



<Presenter_Name>

M17 Project
m17project.org

Amateur Digital Landscape

- Many protocols exist and you could use any of them:
 - AX.25 : Data, VHF/UHF. Adaptation of the X.25 protocol for amateur radio.
 - DSTAR: First protocol created for amateur radio. Designed for digital voice. VHF/UHF. Open specifications.
 - YSF: Proprietary mode from Yaesu. Data and digital voice.
 - FT-4 / FT-8 : Very long range (1000s km), very low power (10 W), very slow speed, HF
 - DMR/TETRA/P.25: A whole range of industrial standards adapted for amateur radio use
- None is truly FOSS. Sometimes only one, closed source, implementation exists.

Amateur Digital Landscape

- First versions of DSTAR specifications is released in 2001 by JARL (Japan).
- Uses the AMBE vocoder from DVSI.
- Specifications are publicly available but no license specified.
- A manufacturer does not have to follow the published specifications.
- DSTAR de-facto became ICOM's proprietary mode.

Amateur Digital Landscape

- Computing power at the time (2001) was limited.
- The vocoder is implemented in an ASIC and the algorithms are protected by patents, industrial secrets, etc...
- The same algorithm (or variants of it) is used in all the mainstream digital voices modes...
 - (DSTAR, YSF, DMR, P25, NXDN,...).
- There are historic reasons, but how does one tinker with it?
- Answer: you do not.

Amateur Digital Landscape

- The solution came in the form of Codec 2 released in 2010 by David Rowe (VK5DGR).
- Fully open-source, no patents, no industrial secrets.
- Since then the computing power increased significantly, so much that a 32-bit ARM MCU is enough.

Amateur Digital Landscape

- A digital protocol designed by hams, for hams
- A response to growing community of digital mode users
- A way to get free from patent encumbrances, licenses etc.
- A chance to bring back digital radio to the experimenting side of amateur radio
- Uses Codec 2

Why is M17 different?

- Created for fun, not profit
- Based on Codec 2, not proprietary vocoders
- Development driven by users, not by a single manufacturer
- Extensible – use cases can be added over time

Who is behind it?

- 2019 – Started by Wojciech Kaczmarski, SP5WWP in Warsaw, Poland
- 2022 – 2024 - a large, multinational group of ham radio operators
- Now – You!

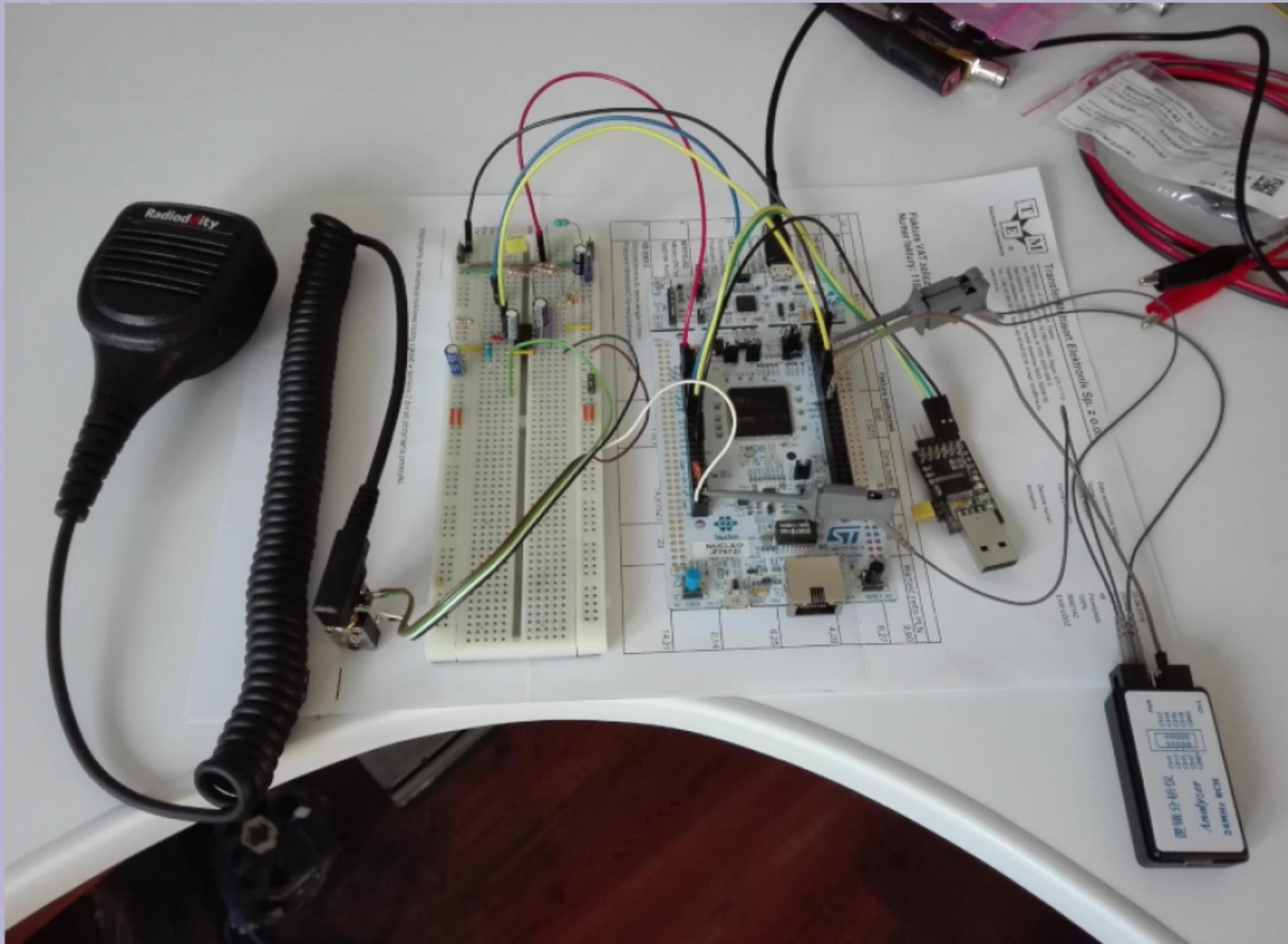
M17 Timeline

M17

2019

- First experiments with Codec 2 and STM32s
- Initial tests with RFM26W modules (Si4463)





2019

- First prototype of an M17-compatible handheld created – TR-9
- Dan, KB6NU's blog entry (M17, an open-source, DMR like system) – pivot point for the project
 - <https://www.kb6nu.com/m17-an-open-source-dmr-like-system/>

