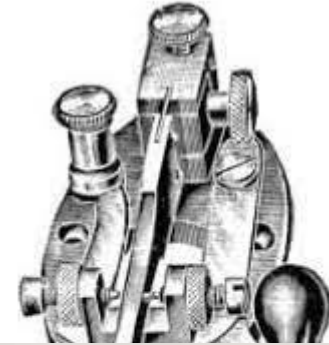


Evolution of 'Keys'



1904

1844



Evolution of 'Keys'

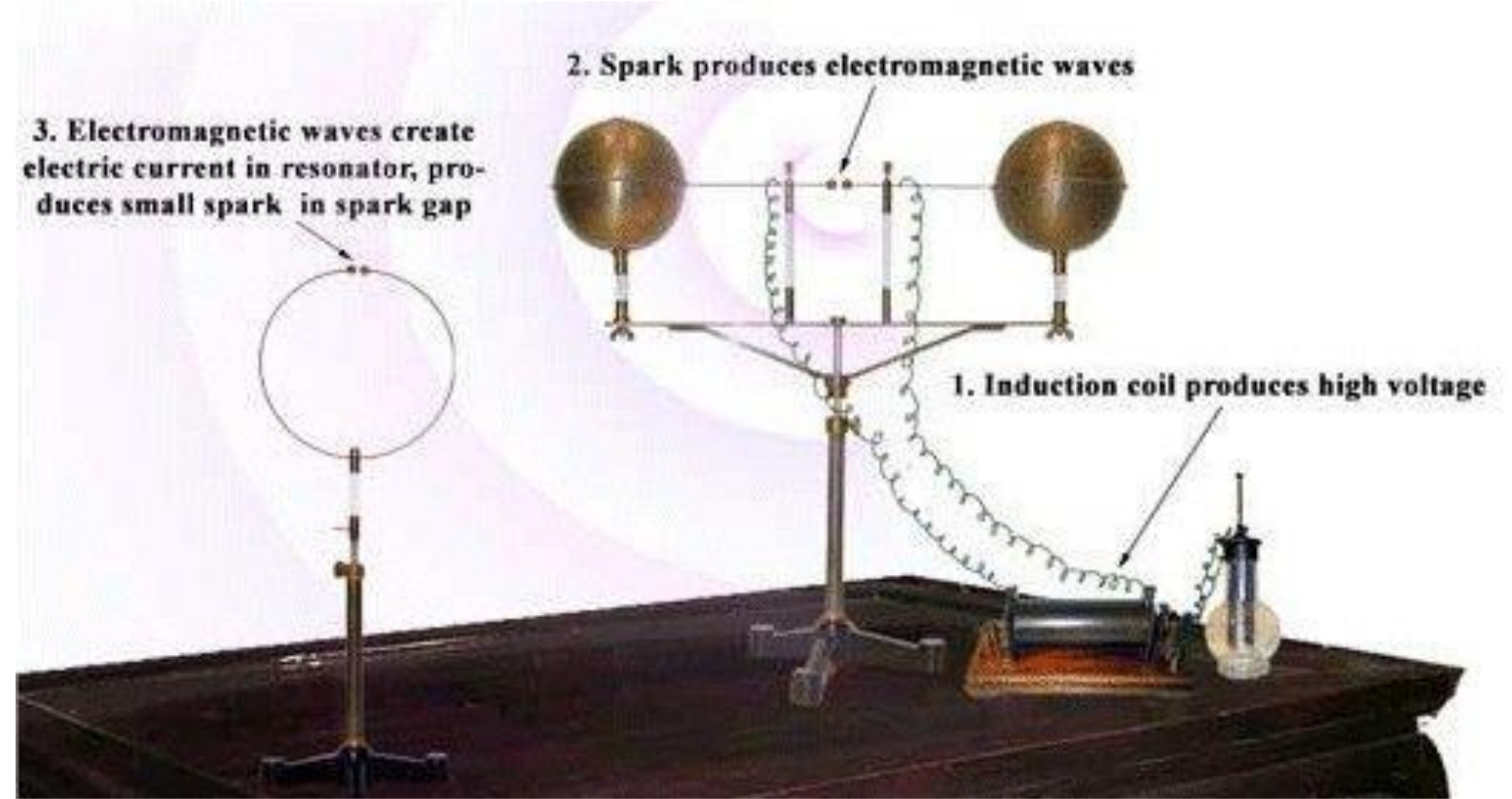


1906



1940 >>>>> Today

Hertz & Electromagnetic Radiation - 1885

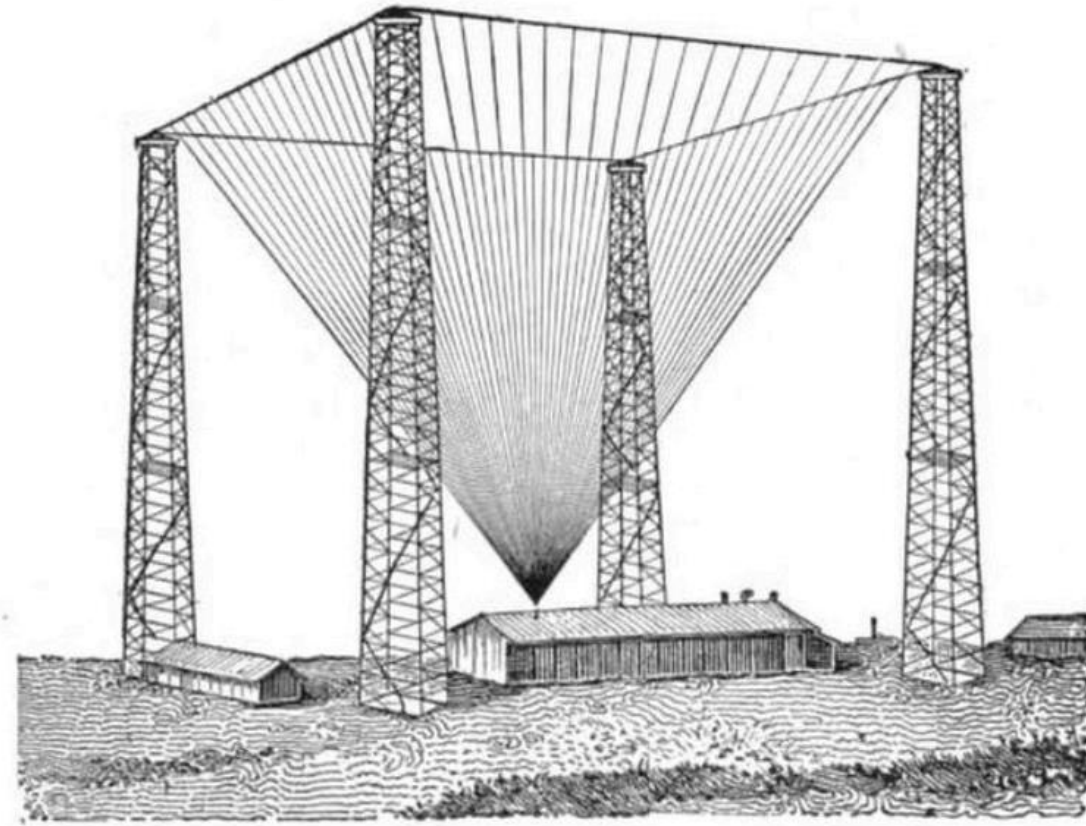


Hertz Quote: “Interesting proof that Maxwell’s was right but of no practical value.”

Marconi demonstrates 'wireless' telegraphy: 1897

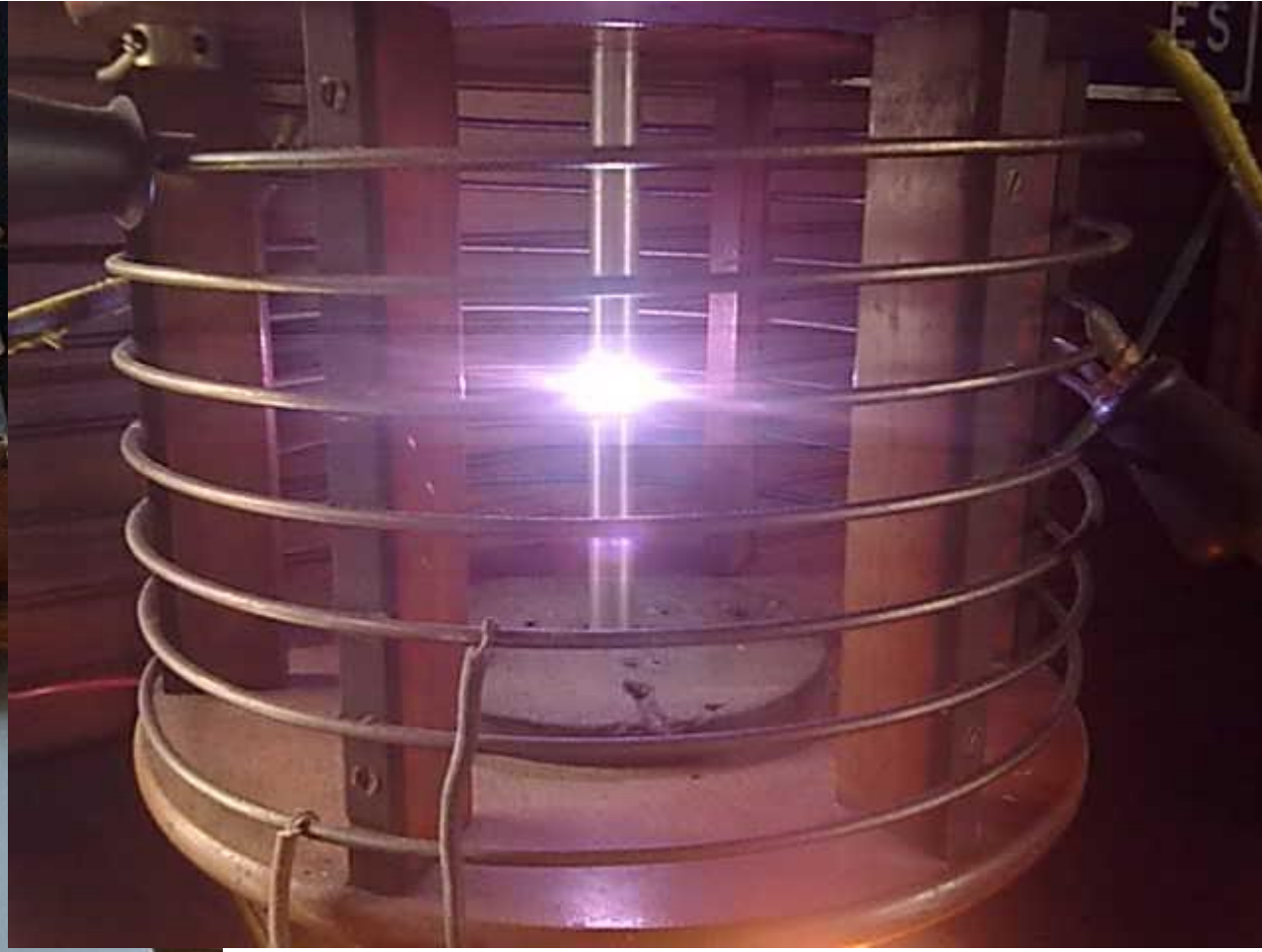
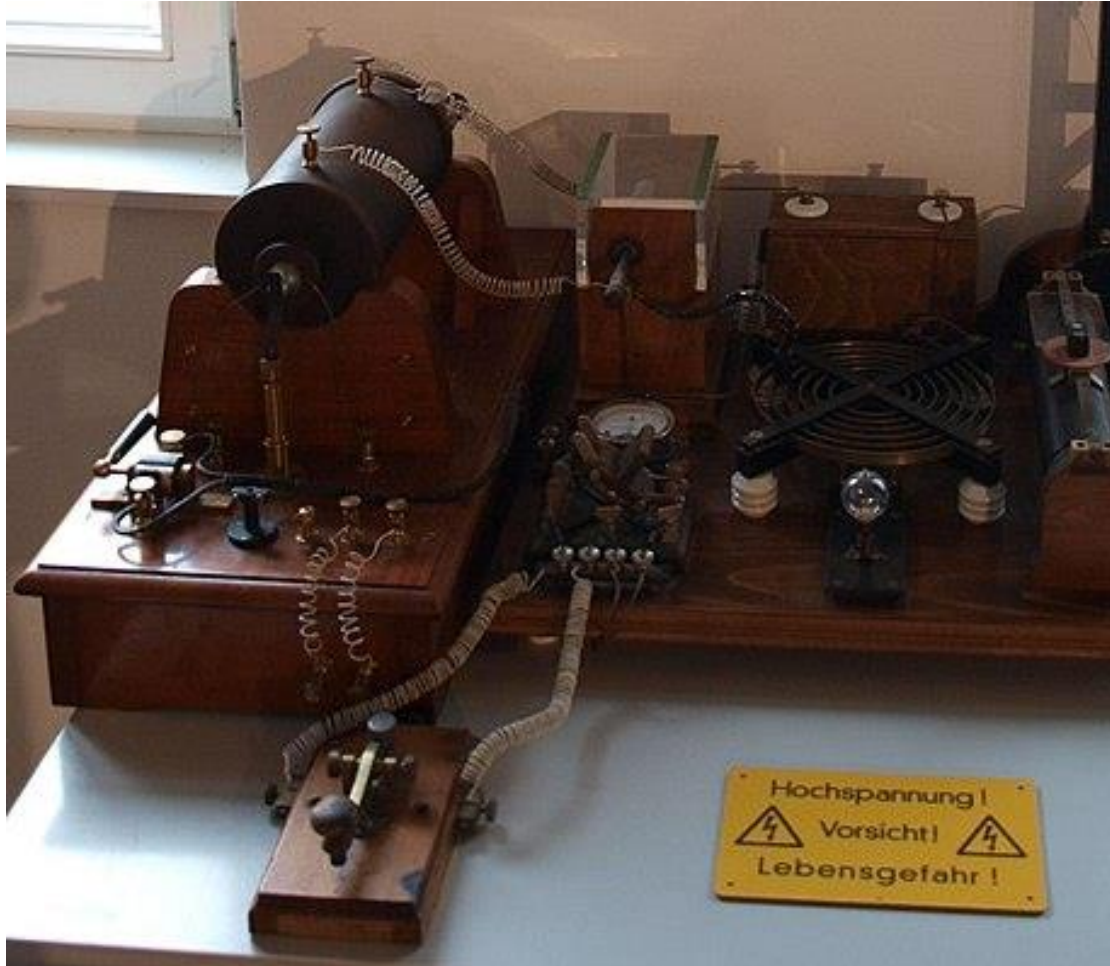


Morse code becomes radio's 'first language'.



