

K4CHN / Jon Marler

Amateur Radio Operator / Hacker

- First radio - Lafayette KT-200
- Passed Technician @ DefCon 27
- Passed General @ DefCon 28
- Passed Extra & DefCon 29
- 40m voice
- Fairly active on 40m FT8
- Monitor 14.230 SSTV
- Breaker and fixer of all things



NETFLIX

TV Shows Movies Recently Added My List Q

N COMEDY SPECIAL

JON MARLER

LIVE AT SECOND CITY!

From kpop to curling to the cyber security world's darkest secrets, this 4 hour standup special will leave you saying... "wait what?"

▶ Play + My List

Popular on Netflix

MURDER MYSTERY

OUR PLANET

TIDYING UP WITH MARIE KONDO

Dead to Me

RAISING DION

AMY SCHUMER GROWING

THE IRISHMAN

Beyoncé's BLACK HOMECOMING A FILM BY BEYONCÉ

Presentation Agenda

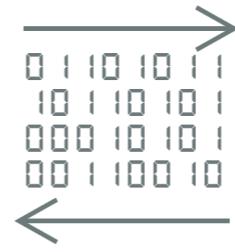
Amateur Radio Digital Modes Primer



Voice

D-Star DMR WiresX

AMBE
FreeDV



Data

SSTV AX25 PSK

RTTY MFSK

Slow Scan Television (SSTV)

Packet / AX25

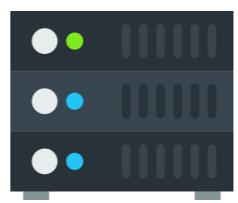
Multiple Frequency-Shift Keying (MFSK)

Phase-Shift Keying (PSK)

Radioteletype (RTTY)

Presentation Agenda

Amateur Radio Digital Modes Primer



Hardware

Commercial

DIY



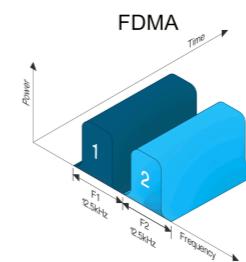
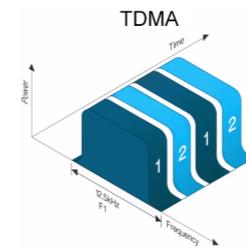
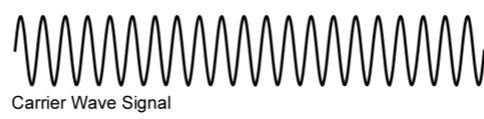
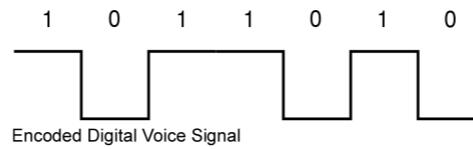
Demo

SSTV

Digital Amateur Radio - Voice

Digital Voice Introduction

How do digital voice modes work at a high level



Digital Voice Mode Implementations

What are some common digital voice mode implementations?



FreeDV

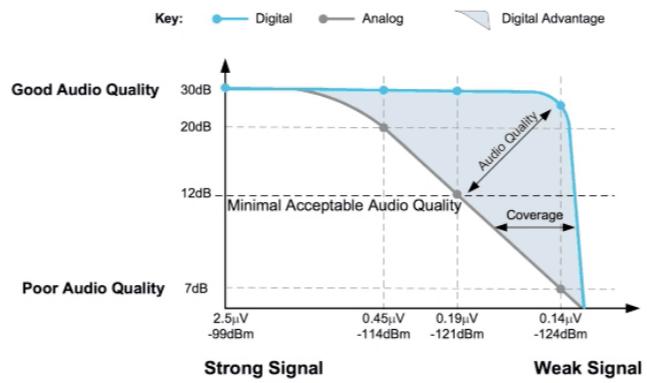


AMBE and AMBE+2 are the most popular voice encoding, but require a license from Digital Voice Systems Inc. This is controversial due to the patent restrictions and typical openness of amateur radio and FCC requirements that any transmission must not use proprietary technology.

DVSI Vocoder chips include a license. There is also M17 version of DMR using Codec2 vocoder.

Why use digital voice?

What benefit does digital voice provide?



