History of Ham Radio

(1985 -2026)

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Recap

This is the 4th presentation (1985-2026) in the series that spans 1895 – present.

Past presentations include the following:

1) History of Ham Radio 1895 -1925

- Technology: Spark transmit coils and mechanical detectors ➔ Electronic age
- Reach: Local (25 miles) ➔ world-wide

2) History of Ham Radio 1925 - 1955

- Voice modes: AM ➔ SSB and FM
- Stations: Homebrew ➔ Kits and commercial radios
- VHF/UHF widespread ➔ WW2 surplus technology

3) History of Ham Radio 1955 – 1985

- Technology: Vacuum tubes ➔ Solid state technology
- Range: Terrestrial ➔ Satellite and moon bounce

Introduction

1985 to present era saw fundamental changes in amateur radio in the following areas:

- Morse Code
- Spectrum
- RF Technology
- Digital Modes
- Internet

Morse Code

United States

Railway Operations:

- Railroad Morse code operations ended mid-1960s.
- Teleprinters and voice radio fully replaced telegraphy.

Maritime Operations:

- Commercial maritime Morse code ended July 12, 1999.
- Last Morse transmissions sent from Globe Wireless stations near San Francisco.

➔ Last message sent Samuel Morse's original 1844 words: "What hath God wrought"

Morse Code

Canada

Railway Operations:

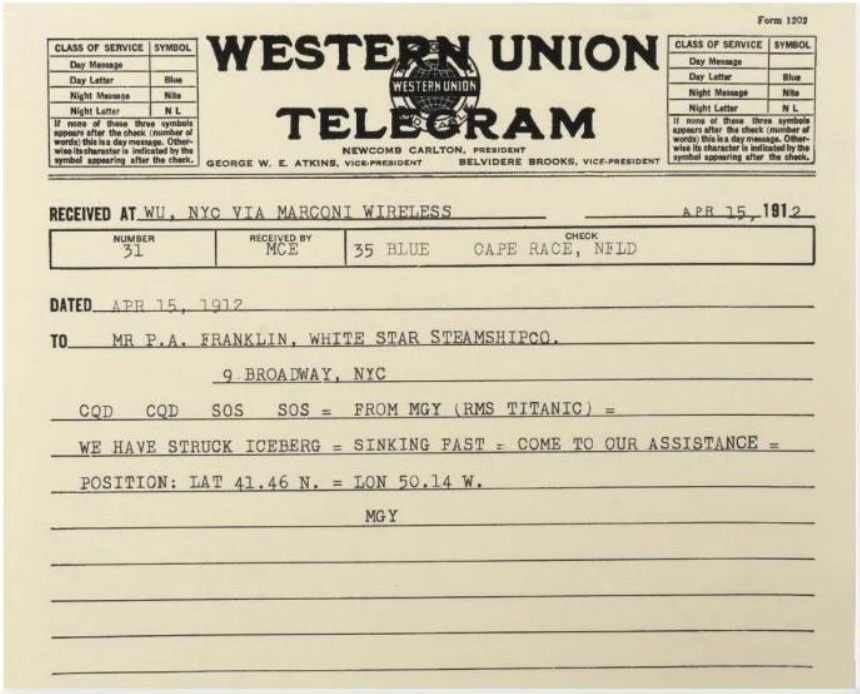
- Dec 30, 1972: Railways stopped using Morse code for dispatching and communication.
- Last transmission was sent from Port Moody, BC

Maritime Operations:

- Last Morse code message sent July 28, 1999 by Canadian Coast Guard.
- Marked end of maritime Morse operations. Replaced by satellite-based communications.

Morse Code

- 1960: Western Union used Morse code on some circuits, but much of network had already shifted to teleprinters.
- 1960s: Morse code phased out entirely from Western Union's operational network.
- 2006: Western Union sent final telegram, long after Morse had gone from internal systems



Form 1203

CLASS OF SERVICE	SYMBOL
Day Message	
Day Letter	Blue
Night Message	Nite
Night Letter	N L

If none of these three symbols appears after the check (number of words) this is a day message. Otherwise its character is indicated by the symbol appearing after the check.

WESTERN UNION

TELEGRAM

NEWCOMB CARLTON, PRESIDENT
GEORGE W. E. ATKINS, VICE-PRESIDENT BELVIDERE BROOKS, VICE-PRESIDENT

RECEIVED AT WU, NYC VIA MARCONI WIRELESS APR 15, 1912

NUMBER	RECEIVED BY	CHECK
31	MCE	35 BLUE CAPE RACE, NFLD

DATED APR 15, 1912

TO MR P.A. FRANKLIN, WHITE STAR STEAMSHIPCO.
9 BROADWAY, NYC

CQD CQD SOS SOS = FROM MGY (RMS TITANIC) =
WE HAVE STRUCK ICEBERG = SINKING FAST = COME TO OUR ASSISTANCE =
POSITION: LAT 41.46 N. = LON 50.14 W.
MGY

Morse Code

Amateur Radio Aftermath

International Context

- Early 2000s, international radio regulations required Morse for operation below 30 MHz.
- 2003, World Radiocommunication Conference (WRC-03) removed Morse requirement
- Each country had freedom to decide whether to keep or drop it.