2019



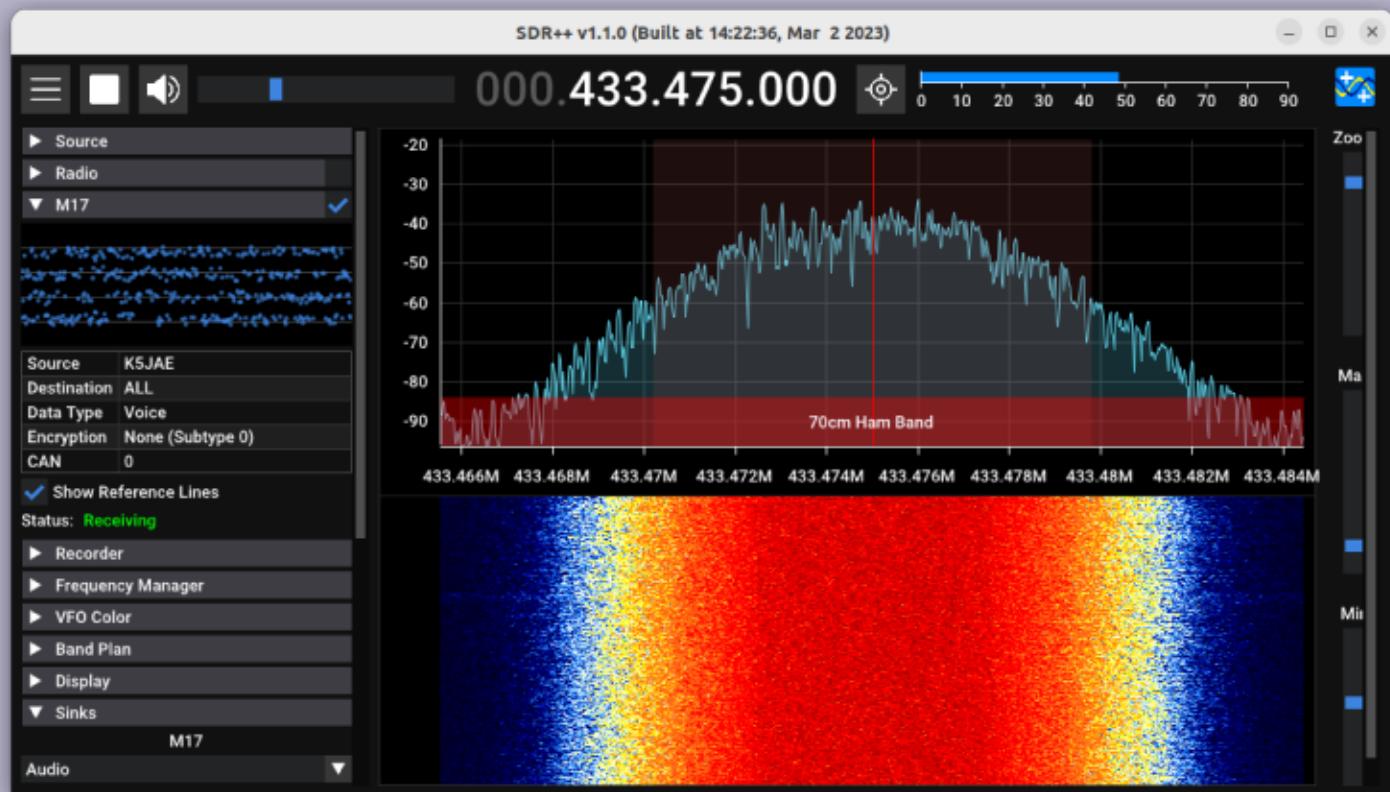
2020

- Media coverage increases via Twitter, blogs
- Protocol specification refinement
- OpenRTX project starts to create replacement firmware for common HTs
- Doug, AD8DP, adds M17 to DroidStar
- Tom, N7TAE, creates mvoice
- Rob, WX9O, creates m17-cxx-demod command line encoder/decoder tools



2021

- Significant financial assistance via ARDC grant
- Win the ARRL's Technical Innovation Award
- MMDVM and OpenWebRX add M17 support
- First QO-100 satellite tests
- SDR++ adds M17 support



2021 ARRL Technical Innovation Award

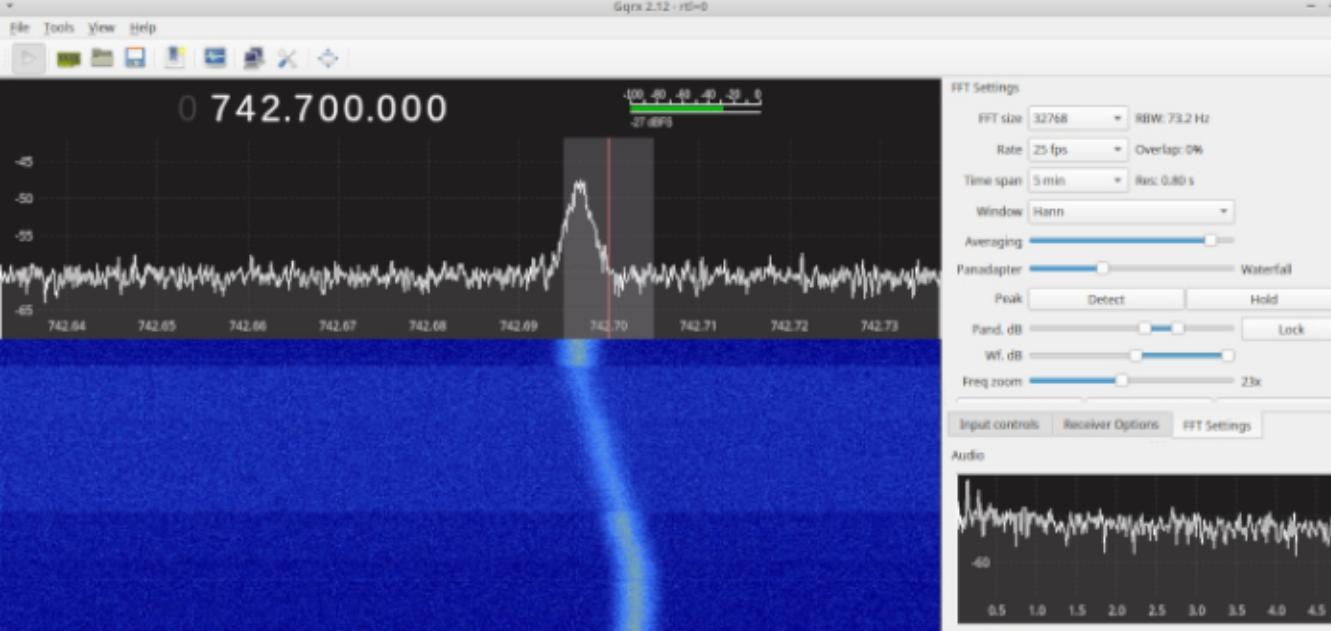
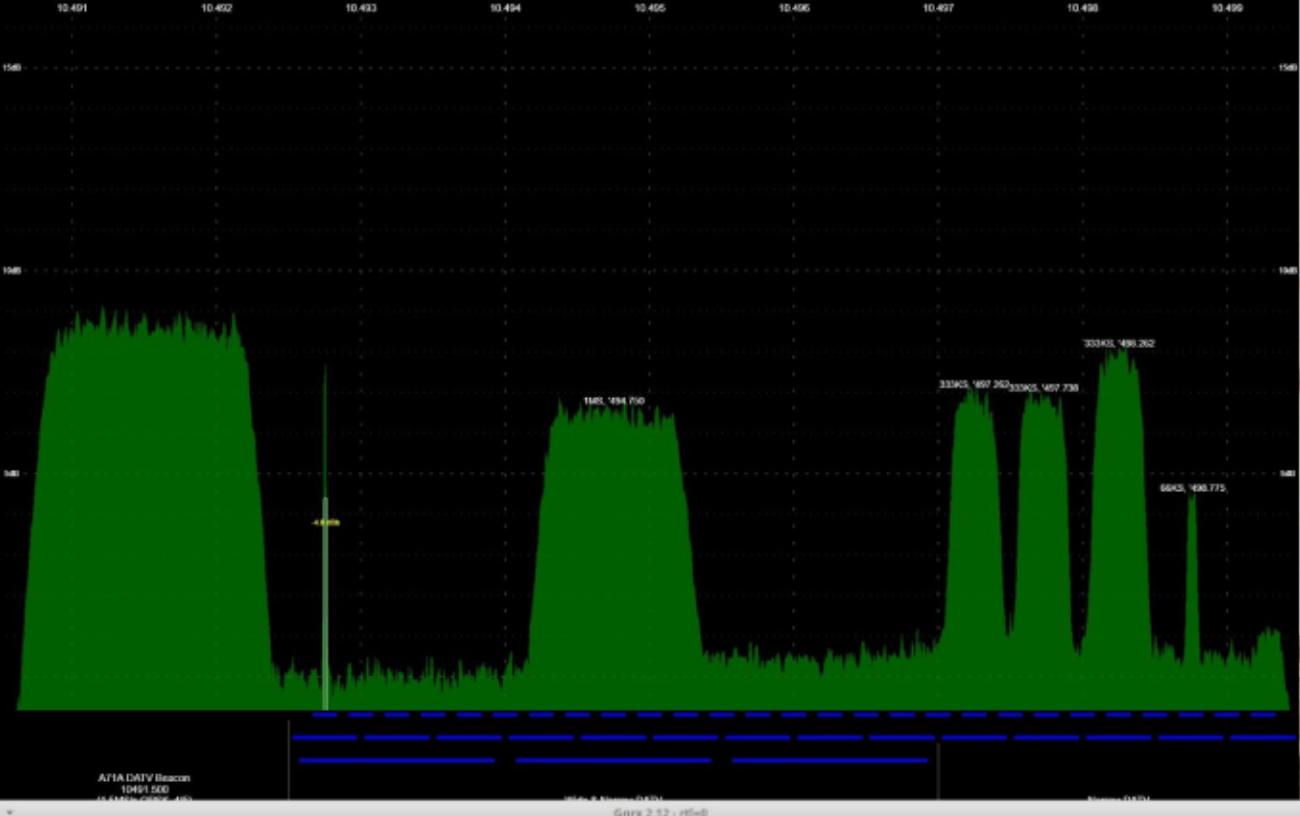