"Big antennas & Long wavelengths"

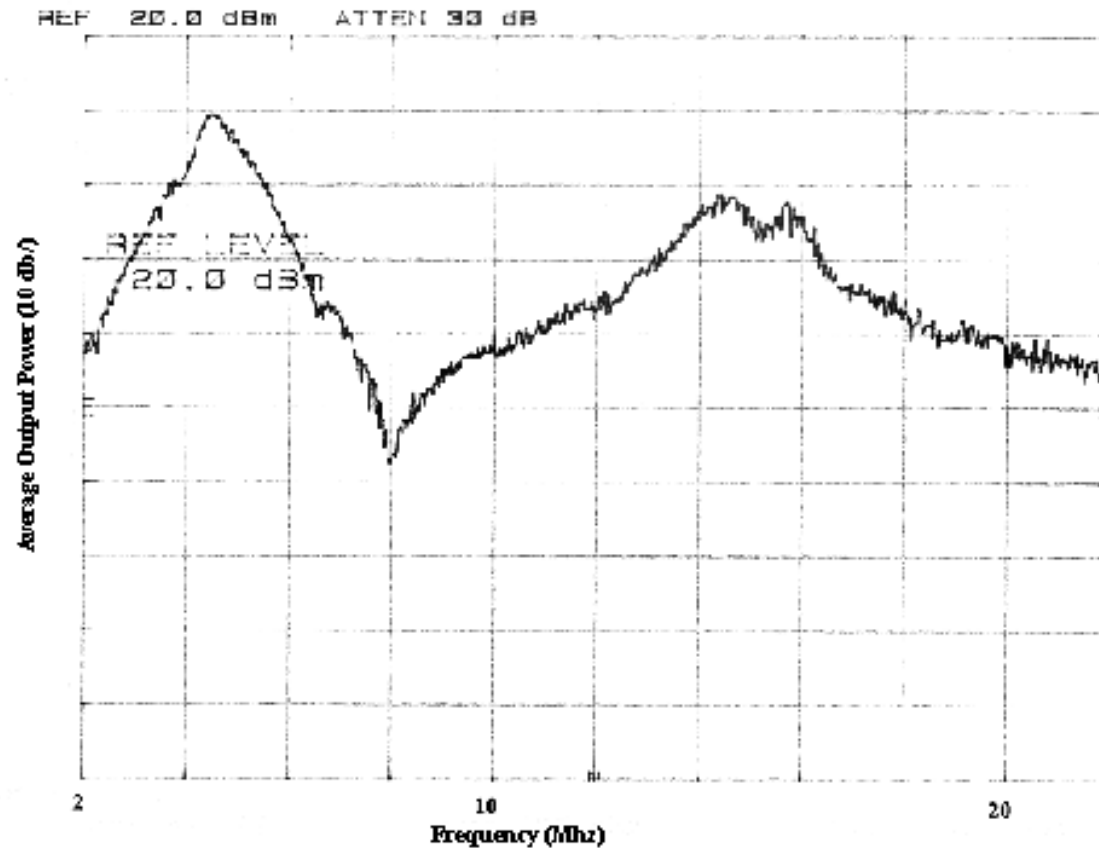
“King Spark”



<https://youtu.be/p9PJTZQgZwo>

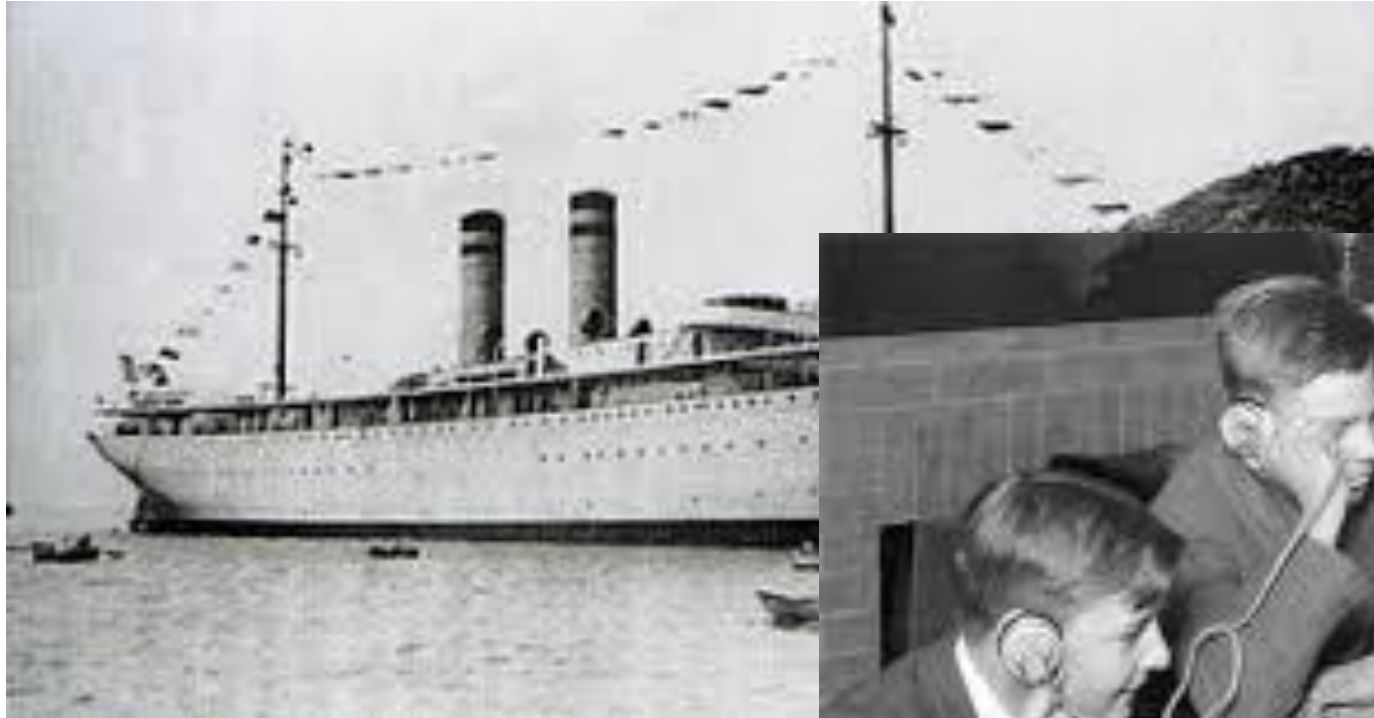
Foundations of Morse Code

- <https://youtu.be/p9PJTZQgZwo>



Spectrum of a Spark Gap Transmitter.

The Beginnings of Radio

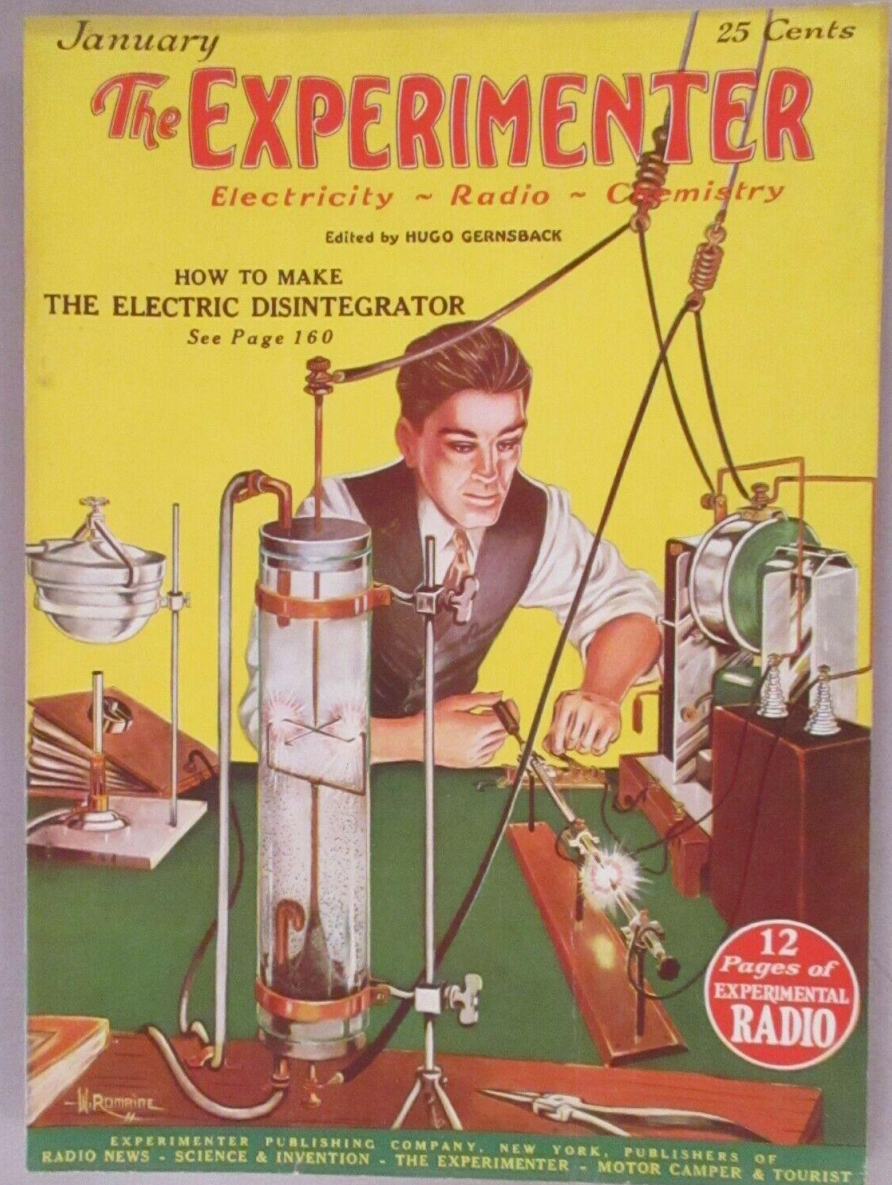


Note the size of the antenna!



The Electrical Experimenter

- an American technical science magazine published monthly. It was the success of a combination of a magazine and mail-order kit that has been published by **Hugo Gernsback** since 1900.
- The Electrical Experimenter continued under that name, focusing on scientific articles, but was eventually discontinued and continued with a broader focus as Science and Invention until August 1931.
- Those boys became the first 'Makers'



Amateur Radio gained wide interest.



Titanic! April 15, 1912

- Morse messages:
- CQD – Normal distress signal.
- SOS – Newly agreed distress signal.
- Radio Act of 1912, the U.S. government entered the regulatory realm of radio.