United States

- FCC gradually reduced Morse requirements through the 1990s to early 2000s.
- After WRC-03, U.S. eliminated Morse entirely for amateur radio licensing by 2007

Canada

- Canada followed same international trend after WRC-03.
- Industry Canada (now ISED) removed Morse requirements for HF privileges after 2003

Spectrum

160 Meters (1.8–2.0 MHz)

1945–1980: Severe restrictions on amateur use due to LORAN navigation systems.

- Limitations varied by power, time of day, and geography (coastal vs. inland).

1980–1985: LORAN phased out and decommissioned.

Post 1985: 160 meters privileges fully restored to amateur radio.

Spectrum

220-225 Mhz

United States

FCC reallocates 220–222 MHz

1988: FCC removed 220–222 MHz from amateur service.

- Spectrum reassigned to Land Mobile and later for UPS for narrowband system (which failed).

Canada

- Entire 220–225 MHz band remains amateur-exclusive.
- Restrictions apply to transmitter sites located within 120km of the U.S. - Canada border.
- Specific antenna height (HAAT) and power (ERP) limitations apply.
- Most restrictive to stations within 6km of border

Spectrum

1979: WARC (World Administrative Radio Conference) bands added

Band	Frequency Range	Modes
30 meters	10.100–10.150 MHz	CW only
17 meters	18.068–18.168 MHz	CW and phone
12 meters	24.890–24.990 MHz	CW and phone

➔ Post-1980 radios feature these new bands

➔ Gentleman’s agreements states that no contesting takes place on WARC bands

Spectrum

60 Meters (5 MHz Region)

United States and Canada

2002: Both countries authorize 60-meter usage.

Feature	U.S. Hams	Canadian Hams
Contiguous WRC-15 band	Yes: 5351.5–5366.5 kHz	Yes: 5351.5–5366.5 kHz
Power on WRC-15 band	**9.15 W ERP**	**15 W EIRP** (≈9.15 W ERP)
Legacy 60-m channels	**4 channels at 100 W ERP**	**None**
Max bandwidth	2.8 kHz	2.8 kHz
License level	General+	Basic with HF or Advanced
Primary/secondary	Secondary	Secondary

- ERP = Effective Radiated Power from ½ wave dipole antenna
- EIRP = Effective Isotropic Radiated Power from isotropic antenna

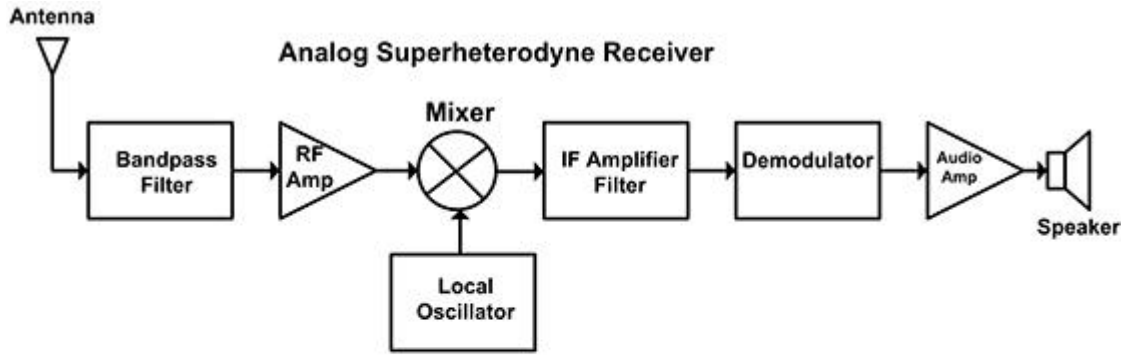
Technology

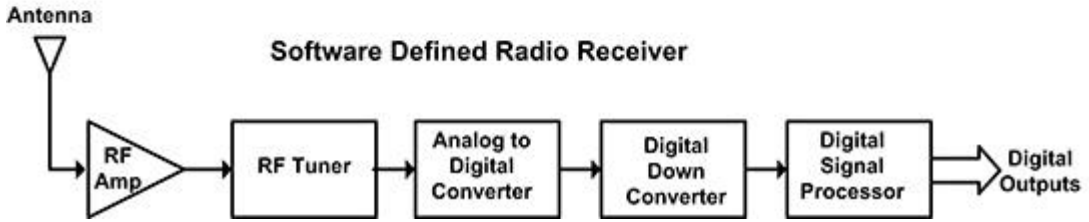
1. Software-Defined Radio (SDR)

SDR is arguably the biggest shift since invention of SSB.

- RF front-end + computer = radio
- Panadapters and waterfall displays became standard
- High-performance direct-sampling radios replaced inefficient superheterodyne designs

➔SDR advanced radio technology widespread — laptop and a $30 dongle entry into SDR





Technology

2. Digital Signal Processing (DSP)

Before mid-1980s, filtering and audio shaping were all analog. DSP changed everything.