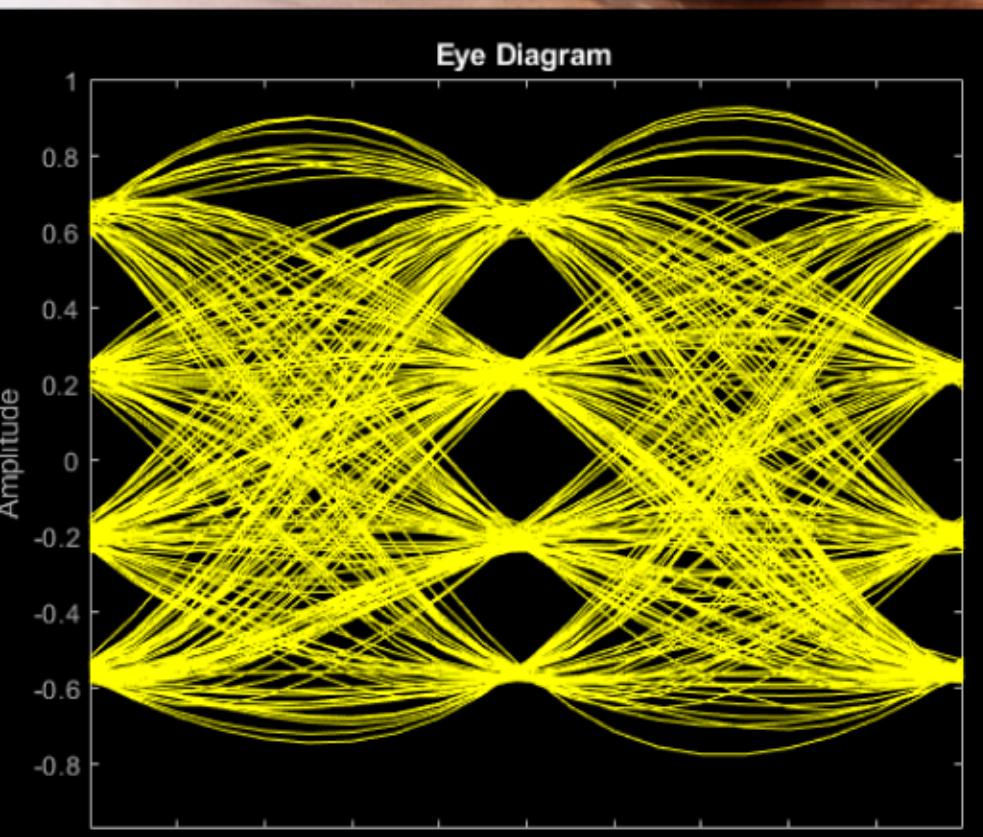
presented to

Wojciech Kaczmarski, SP5WWP

For developing a new digital radio communication M17 protocol for the good of amateur radio. M17 is a new open source and patent free digital radio protocol with a goal to provide a fully sustainable option for digital radios in the future. His project has led to development of DroidStar (an Android application) by Doug McLain, AD8DP, and the protocol has also been incorporated within other amateur radio related projects to help advance the radio art.

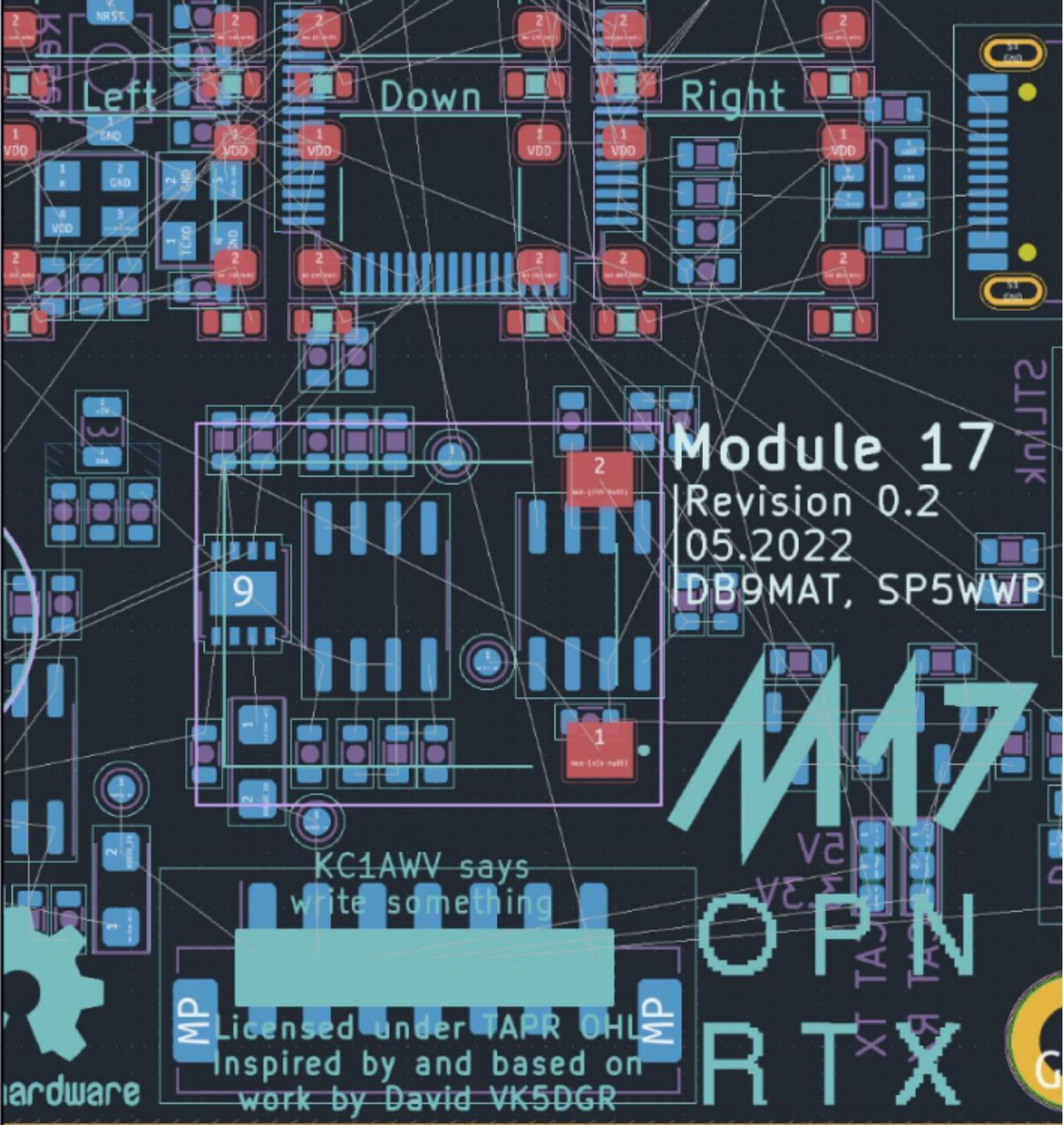
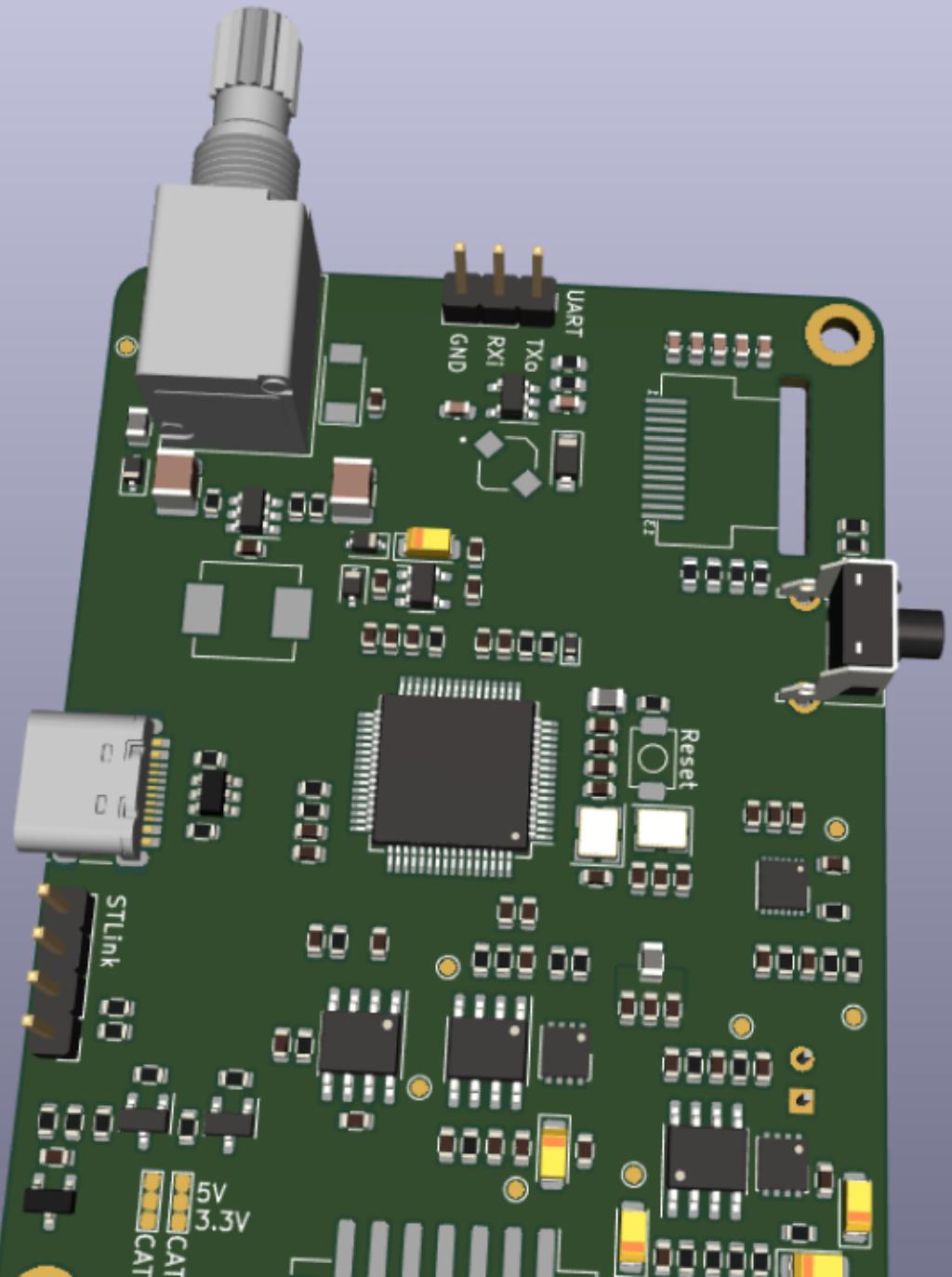