Regulation:

- The 1912 Radio law was preceded by the Wireless Ship Act of 1910, which had a key flaw: It did not allocate radio frequencies (*), and as a result, interference over the airwaves remained a major problem in wireless communications.
- *(At that time the only way known to ‘control’ frequencies was with antenna sizes.) ...and....*
- “What do we do about all those ‘Hams’? “

“Hams” Label Begins:

Early “HAM” Radio Station



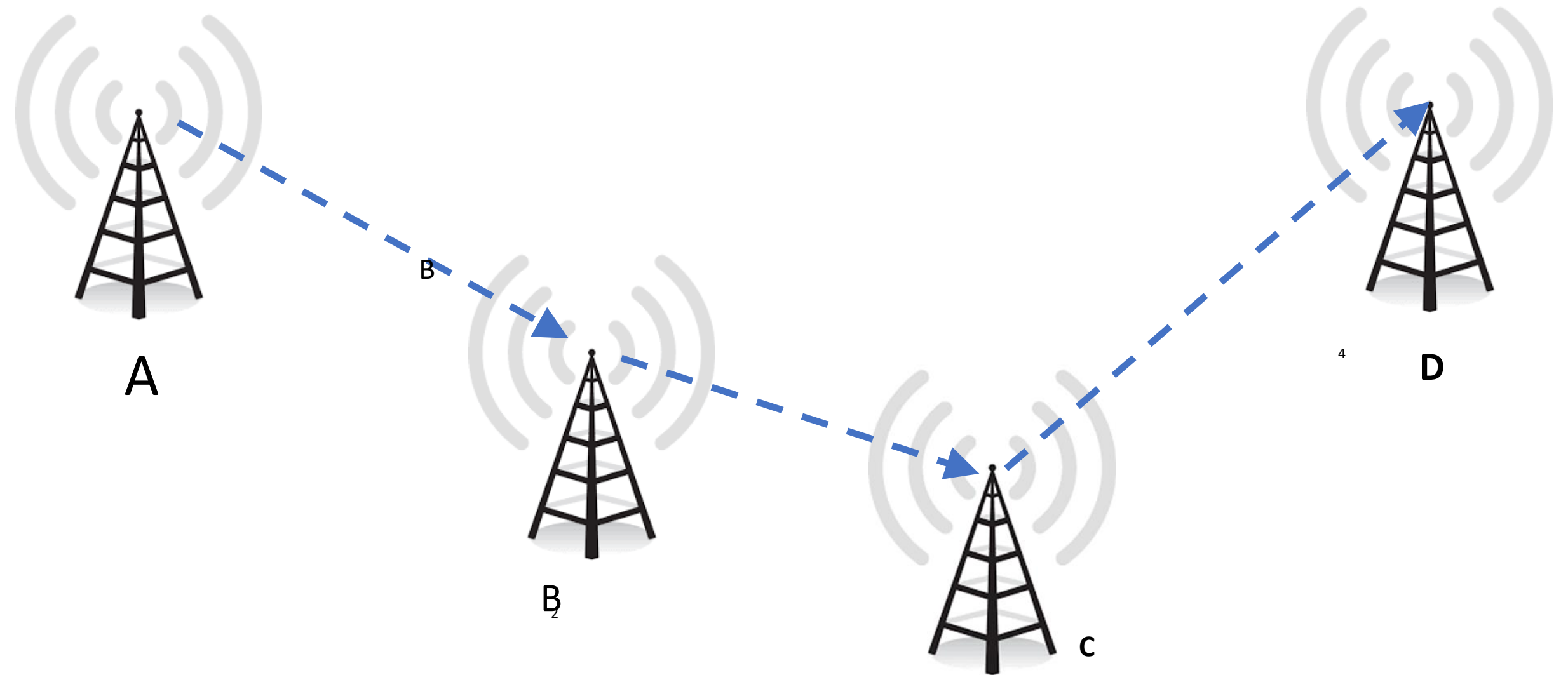
The ‘HAM’ legend:

- Three experimenters with last names Beginning with “H” “A” and “M” had self assigned their station call sign as “HAM”.
- They received national attention when their congressman defended their ‘right’ to use the airwaves.
- Congress agreed, and the term “HAM” has stuck with Amateur Radio ever since.

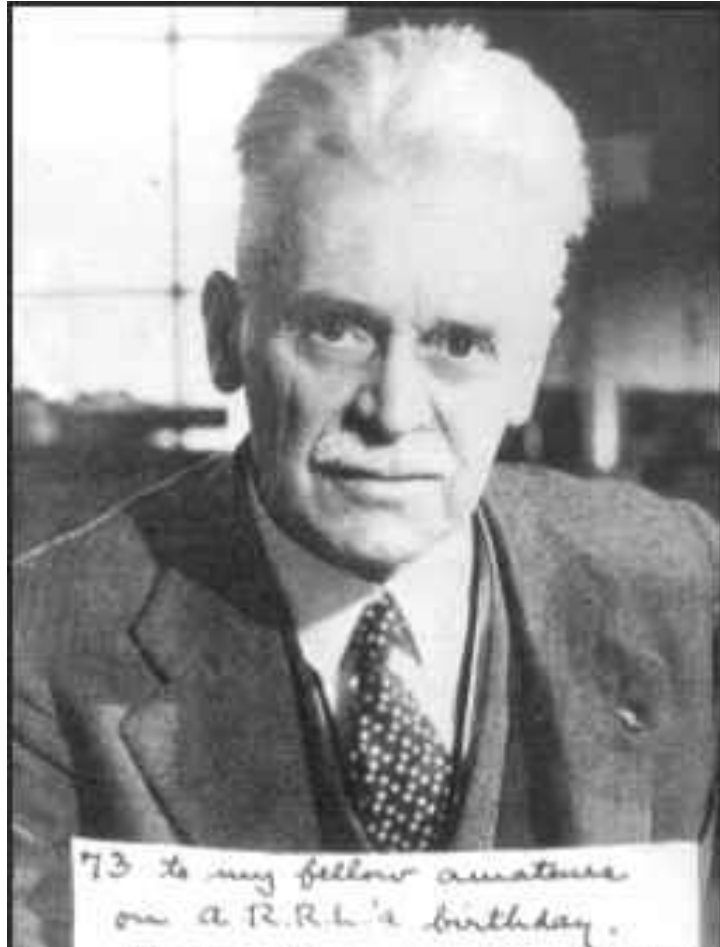
200 Meters and Down!

- The conclusion: *“Give those ‘Hams’ the frequencies from 200 Meters (wavelength) and down. With those useless short waves they won’t get out of their back yards and they’ll eventually give up.”*
- But, ‘HAMs’ had other ideas!
- Amateur Radio experimenters began working in these ‘useless’ short waves and began a revolution!

Relaying messages



American Radio Relay League: 1914



- **ARRL's Mission Statement:**

- To advance the art, science, and enjoyment of Amateur Radio. ARRL is the national association for Amateur Radio in the US. ...
- ARRL's underpinnings as Amateur Radio's witness, partner and forum are defined by five pillars: Public Service, Advocacy, Education, Technology, and Membership.

National Traffic System



- During disasters or other emergencies, radiograms are used to communicate information critical to saving lives or property, or to inquire about the health or welfare of a disaster victim.

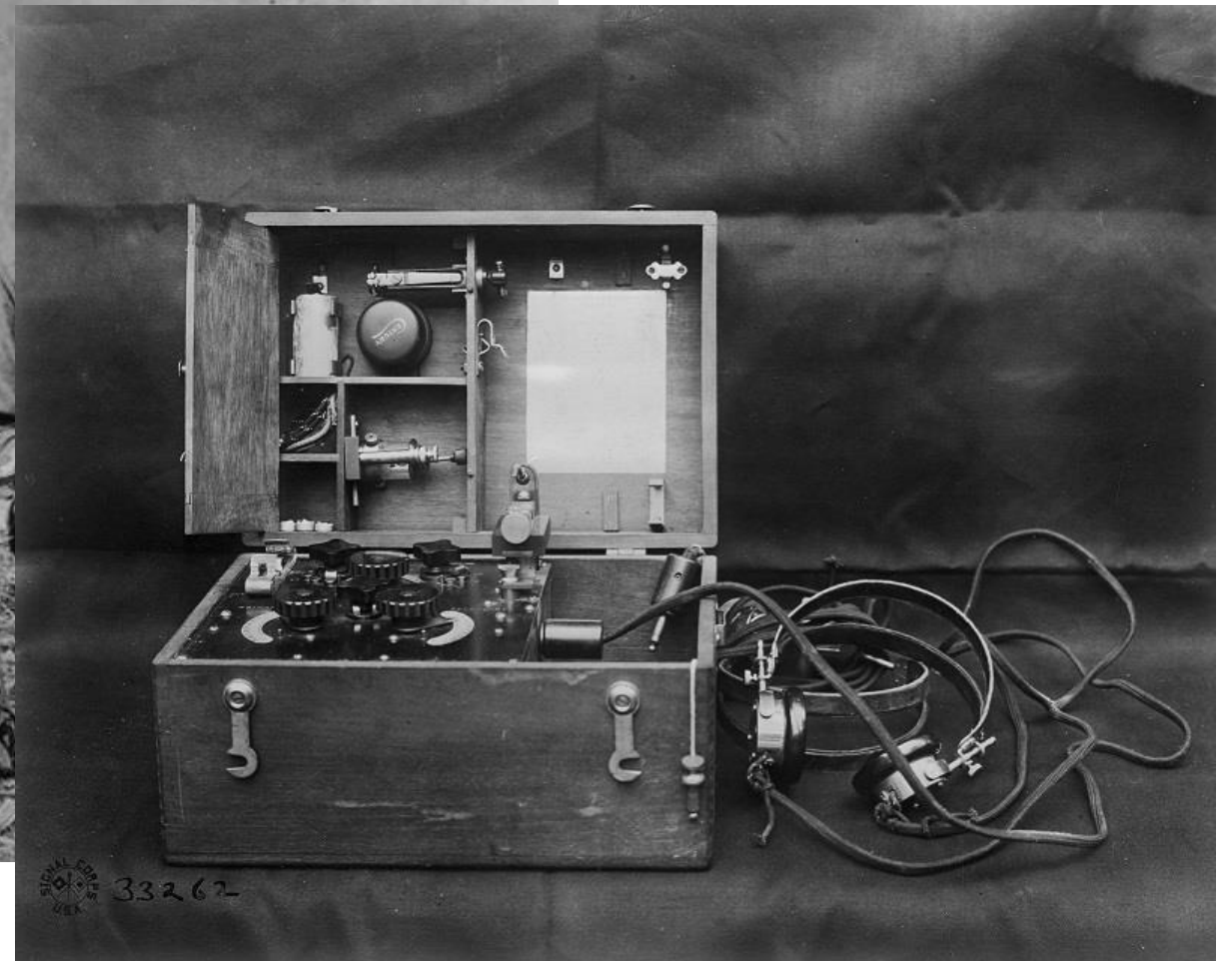
WW1 – July 1914 to November 1918

- By 1917, World War I put a stop to amateur radio. In the United States
- Congress ordered all amateur radio operators to cease operation and even dismantle their equipment.
- These restrictions were lifted after World War I ended
- the amateur radio service restarted on October 1, 1919

Radio in WW1

- As in the Civil War, communications was a vital link. Radio augmented the telegraph and 'field telephone'.
- The military installed 40,000 miles of combat lines and established 134 permanent telegraph offices and 273 telephone exchanges.
- Radio served where telegraph and telephone lines were impractical and coordinated naval activity for the first time in history.

Radio in WW1

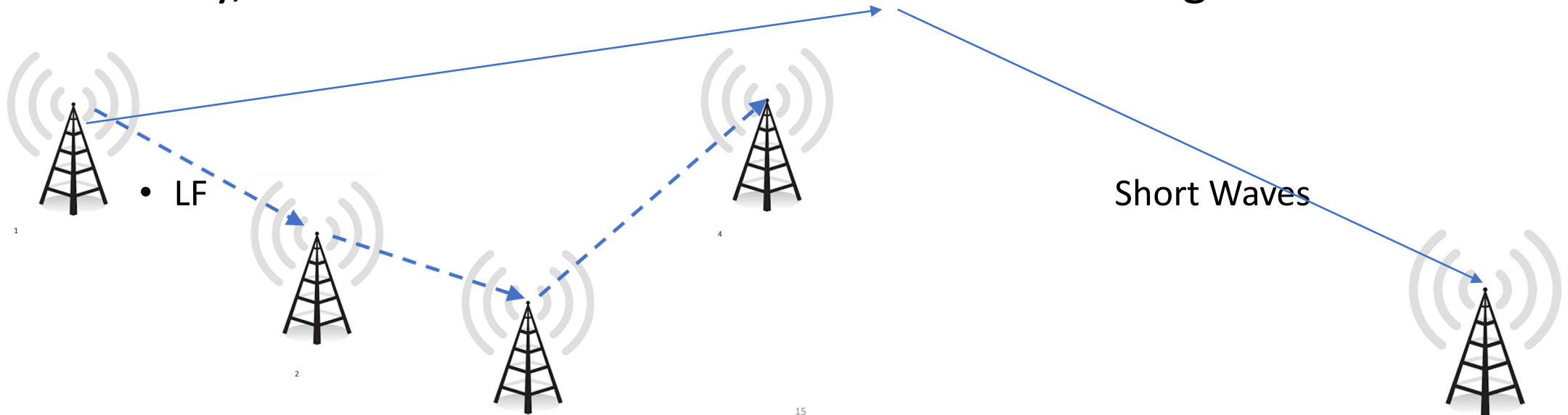


Tubes - CW

- John Ambrose Fleming
- Lee de Forest
- Edwin Howard Armstrong is considered by many to be the father of modern radio. Born in New York City in 1890, young Armstrong was fascinated by journalist Ray Stannard Baker's *The Boy's Book of Inventions* and other stories of popular engineering. He became a "radio boy," one of many swept up in a ham radio craze just after the turn of the century.
- Armstrong designed the circuits that not only detected and amplified radio waves; but also generate them.