Weak signal propagation

Digital Voice - Getting Started

I'm convinced. How do I get started



Yaesu FT-991a FT2DR HRI-200, ICOM IC-7100 IC-7900 ID-52
openSPOT 2/3, Lonestar / Generic MMDVM simplex/duplex

Digital Amateur Radio - Data

Amateur Radio Digital Modes - RTTY

Radio Teletype

- First widely adopted digital mode
- Uses Frequency Shift Keying
- Data sent using Murray / Baudot code
- Very limited character set
- Very slow (45.5 baud standard, up to 75 baud)
- Very prone to interference with no error correction
- <https://www.rttycontesting.com/>



Speed is around 6 characters per second

RTTY app on linux or MMTTY for windows

Sample is RU3AMO calling CQ on 14.047

Amateur Radio Digital Modes - PSK

Phase Shift Keying (PSK)

- PSK31, created by Peter Martinez (G3PLX), is most popular
- Transmits at 31 baud using BPSK modulation
- Sounds like whistling
- Very resistant to crowding and interference
- QPSK implements error correction for difficult QSOs
- DigiPan, fldigi, multimode, dxlab, DM-780

Frequency	Amateur Band
1.838 MHz	160 meter
3.580 MHz	80 meter
7.035 MHz	
7.040 MHz	40 meter
7.070 MHz	
7.080 MHz	
10.142 MHz	30 meter
14.070 MHz	20 meter
18.097 MHz	17 meter
21.080 MHz	15 meter
24.920 MHz	12 meter
28.120 MHz	10 meter
50.290 MHz	6 meter
144.144 MHz	2 meter
222.07 MHz	1.25 meter
432.2 MHz	70 cm
909 MHz	33 cm

31 baud was selected in part because it transmits at about the same speed as 51wpm typing. PSK63 and PSK125

An improvement to SLOWBPSK, an idea and implementation of Paweł SP9VRC

Amateur Radio Digital Modes - Packet

AX.25 protocol digital mode

- First used by Canadian amateur radio operators in 1978
- Authorized for use in the US in 1980
- Requires a modem or Terminal Node Controller (TNC)
- Offers error collection and message forwarding
- Automated Packet Reporting System (APRS)
- TARPN, G8BPQ, ROSE, TexNet, BBS, KA
- Most commonly used on 2m

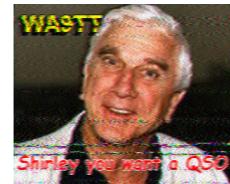


Montreal amateur radio club. APRS is used to transmit real-time data, information and reports of the exact location of a person or object via a data signal sent over amateur radio frequencies. In addition to real-time position reporting capabilities using attached GPS receivers, APRS is also capable of transmitting a wide variety of data, including weather reports, short text messages, radio direction finding bearings, telemetry data, short e-mail messages (send only) and storm forecasts. Once transmitted, these reports can be combined with a computer and mapping software to show the transmitted data superimposed with great precision upon a map display.

Amateur Radio Digital Modes - SSTV

Slow scan television

- Transmits low-resolution images in b/w or color
- Developed in the 1950's using vidicon tubes for image capture
- FCC approved for amateur radio operators in 1968
- Multiple different transmission modes and protocols
- Very easy to monitor popular frequencies
- Apps available for desktop and mobile
- Demonstration at the end of the presentation



mmsstv is most popular windows app.

Amateur Radio Digital Modes - MFSK

Multi-Frequency Shift-Keying

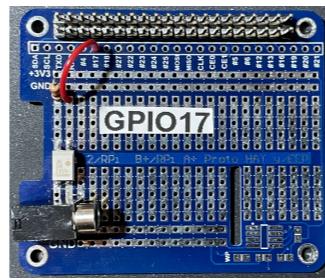
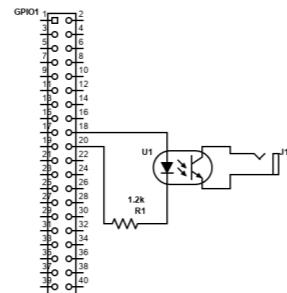
- Very useful for long range communication over troposcattering radio paths
- Large number of modes makes it both confusing and easy to get started
- Depending on the mode, communications is very limited or very flexible
- Made popular by Joe Taylor's (K1JT) popular WSJT-X Software
- WSJT-X makes it easy to get started and collect lots of global QSOs
- WSPR is a great way to test current propagation across different bands

This method of propagation uses the tropospheric scatter phenomenon, where radio waves at UHF and SHF frequencies are randomly scattered as they pass through the upper layers of the troposphere. Radio signals are transmitted in a narrow beam aimed just above the horizon in the direction of the receiver station. As the signals pass through the troposphere, some of the energy is scattered back toward the Earth, allowing the receiver station to pick up the signal. Troposcatter digital radio communications has long been used by the military and is used by Raytheon to achieve 100Mbps radio communication links over extremely long distances.

Digital Amateur Radio - DIY

Amateur Radio Digital Modes - Hardware

How I made my own



Raspberry pi hat from Amazon, USB SYBA sound card. Ground loop isolator. Optoisolator.

Digital Amateur Radio - Demo

Stay in Touch

How to stay in touch with me

- QRZ - <https://www.qrz.com/db/K4CHN>
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