2022

- Successful QO-100 loopback test by Charles G4GUO
- Ongoing specification improvements by Jay KA1PQK
- Upcoming OOT GNU Radio blocks by Dave N1AI
- Module17 modem board by Mathis DB9MAT
- OpenRTX supports M17 on MD-(UV)380



Module 17 pre 1.0



2022

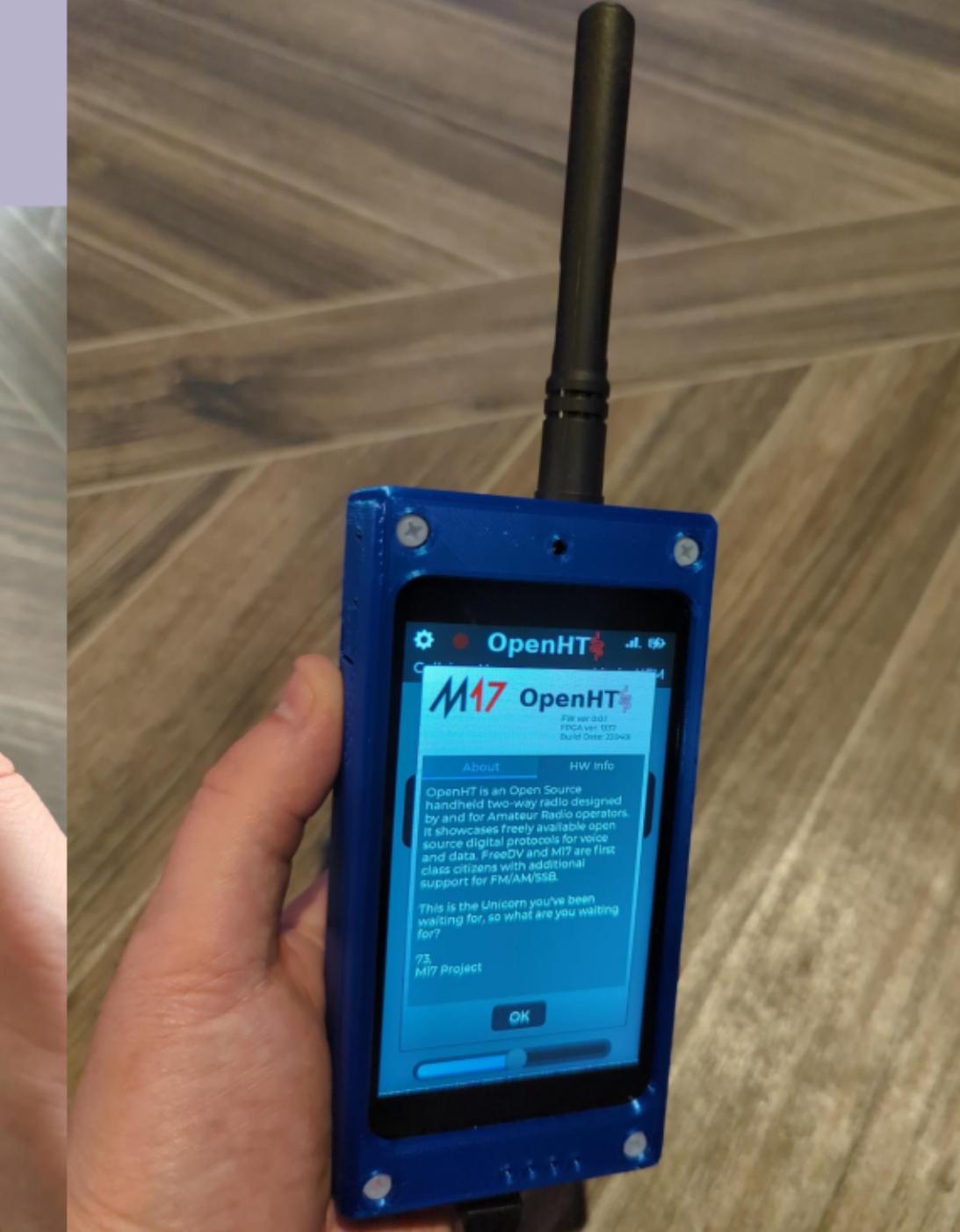
- Steve KC1AWV and Ed N2XDD give numerous interviews
 - QSO Today, Ham Radio 2.0, Ham Radio Crash Course,
 - KM4ACK, Tank Radio, DixieDX,...
- Attendance at major ham festivals in the US
 - NEARfest/Deerfield, HamCation/Orlando, Hamvention/Dayton,
 - HOPE/NYC, ...

2023 - OpenHT

- SDR handheld
 - If you can modulate it we can send it
- Currently
 - Open-source hardware and firmware*
 - 430 MHz / 2.4 GHz @25 mW
 - *FPGA toolchain and IPs are not open-source
- In the future
 - OpenRTX
 - USB-C charging
 - Open-source FPGA
 - 5W output



2023 - OpenHT



2023 – Supported HTs

- TYT and Retevis
- Supported by OpenRTX
- Require a small hardware mod



2023 - WPSD Hotspot

- Created by Chip, W0CHP
 - Started as a fork of Pi-Star
 - Repeater and personal hotspot
 - First hotspot to support M17 (in 2020)
 - Became an official M17 sub-project
- Future
 - Support for Raspberry Pi 5
 - CC1200 Hats

WPSD Digital Voice Dashboard for K5JAE

11:17:56 AM, Feb 23

WPSD Ver. # 14e8246755

Radio Status	TX/RX Freq.	Radio Mode	Modem Port	Modem Speed	TCXO Freq.	Modem Firmware
TX: M17	433.475 MHz	Simplex	/dev/ttyAMA0	115,200 bps	14.7456 MHz	MMDVM_HS-Dual_Hat:v1.6.1

Mode Status		Current / Last Caller Details							
D-Star	DMR	Callsign	Country	Name	Location	Mode	Target	Sec	Dur(s)
YSF	P25	SP5WWP	PL	Wojciech None	Nowy Dwor Mazowiecki, Mazowieckie, Poland	M17	ALL	Net	TX 8+ sec
M17	NXDN								
DMR X-Mode	YSF X-Mode								
POCSAG									

