Jon Marler - K4CHN - August 2021

Amateur Radio Digital Modes Primer

Introduction to common digital modes used globally by amateur radio operators

K4CHN / Jon Marler

Amateur Radio Operator / Hacker

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

Presentation Agenda

Amateur Radio Digital Modes Primer

Voice

D-Star DMR Fusion

AMBE

FreeDV

Data

SSTV AX25 PSK

RTTY MFSK

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?

D-STAR

DMR
DIGITAL MOBILE RADIO

YAESU
System Fusion

FreeDV

P25
DIGITAL WIRELESS • SANS FIL NUMERIQUE • INALÁMBRICO DIGITAL

M17

Why use digital voice?

What benefit does digital voice provide?

Digital Voice - Getting Started

I’m convinced. How do I get started

Ham Radio Village Digital Modes

What resources are available from HRV?

- D-Star RF/Hotspot
  - Reflector XLX478 (or XRF478)
  - Module A for cross-mode chat
- D-Star Terminal Mode
  - Host: xlx.hamvillage.org
  - URCALL: /XLX478A (Module A)

- Yaesu System Fusion (YSF) Hotspots - **Not Wires-X**
  - YSF Reflector 74306
  - Host: xlx.hamvillage.org
  - XLX Module A
- M17
  - Reflector M17-HRV
  - Module A -> XLX Module A
- Digital Mobile Radio (DMR)
  - Network: Brandmeister
  - TG 3177826 -> XLX478 Module A

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

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 7.070 MHz 7.080 MHz	40 meter
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

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

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

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

Digital Amateur Radio - DIY

Amateur Radio Digital Modes - Hardware

How I made my own

Digital Amateur Radio - Demo

Stay in Touch

How to stay in touch with me

- GitHub - https://www.github.com/jmarler
  - This presentation: https://github.com/jmarler/AmateurRadioDigitalModesPrimer
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