SKIP!

- During this period of experimentation and message ‘Traffic’ handling radio amateurs discovered they could ‘skip’ signals in these “Useless” Short Wave frequencies over longer distances!
- Suddenly, short wave communication had ‘seven league boots’!

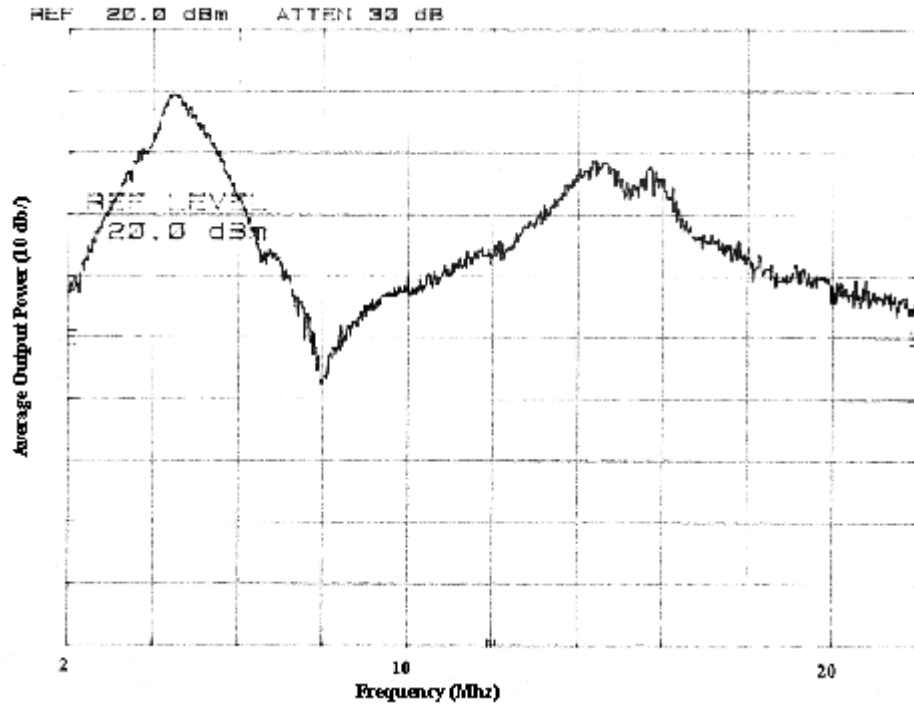


Voice over Radio - 1921

- AM 1919
- Edwin Armstrong - Oscillator circuits gave us narrow bandwidth
- super heterodyne receiver. The basis for most existing receivers.
- (Note: Direct Conversion and Software Defined Radio have displaced heterodyne in recent years.)
- FM 1933
- Armstrong – suppressed by RCA as a ‘threat’ to its expanding AM radio base.

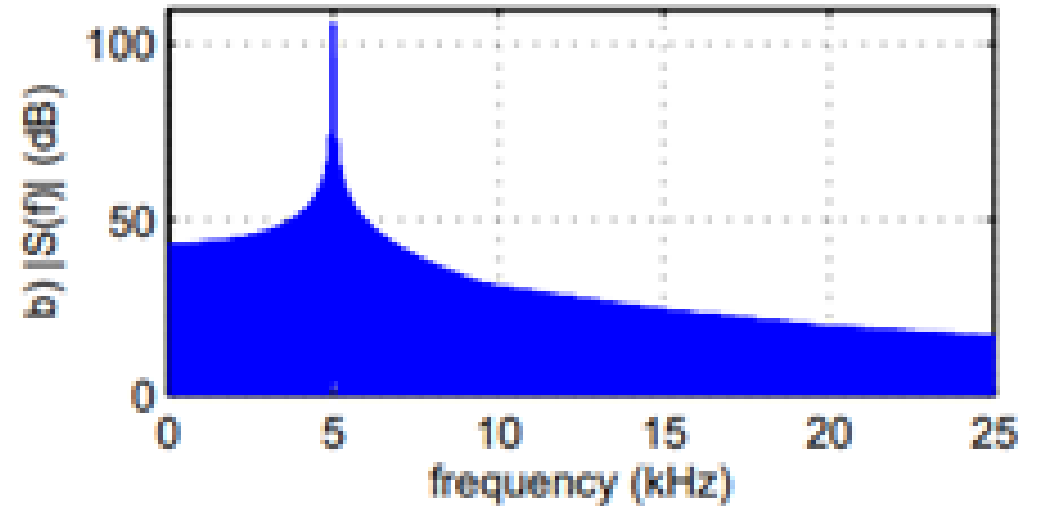


Spark vs Continuous Wave (CW) Bandwidth



Spark

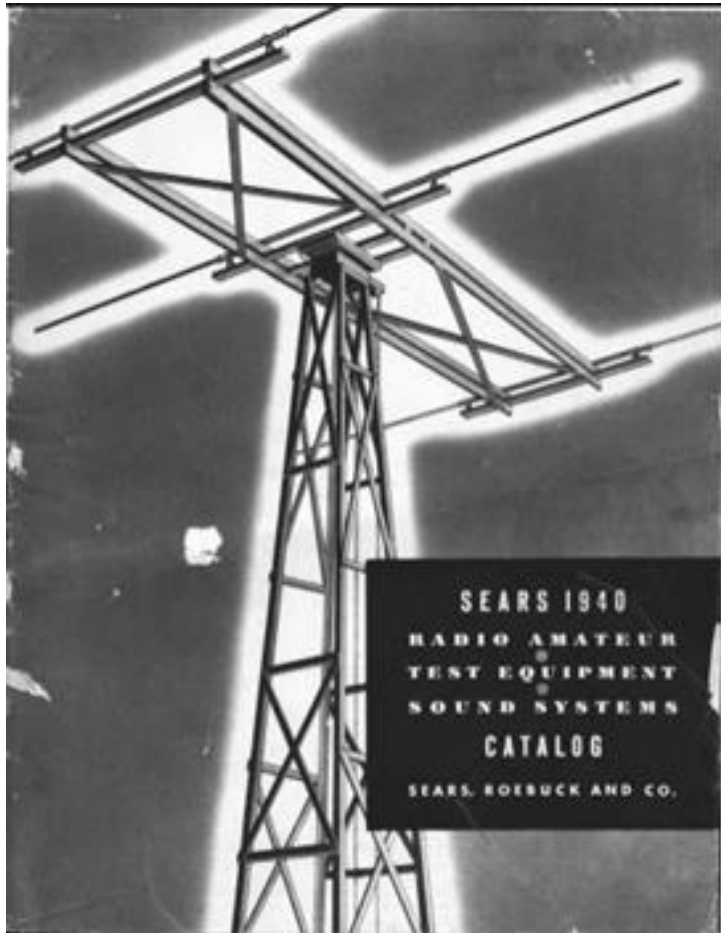
Continuous Wave (CW)



Emergency Communications

- In 1935, the Amateur Radio Emergency Service (ARES) was established by the American Radio Relay League.
- Licensed amateur radio operators belong to the ARES, registered their equipment and qualifications to be ready to assist the public in the event of a disaster.
- Meanwhile:... Commercial Radio Broadcasting and the federal government pushed Amateur Radio into even further into those 'useless' higher frequencies.

Equipment Manufacturers



HALLICRAFTERS

The New SUPER DEFIANT
 The best Halli-crafting receiver... More power and more and more audio than the standard 100 watt... \$99.50

New HALLICRAFTERS Sky Champion
 The Sky Champion... \$49.50

HALLICRAFTERS Sky Buddy
 The Sky Buddy... \$29.50

HALLICRAFTERS Skyrider 5-10
 The Skyrider... \$69.50

TUBES

Elmer High Frequency Tubes

Type	Power	Frequency	Price
6X4	100	100-1000	\$12.00
6X5	100	100-1000	\$12.00
6X6	100	100-1000	\$12.00
6X7	100	100-1000	\$12.00
6X8	100	100-1000	\$12.00
6X9	100	100-1000	\$12.00
6X10	100	100-1000	\$12.00
6X11	100	100-1000	\$12.00
6X12	100	100-1000	\$12.00
6X13	100	100-1000	\$12.00
6X14	100	100-1000	\$12.00
6X15	100	100-1000	\$12.00
6X16	100	100-1000	\$12.00
6X17	100	100-1000	\$12.00
6X18	100	100-1000	\$12.00
6X19	100	100-1000	\$12.00
6X20	100	100-1000	\$12.00
6X21	100	100-1000	\$12.00
6X22	100	100-1000	\$12.00
6X23	100	100-1000	\$12.00
6X24	100	100-1000	\$12.00
6X25	100	100-1000	\$12.00
6X26	100	100-1000	\$12.00
6X27	100	100-1000	\$12.00
6X28	100	100-1000	\$12.00
6X29	100	100-1000	\$12.00
6X30	100	100-1000	\$12.00
6X31	100	100-1000	\$12.00
6X32	100	100-1000	\$12.00
6X33	100	100-1000	\$12.00
6X34	100	100-1000	\$12.00
6X35	100	100-1000	\$12.00
6X36	100	100-1000	\$12.00
6X37	100	100-1000	\$12.00
6X38	100	100-1000	\$12.00
6X39	100	100-1000	\$12.00
6X40	100	100-1000	\$12.00
6X41	100	100-1000	\$12.00
6X42	100	100-1000	\$12.00
6X43	100	100-1000	\$12.00
6X44	100	100-1000	\$12.00
6X45	100	100-1000	\$12.00
6X46	100	100-1000	\$12.00
6X47	100	100-1000	\$12.00
6X48	100	100-1000	\$12.00
6X49	100	100-1000	\$12.00
6X50	100	100-1000	\$12.00

Raytheon Power Tubes

Type	Power	Frequency	Price
6X5	100	100-1000	\$12.00
6X6	100	100-1000	\$12.00
6X7	100	100-1000	\$12.00
6X8	100	100-1000	\$12.00
6X9	100	100-1000	\$12.00
6X10	100	100-1000	\$12.00
6X11	100	100-1000	\$12.00
6X12	100	100-1000	\$12.00
6X13	100	100-1000	\$12.00
6X14	100	100-1000	\$12.00
6X15	100	100-1000	\$12.00
6X16	100	100-1000	\$12.00
6X17	100	100-1000	\$12.00
6X18	100	100-1000	\$12.00
6X19	100	100-1000	\$12.00
6X20	100	100-1000	\$12.00
6X21	100	100-1000	\$12.00
6X22	100	100-1000	\$12.00
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6X26	100	100-1000	\$12.00
6X27	100	100-1000	\$12.00
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6X31	100	100-1000	\$12.00
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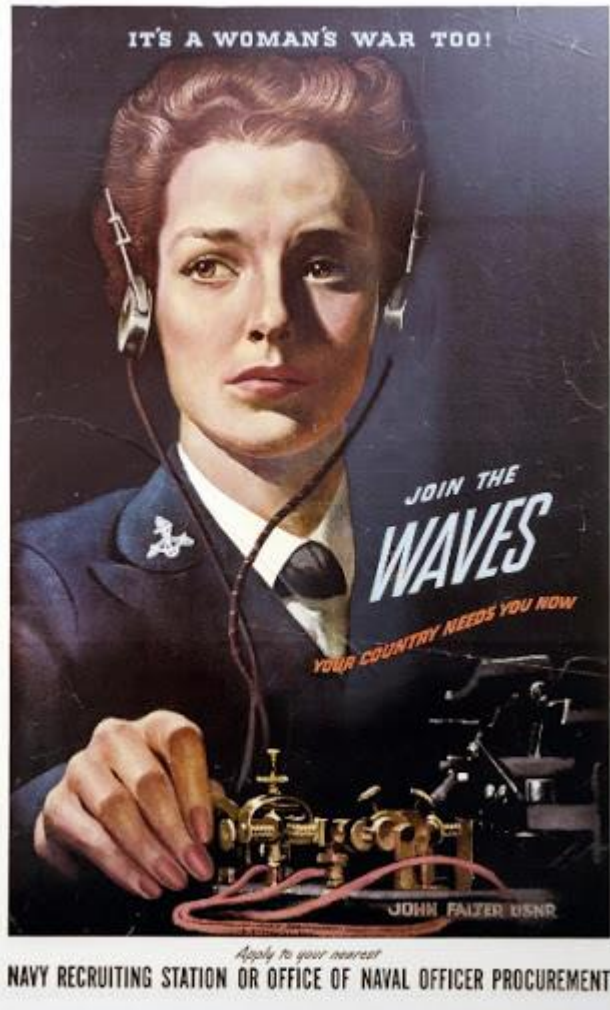
Gold and Photo Caps