Network Status		Gateway Activity								
D-Star Net	DMR Net	Time (CST)	Callsign	Country	Mode	Target	Src	Dur(s)		Loss
YSF Net	P25 Net	11:17:48 AM Feb 23	SP5WWP	PL	M17	ALL	Net	TX		---
M17 Net	NXDN Net	11:15:36 AM Feb 23	KK4EHV	US	M17	ALL	Net	0.6		---
DMR2NXDN	DMR2YSF	11:15:31 AM Feb 23	KC1AWV	US	M17	ALL	Net	137.5		---
YSF2DMR	YSF2NXDN	11:12:32 AM Feb 23	KC1AWV	US	M17	ALL	Net	0.7		---
YSF2P25	APRS Net	11:07:38 AM Feb 23	KJ6UVT	US	M17	ALL	Net	8.0		---
POCSAG Net		11:06:41 AM Feb 23	W6VS	US	M17	ALL	Net	7.5		---
RPT	K5JAE H	11:06:24 AM Feb 23	K5JAE	US	M17	ALL	Net	0.1		---
CAN	0	11:06:24 AM Feb 23	K5JAE	US	M17	ALL	RF	1.6		---
Reflector	M17-M17 C									

Local RF Activity						
Time (CST)	Callsign	Mode	Target	Dur(s)	BER	RSSI
11:06:24 AM Feb 23	K5JAE	M17	ALL	1.6s (12 mins ago)	---	---

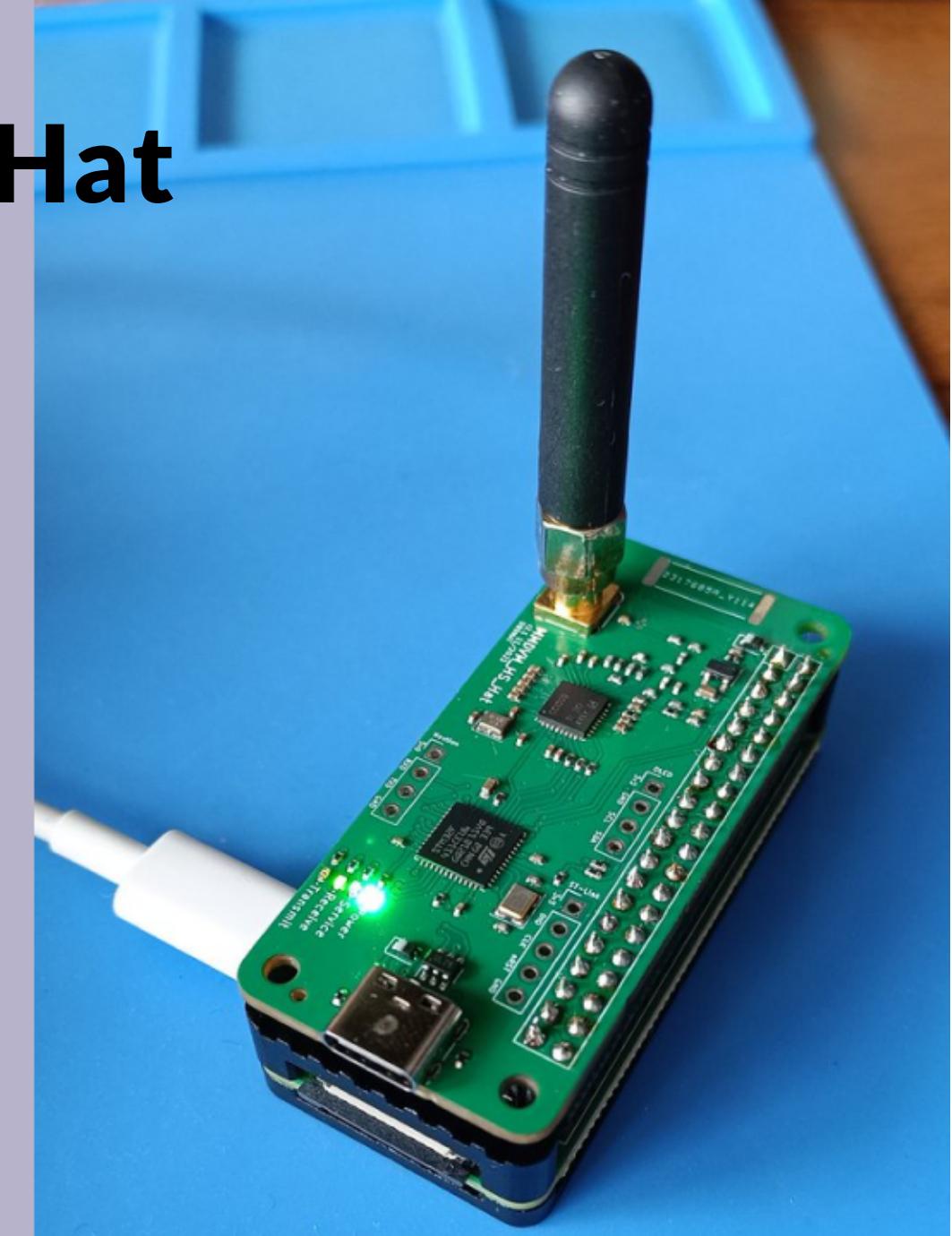
2024 - Module17 v1.0

- Modem that allows you to TX/RX M17 using FM radio
 - Open-source protocol
 - Open-source hardware
 - Open-source software
 - Affordable
 - Build it yourself!
(or purchase online)

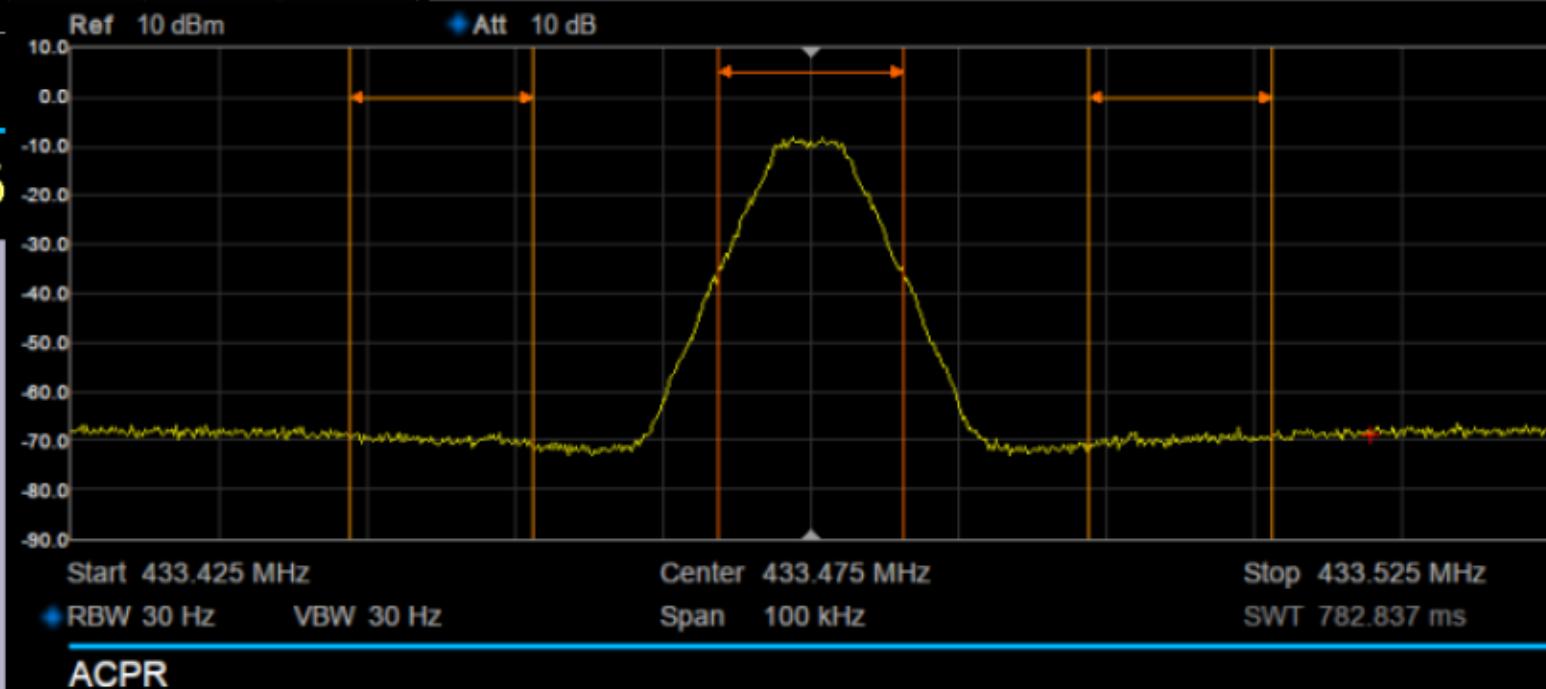
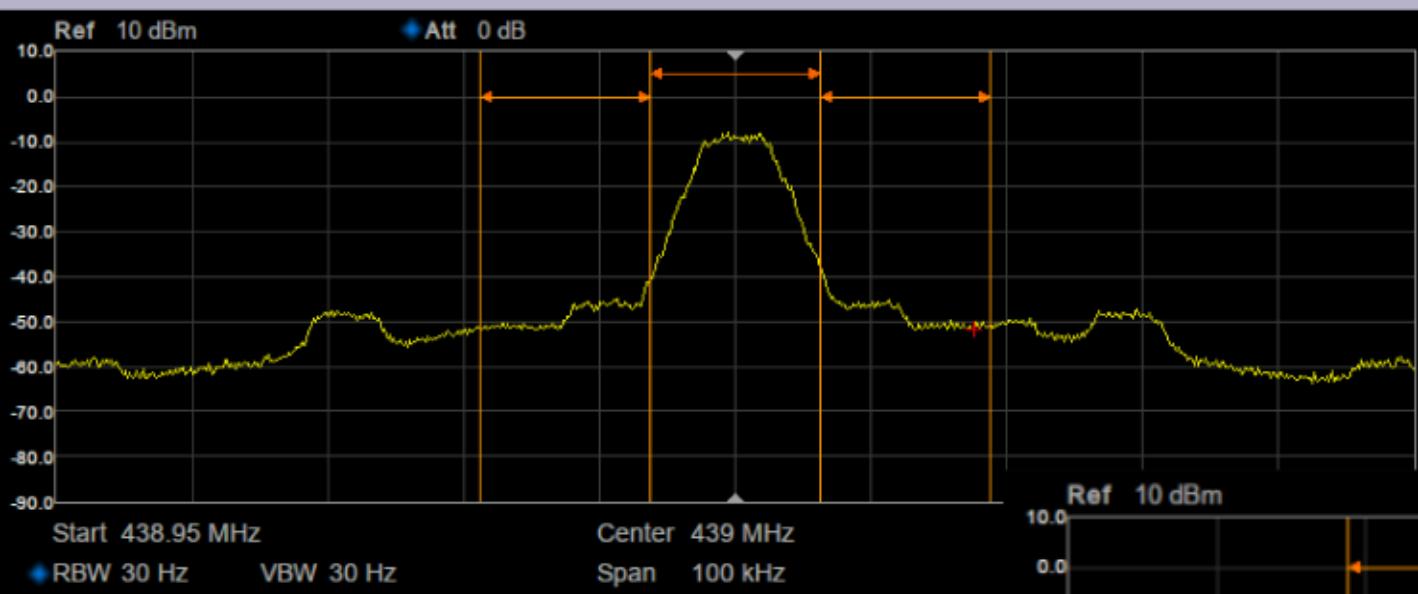