Key advancements

- Digital IF and AF filtering
- Noise reduction and automatic notch filters
- Adaptive filtering for weak-signal work
- Digital speech processing via software or programmable chips (FPGAs)
- No more expensive multiple crystal filters

➔DSP radios smaller + cleaner, and far more capable in crowded band conditions.

Technology

3. Satellite and Space Communications

- **Satellites:** Amateur-radio **repeaters/transponders** that relay signals between operators.
- Similar to terrestrial repeater operation (i.e. different Rx and Tx frequencies)

- **Common types:** FM voice, digital, and linear-transponder satellites.
- 2 meter and 70 cm bands most commonly used frequencies
- **LEO satellites:** Pass overhead for only a few minutes, making timing and tracking important.
- **Equipment:** Radio(s) for dual band, suitable antenna, and satellite-tracking software.

- **Key challenge: Doppler shift** changes the received frequency as the satellite moves.

Technology

4. Antenna and RF Engineering Improvements

Computer Modeling

- Hams can simulate antenna performance before construction.
- Advances in modeling and materials changed antenna design.

Advanced RF components

- LDMOS dominating linear amplifiers
- Improved baluns, chokes, and ferrite technology

Smaller, better antennas

- Compact multiband HF antennas
- Magnetic loop antennas for small spaces

Better Antennas for 160m

- Phased vertical arrays for low-band DX

Digital Modes

Packet Radio

1970s: Packet radio developed for sending digital data over radio.

- **X.25** protocol developed for amateur-radio digital communication.
- **AMPRNet**: AMateur Packet-Radio Network is application on top of X.25 protocol

1978: MARC members instrumental in introducing this technology to amateur radio

- Robert Rouleau, VE2PY
- Bram Frank, VE2BFH
- Norm Pearl, VE2BQS
- Jacques Orsali, VE2EH

1980s–90s: Used for **messaging, BBS, and computer networking**.

- Used on VHF (2 meters, 220 MHz and 70 cm)

Fun Facts: First digital modes

CW (Morse Code): 1840’s

RTTY (Radio Teletype): 1940’s

Digital Modes

VARA HF (Winlink)

- High-speed **HF digital modem** (8 Kbps)
- Uses **ARQ** for reliable data transmission
  - **ARQ = Automatic Repeat reQuest**
- Supports **email, messaging, files & emergency data**

Digital Voice

- **D-STAR:** Digital voice + data (low bandwidth: GPS, callsigns, short text)
- **DMR:** Two time slots → **2 conversations/channel**
- **Yaesu System Fusion:** Digital + analog FM
- **NXDN:** Narrowband, efficient digital voice
- 6 m to 1.2 GHz operation

Digital Modes

Full internet service via amateur radio not possible with VARA and DStar

- Limited bandwidth (despite compression): Video and modern web sites require Mbps
- Most internet traffic is encrypted (i.e. SSH and HTTPS).
- Encrypted communication not allowed on ham radio unless keys are in public domain.

Weak Signal Digital modes for awards and contesting:

- PSK31 (late 1990s)
- JT65, JT9 (weak-signal modes by K1JT)
- FT8 (2017, now the most popular HF mode)
- FT4 (2019) Twice as fast as FT8
- FT2 (Feb 2026) four times faster than FT8

➔ WS digital modes: Reliable communication at power and distances previously impossible.

Digital Modes

JS8 Call

- **JS8Call** amateur-radio App for **digital, keyboard-to-keyboard communication**.
- Use **JS8 digital mode** for reliable communication when radio signals are weak.

JS8Call	FT8
Interactive messaging	Short automated contacts
Longer text messages	Very short messages
Keyboard communication	Mostly computer-controlled
JS8 mode	FT8 mode

Internet

Pre-internet era (i.e. before 2000) contacts confirmed via paper QSL

Could take months via direct mail or QSL bureau

Internet logging (LoTW, QRZ, and eQSL) was introduced in late 1990's / early 2000's

- In the past, awards required sending all QSLs to award organization for confirmation by mail. This took weeks, including return of cards
- Awards can be now applied for and received instantly from ARRL, QRZ, and eQSL

Many DxPedition require payment to get physical cards and LoTW confirmation

OQRS (Online QSL Request Service) allows to send payment via 3rd party (i.e. Clublog)

to get physical cards and electronic confirmation.

In the past, IRC were required to get QSL card by mail from Dx station. IRCs are now obsolete.

Conclusion

The 1985-to present era saw many fundamental changes in the amateur radio world.

- Morse code requirement phased out
- Band spectrum changes (160m, 220 Mhz)
- Band Spectrum additions (WARC: 60, 30, 17 and 12 meters)
- Digital modes: AMPRNet, Dstar, VARA, FT8 and JS8Call
- Technology amateur radio has transformed from: Analog → Digital architecture
- Better performance thanks to new semiconductors (LDMOS) and improved ferrites
- Internet (Logging, awards)

Questions ?