HAMMILLIN 10-4 BAND SWITCHING EXCITER KIT
 For 10, 20, 40 and 80 Meter Bands... \$6.90

HAMMILLIN 10-40 BAND SWITCHING EXCITER KIT
 For 10, 20, 40 and 80 Meter Bands... \$12.95

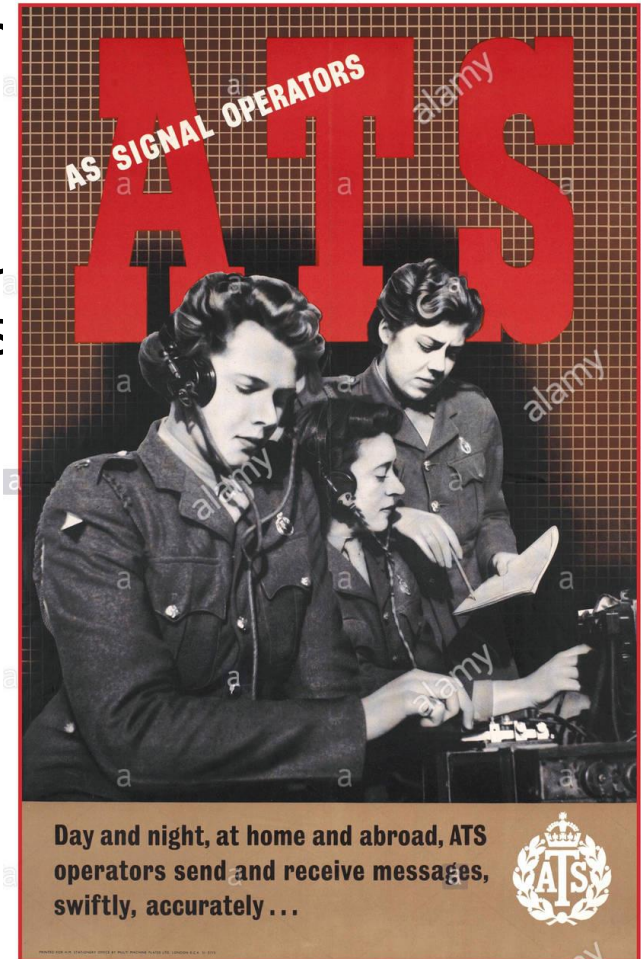
HAMMILLIN PA-500 AMPLIFIER FOUNDATION KIT
 For 10, 20, 40 and 80 Meter Bands... \$1.95

WW2 September 1939 to September 1945

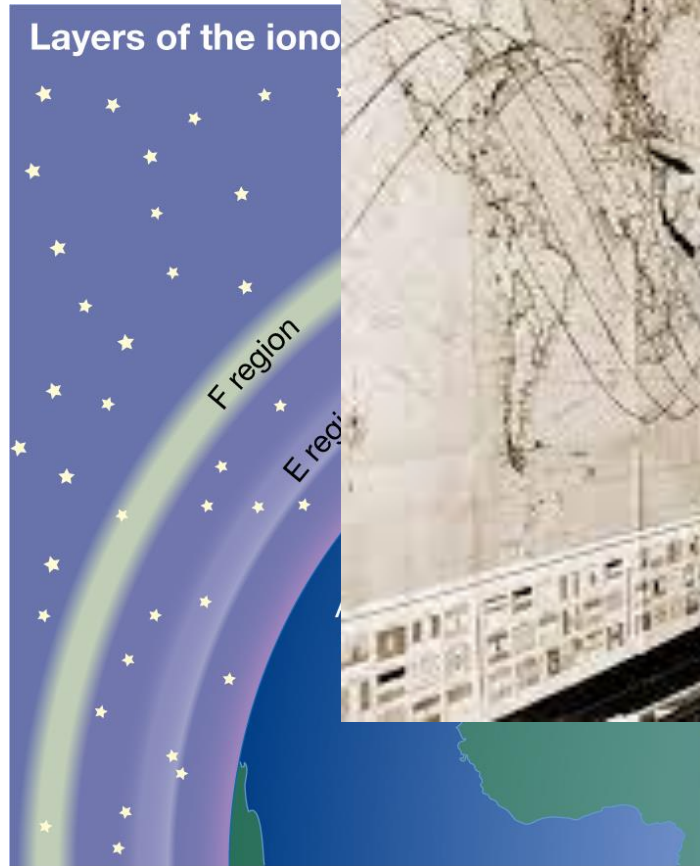
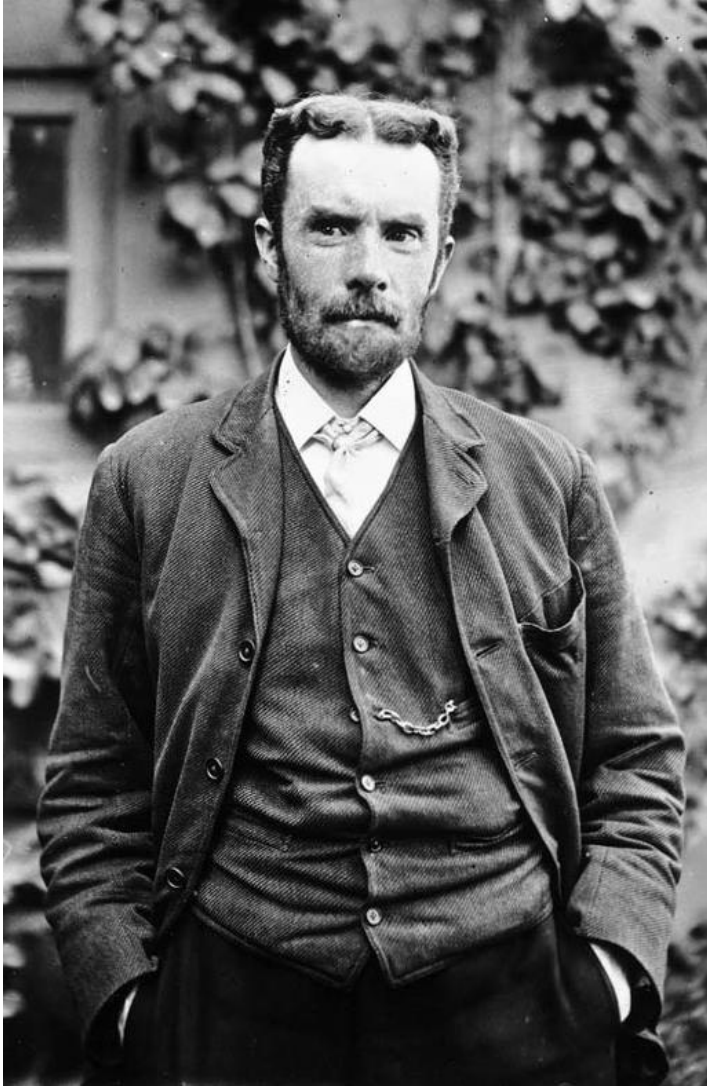


down all amateur radio traf

alled on known radio amateu
ded military communications
erators and technicians.



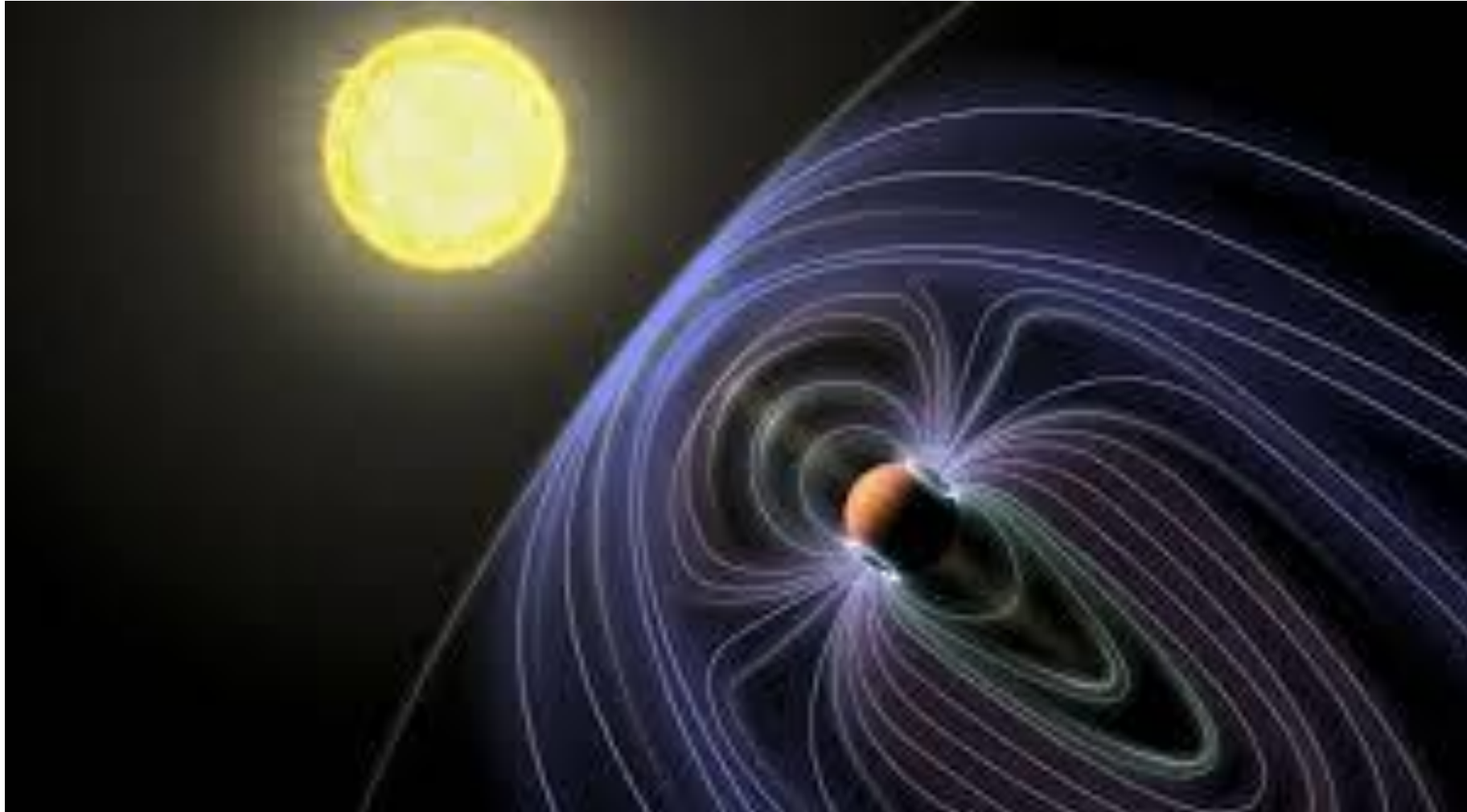
Ionosphere 'Layers' & 'Belts'