2024 - CC1200 Hotspot Hat

- Uses Texas Instruments CC1200 silicon
 - Superior Adjacent Channel Power Ratio (ACPR) vs incumbent hotspot hardware (ADF7021)
 - Designed as a Raspberry PI hat
- Full M17 spec conformance
 - Soft decoding capabilities (with libm17)
- Supports FM Analog
 - Allows for use of FM Analog HTs to access M17 reflectors



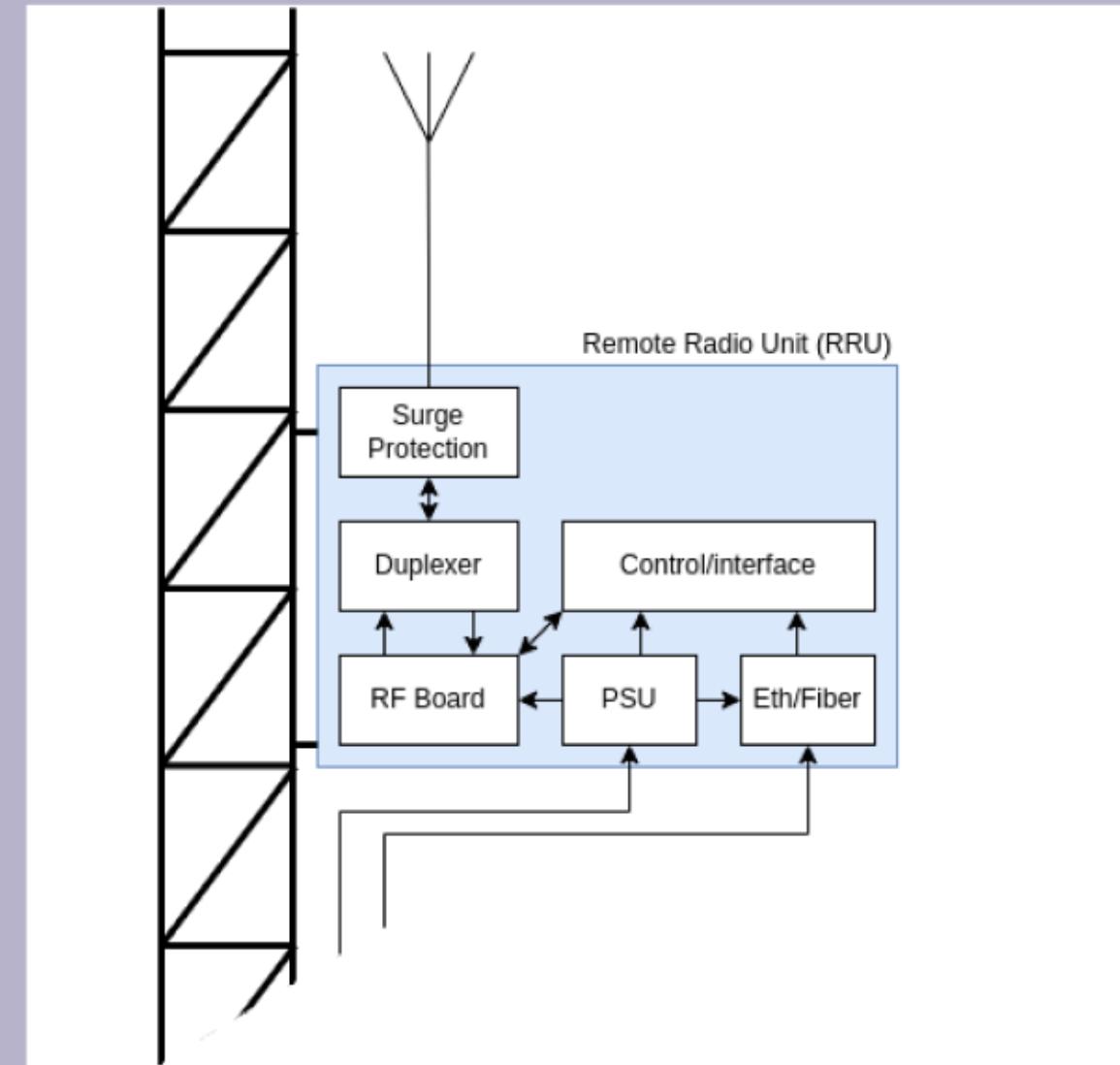
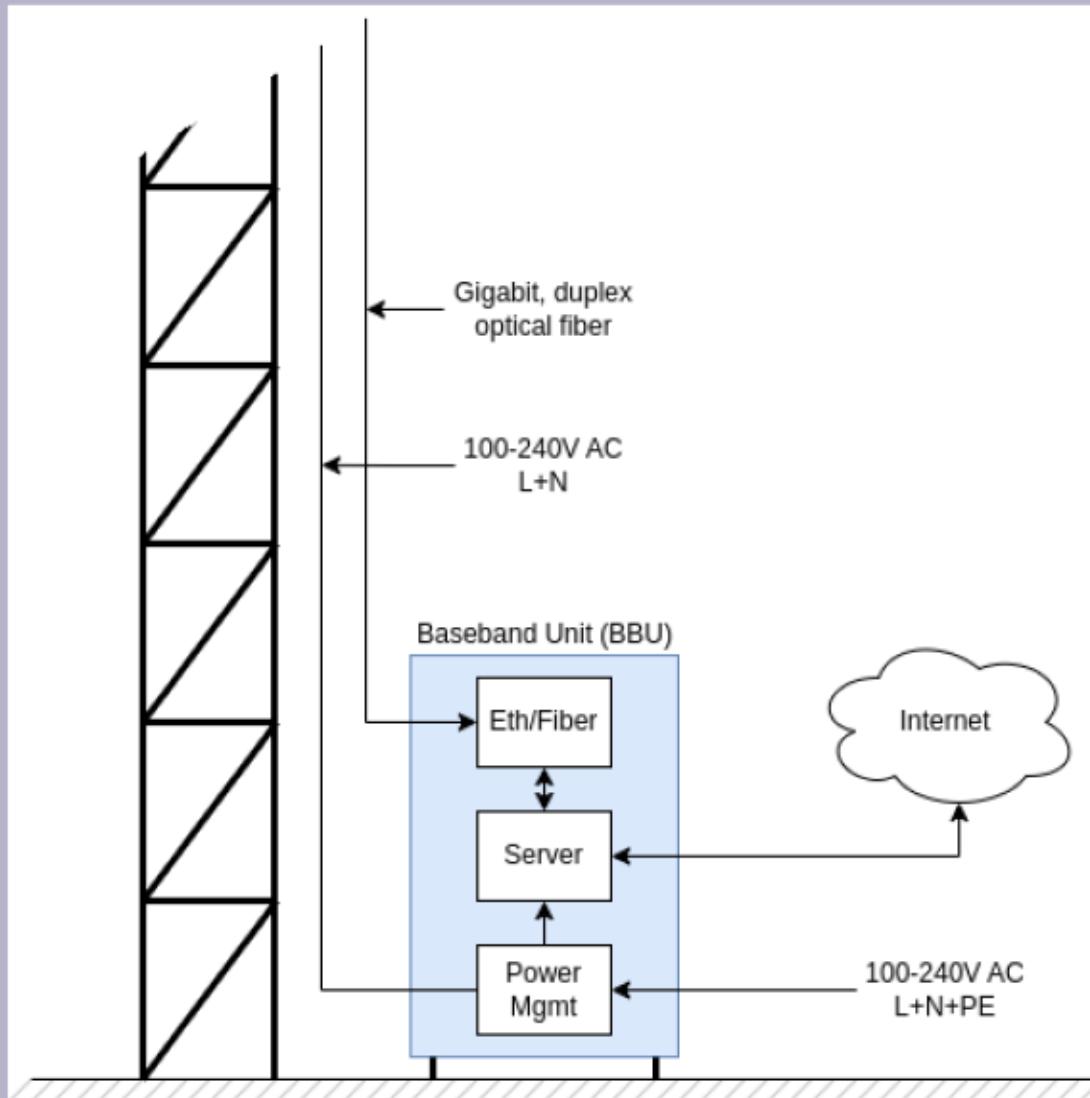
2024 - C1200 Hotspot ACPR Comparison