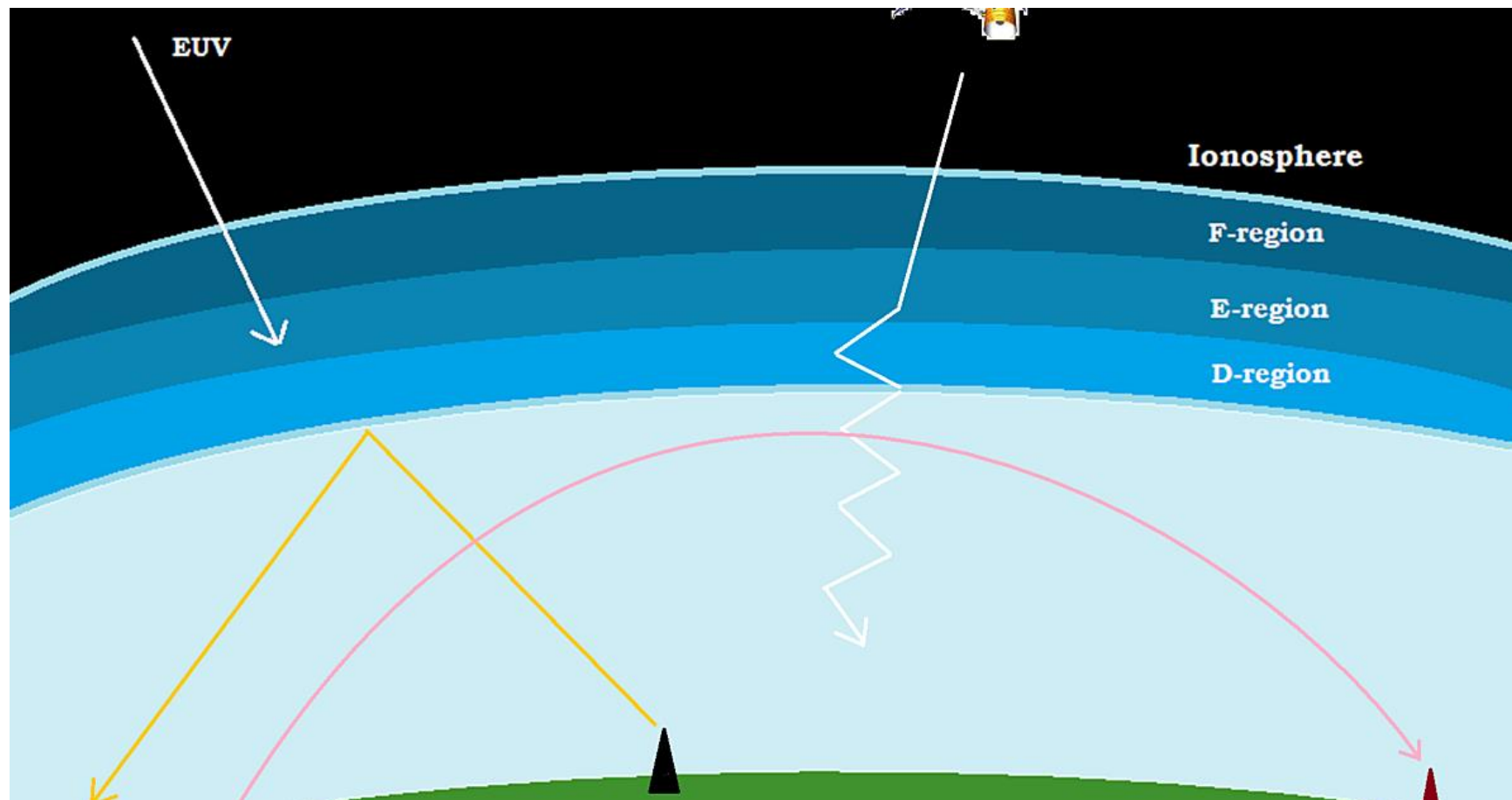
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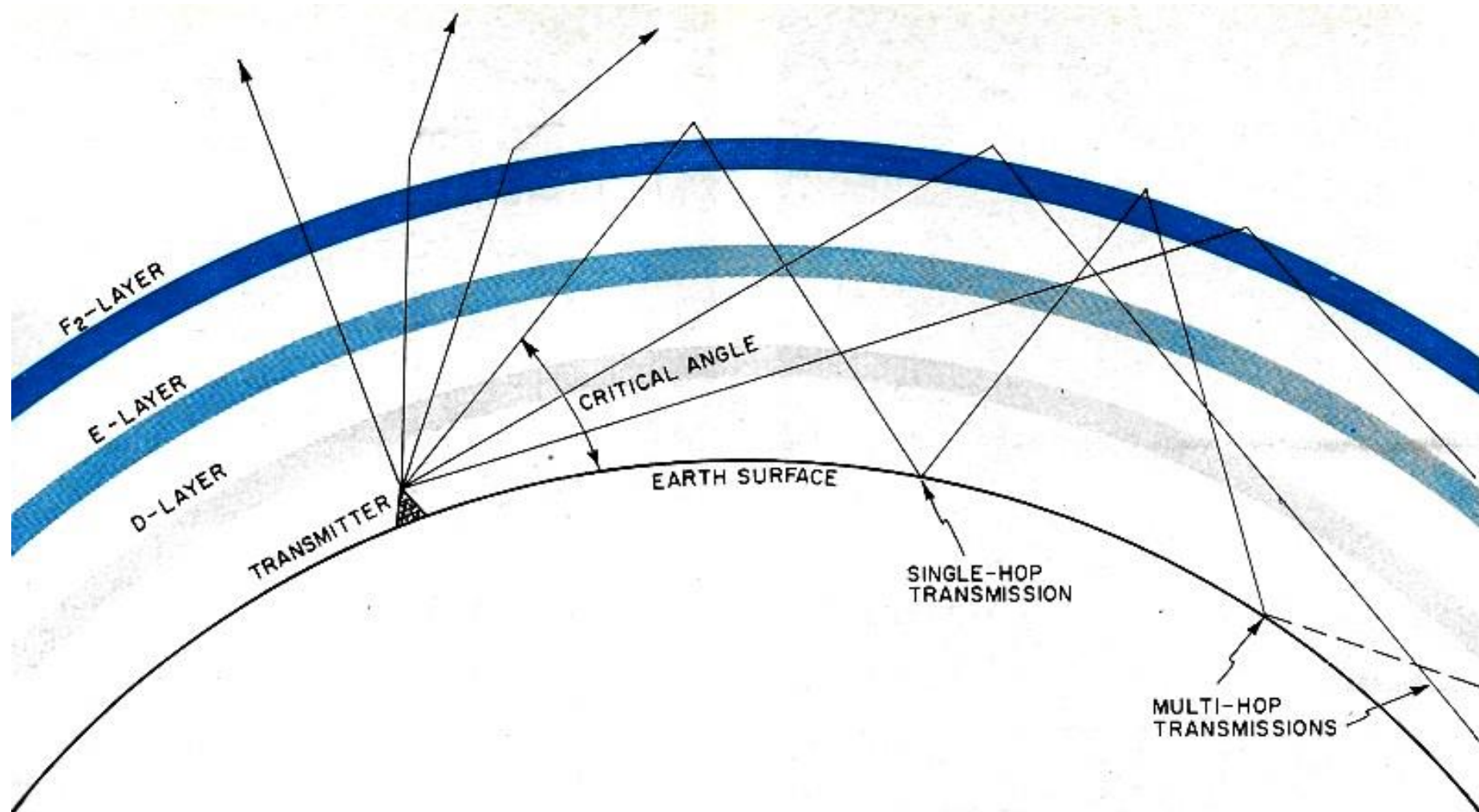
Understand the Earth's Magnetic Environment



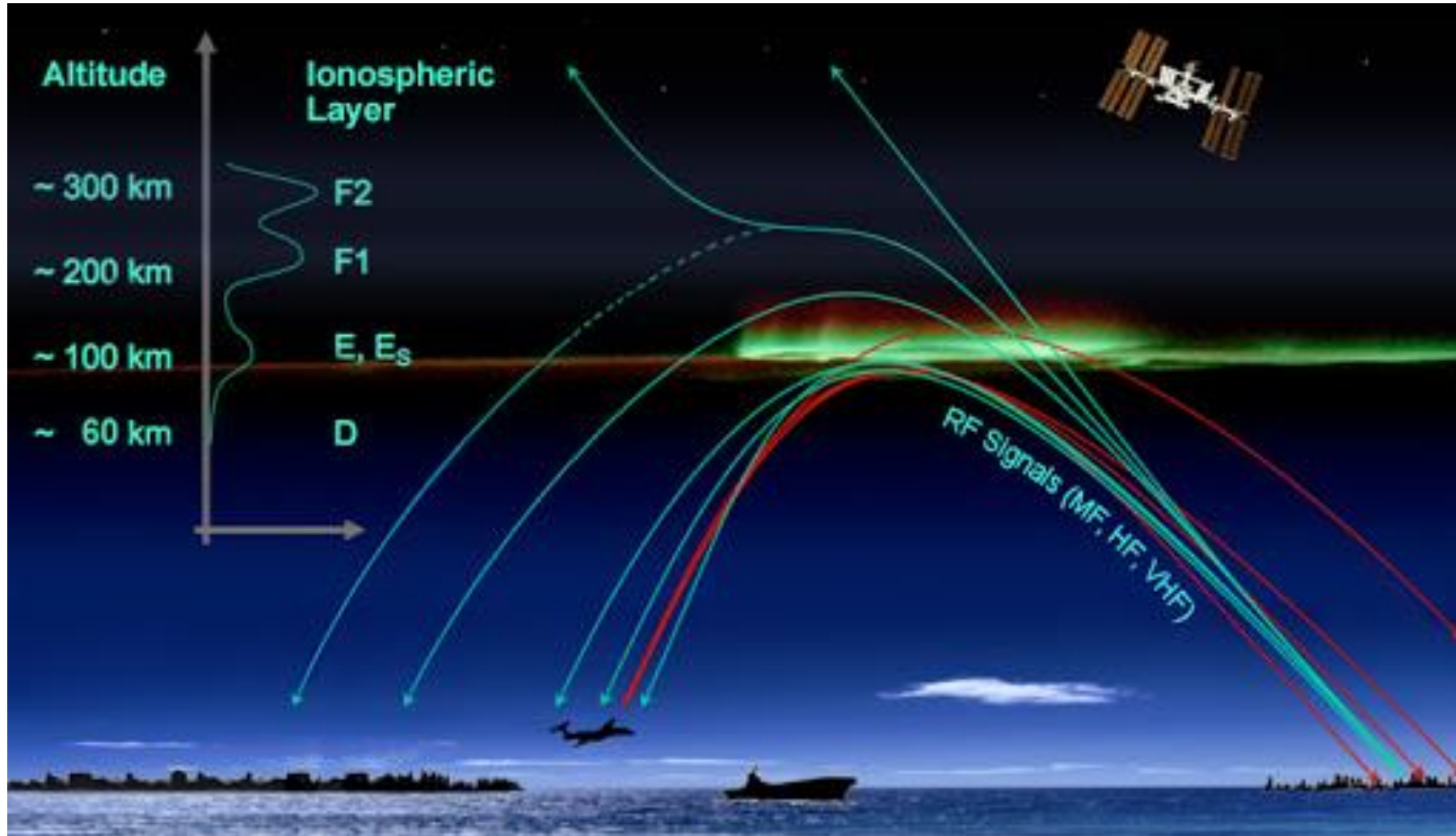
The Propagation of Radio Waves



Skip! (The Propagation of Radio Waves)



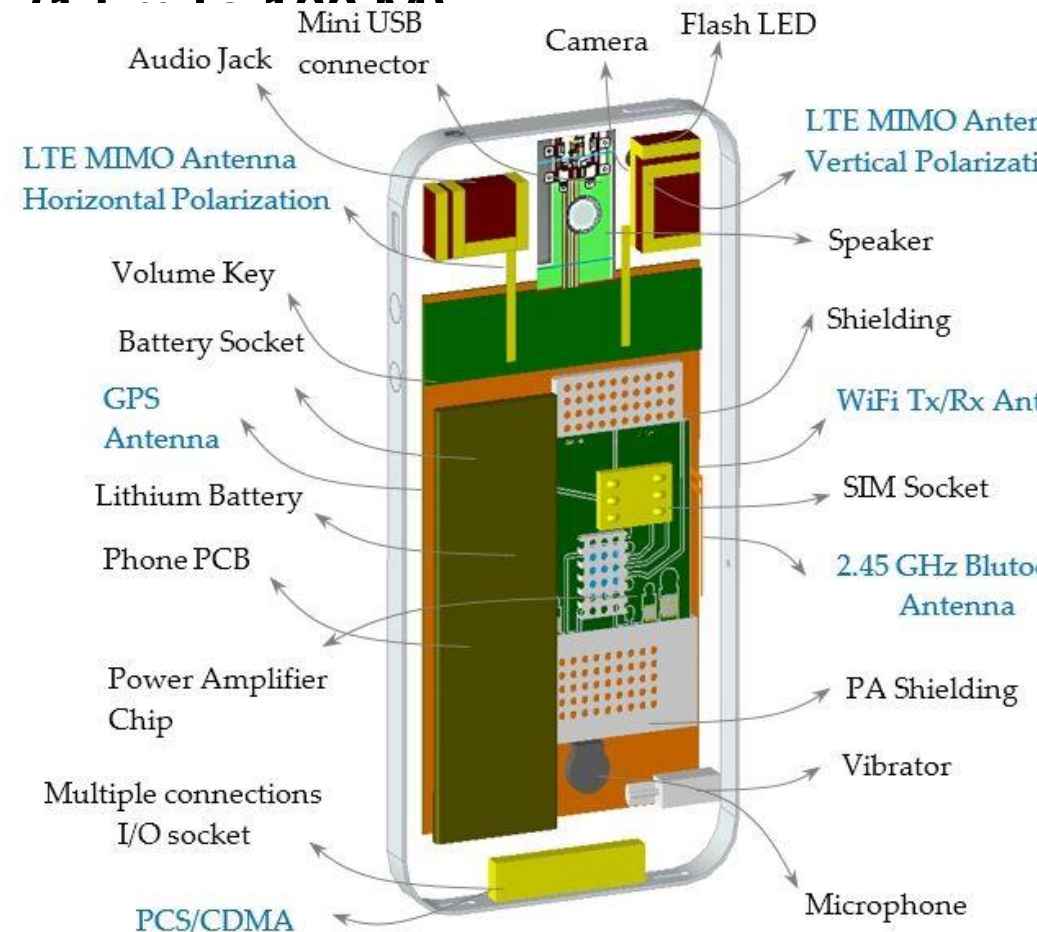
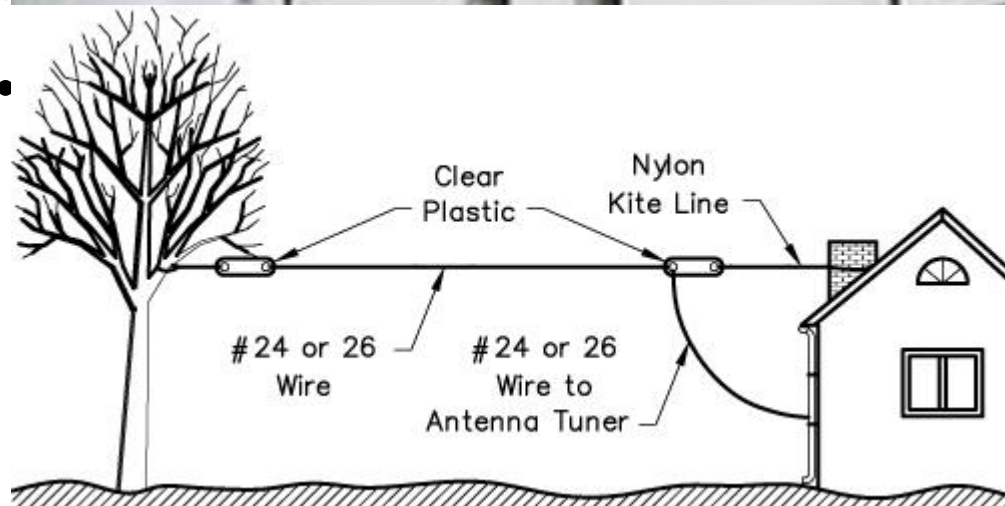
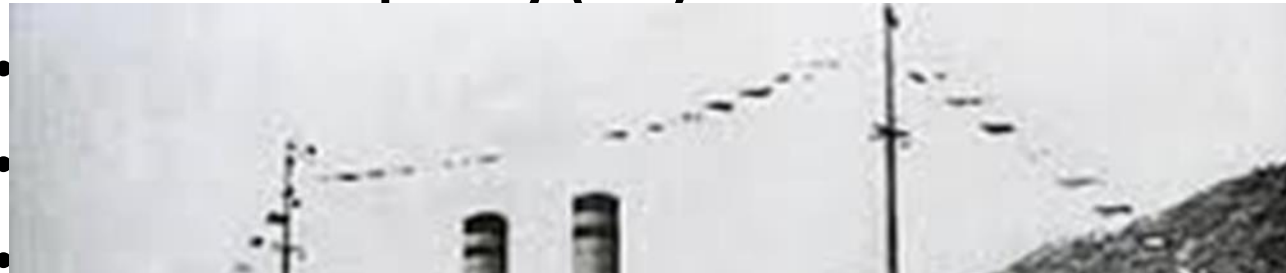
Skip! (The Propagation of Radio Waves)



LF / MF / HF / VHF / UHF / Microwave

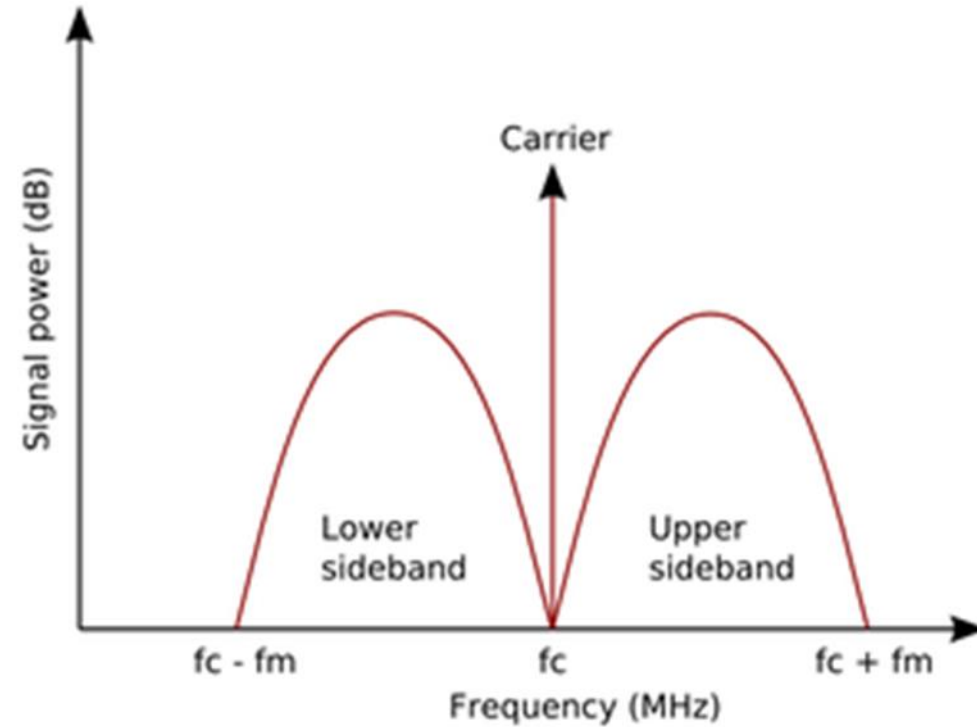
- Low-frequency (LF) band: 30 kHz to 300 kHz (10 km to 1 km)

- Medium-frequency (MF) band: 300 kHz to 3 MHz



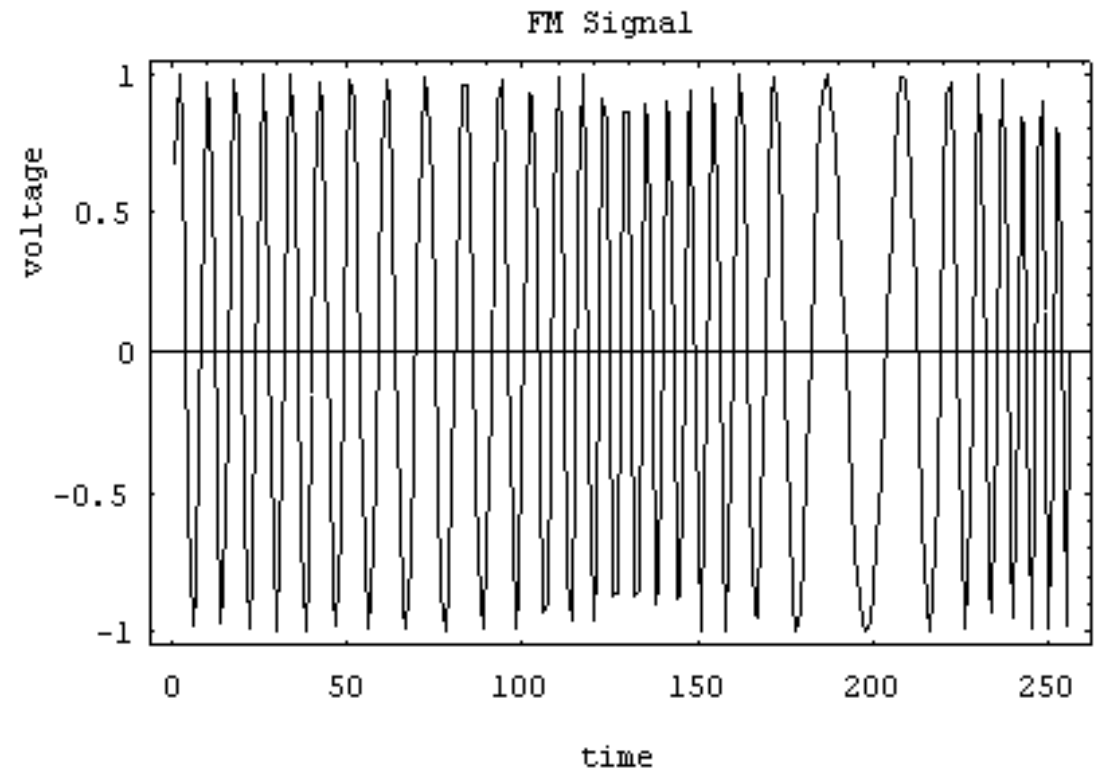
Voice (AM / FM / PM / DSB / SSB)

- Amplitude Modulation (AM)

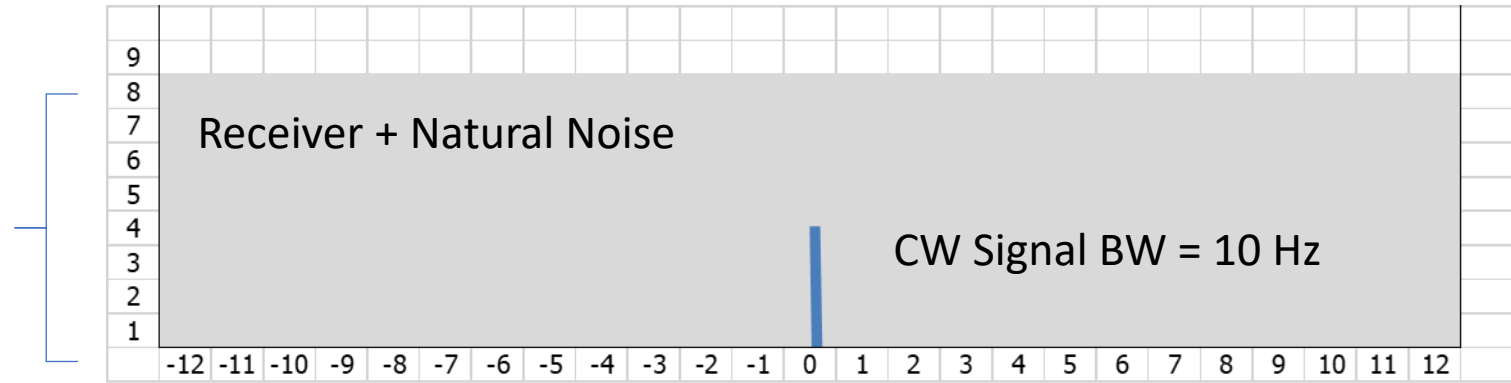


Voice (AM / FM / PM / DSB / SSB)

- Amplitude Modulation (AM)
- Frequency Modulation (FM)



Receiver. BW = 2400 Hz

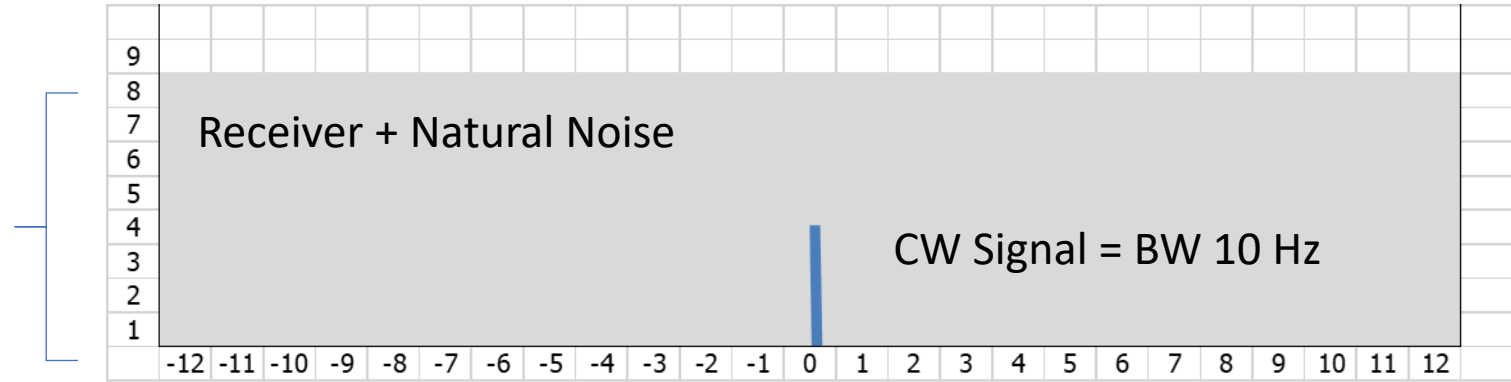


2500 Hz = Bandwidth necessary to carry voice messages.

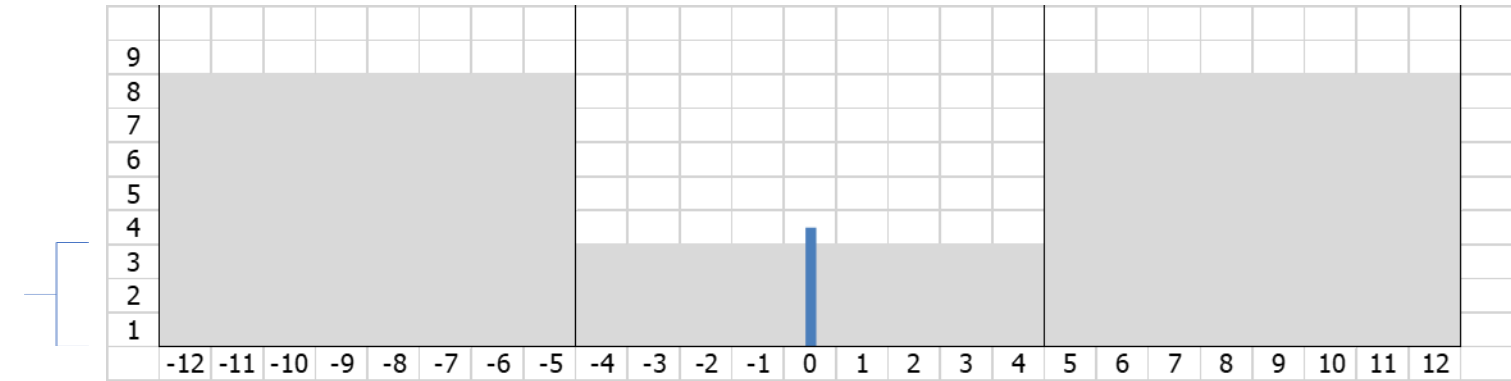
SNR = $P_{\text{signal}} / P_{\text{noise}}$