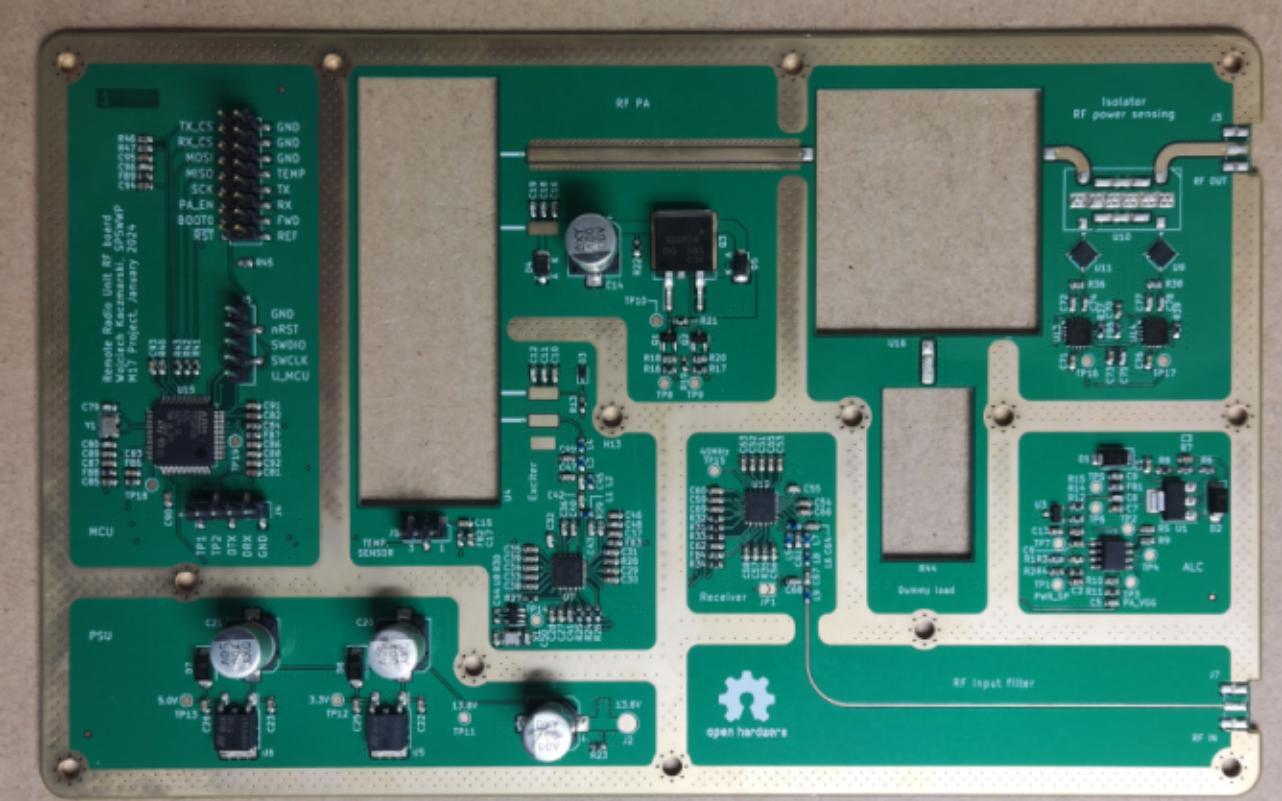
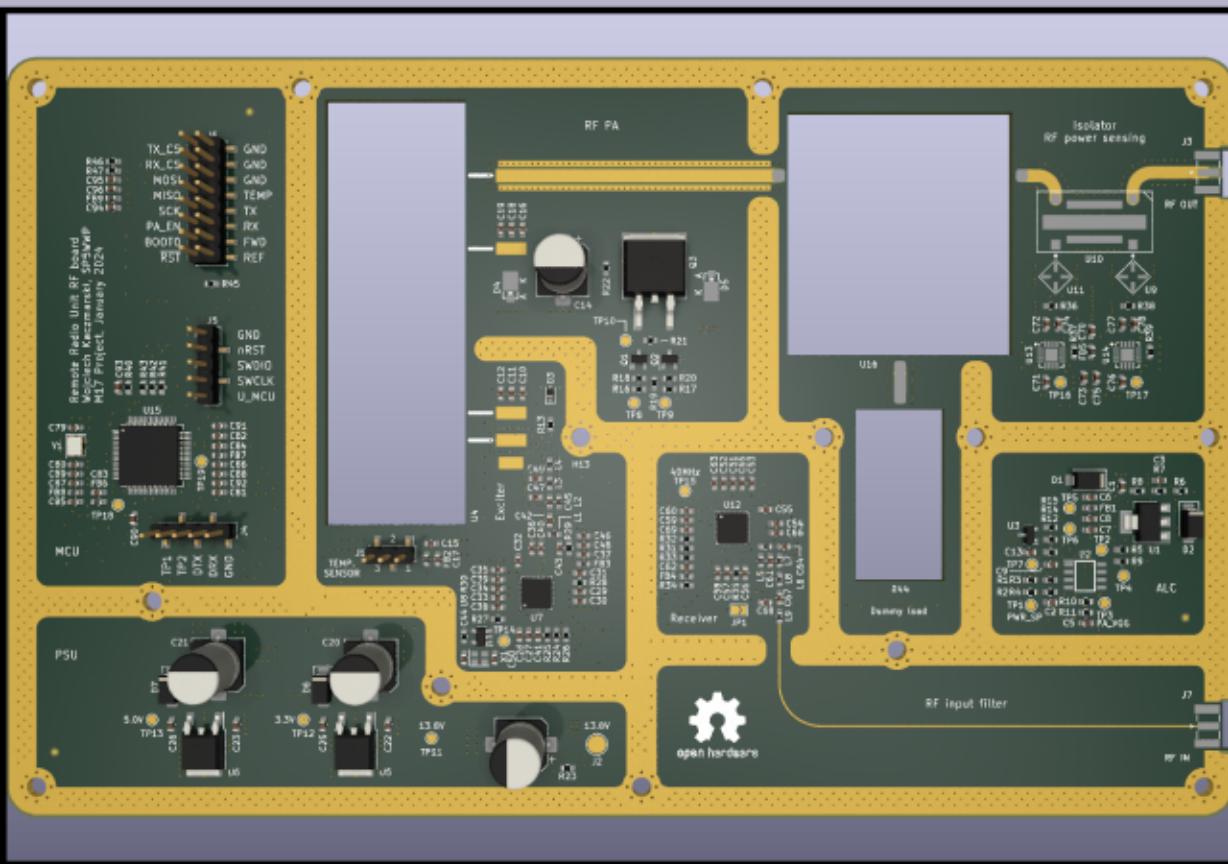
2024 - M17 Radio Access Network