f

Receiver BW = 2400 Hz



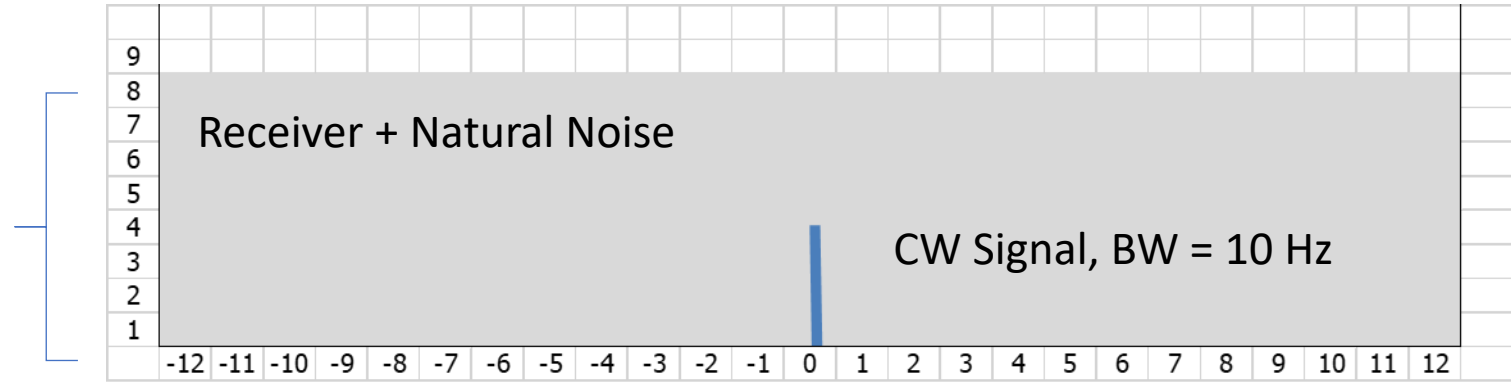
BW = 300 Hz
SNR = P signal / P noise



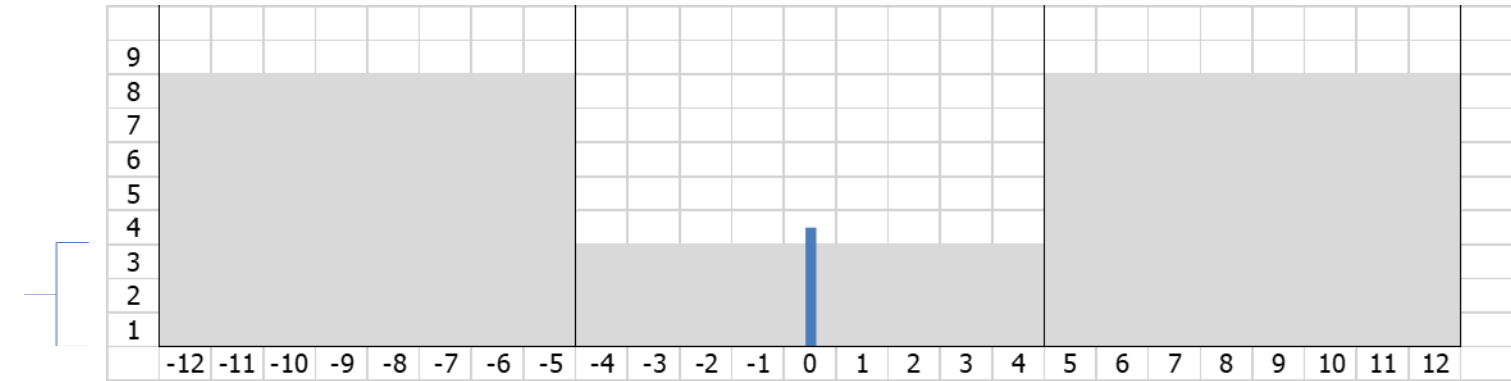
Reduction of the receiver's band-width lowers received noise.

f

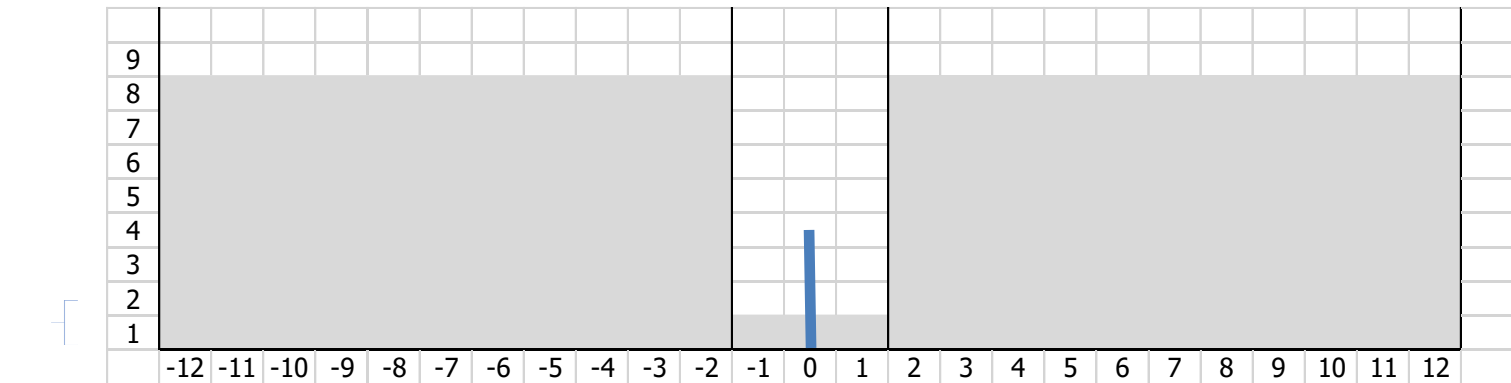
Receiver BW - SSB = 2400 Hz



BW = 300 Hz



BW = 100 Hz
SNR = P signal / P noise



Continuing usages

- Aircraft (navigation)



Continuing usages

- Aircraft (navigation)
- Marine
- Military
- NSA (Elephant Cage antenna system)



Continuing usages

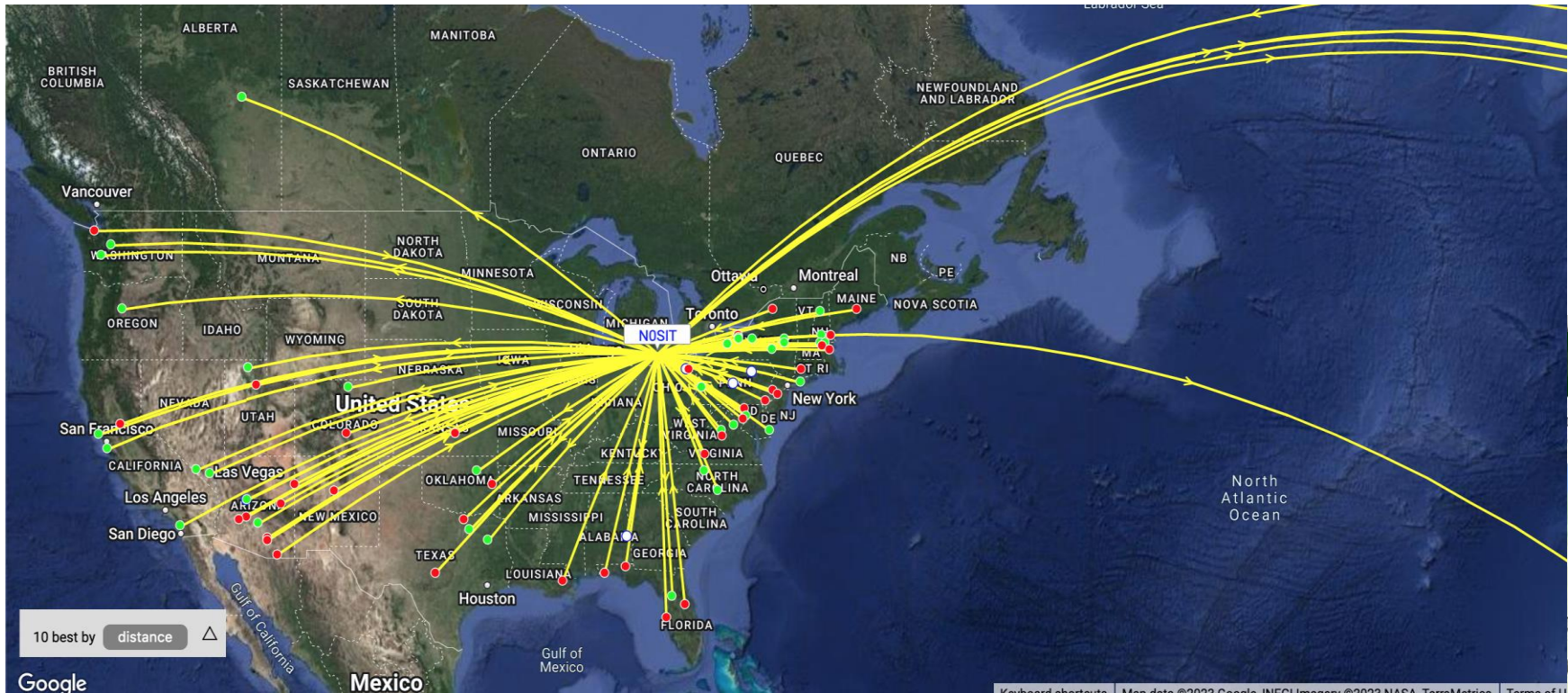
- Marine
- Military
- NSA (Elephant Cage antenna system)
- Amateur Radio Service
 - Emergency Communications
 - Field Day 1933 - Today
 - 2016 Cascadia Rising (FEMA Exercise)
(CW 99.998% / Digital 99.997% accuracy)
 - Teaching tool for autistic persons (2nd language)

Advances in Amateur Radio

- Field Day
- QRP 1920s
- Sota (UK 2002)
- Pota (USA 2010)
- QRPP
- Miles/Watt Record:

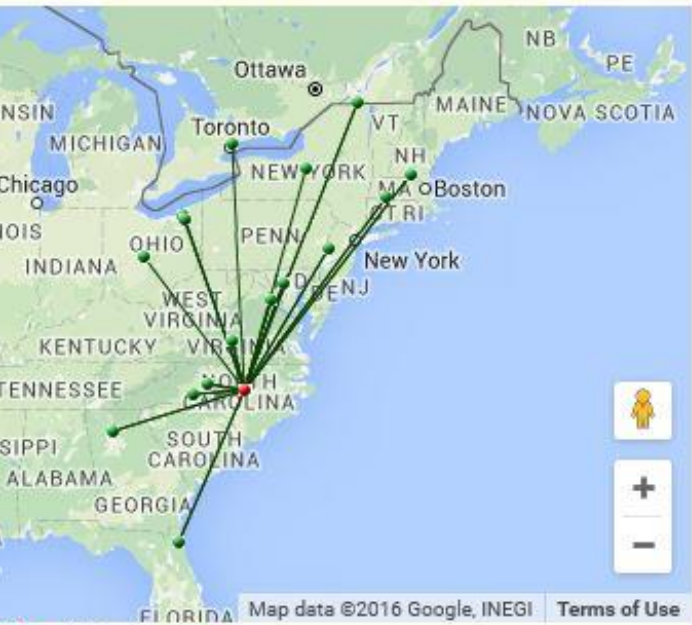
The current QRPP miles per watt record is 1,650 miles from Oregon to Alaska on the 10-meter band using 1 microwatt! That's the equivalent of 1.6 billion miles per watt. Mar 8, 2016





NETWORK

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- Whisper Test Signals
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