- M17RAN, a repeater project utilizing the philosophy of the cell phone industry.
- Remote Radio Unit (RRU) enclosed in a milled aluminum chassis and placed on the tower
 - Uses a pair of CC1200 chips from Texas Instruments and an RF power amplifier.
 - CC1200 RF front-ends supports various FM-based modes, including M17 and AFSK
 - Only need Power and Fibre optic network to the ground
 - No need for expensive hard line and the RF losses that ensue
- Baseband Unit (BBU) is placed on the ground in the shelter
 - Provides all DSP and encoding/decoding
 - Provides internet backbone interface
 - Provides the infrastructure to remote boot the RRU

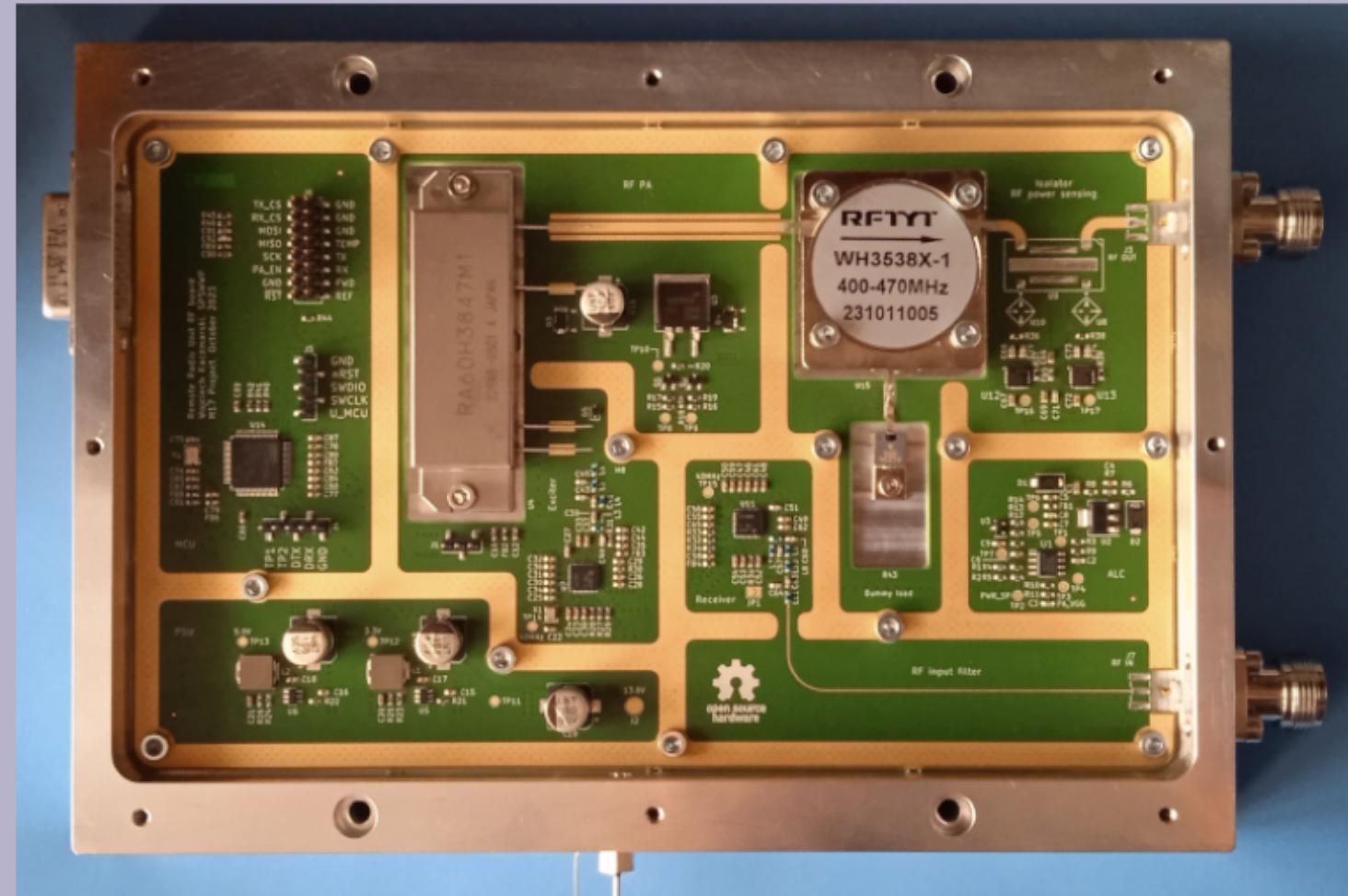
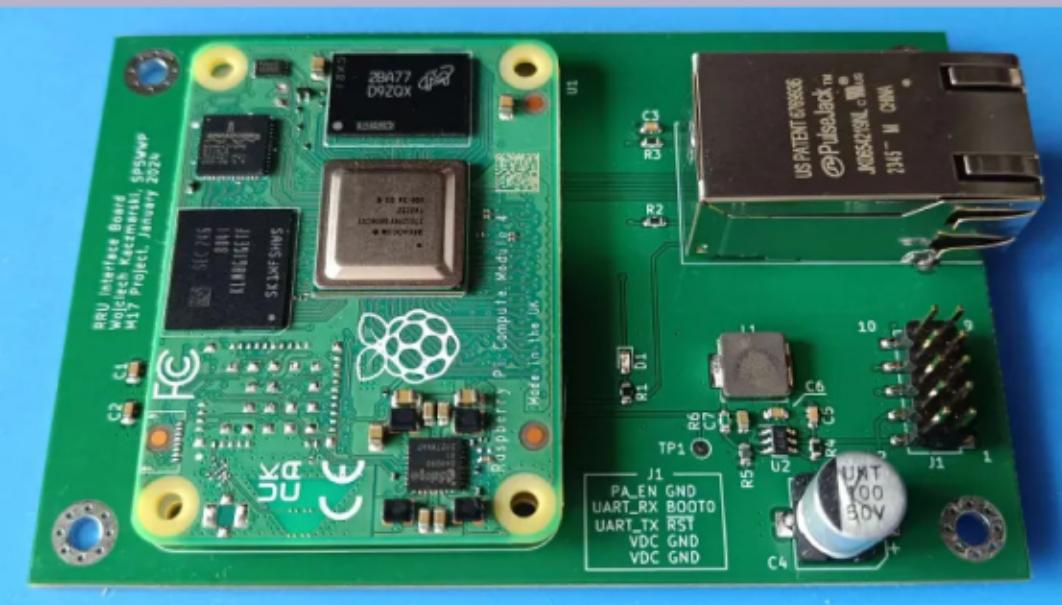
2024 - M17RAN Block Diagram



2024 - Remote Radio Unit (RRU)



2024 - Remote Radio Unit (RRU)



Some Stats

- Over 200 reflectors worldwide
- 10-15 active weekly NET check-ins at M17-M17 C reflector
- Over 3300 X (formerly Twitter) followers
- More than 1395 Discord chat users
- “M17 (amateur radio)” Wikipedia article in 9 languages

M17 Physical Layer

- 4FSK modulation, 12.5 kHz channels
- 4800 symbols per second, 9600 bps gross throughput
- Stream and packet modes
- Error-control coding

M17 Additional Features

- IDs are based on callsigns (no user ID database needed)
- 16 Channel Access Numbers
- AES encryption support

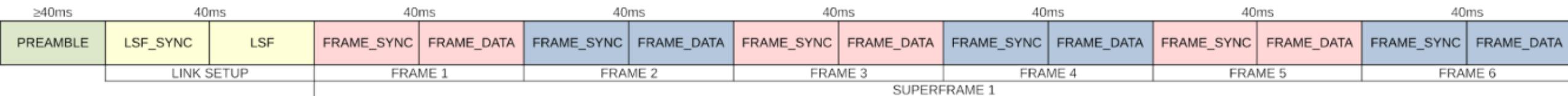
FAQ

- How to get involved
 - Start by going to <https://m17project.org>
 - Join the M17 Discord group
 - Financially (501c3 tax deductible)
- How to get on the air
 - Get a MD-(UV)380 or clone and flash it with OpenRTX
 - Get a Module17 and connect it to the 9600 bps packet port of your mobile FM transceiver
 - Get a hotspot and configure it for M17 to connect to online reflectors
 - Install DroidStar on your mobile device and connect directly to reflectors using M17 over IP only
- How to promote M17
 - Use it and tell others about it!

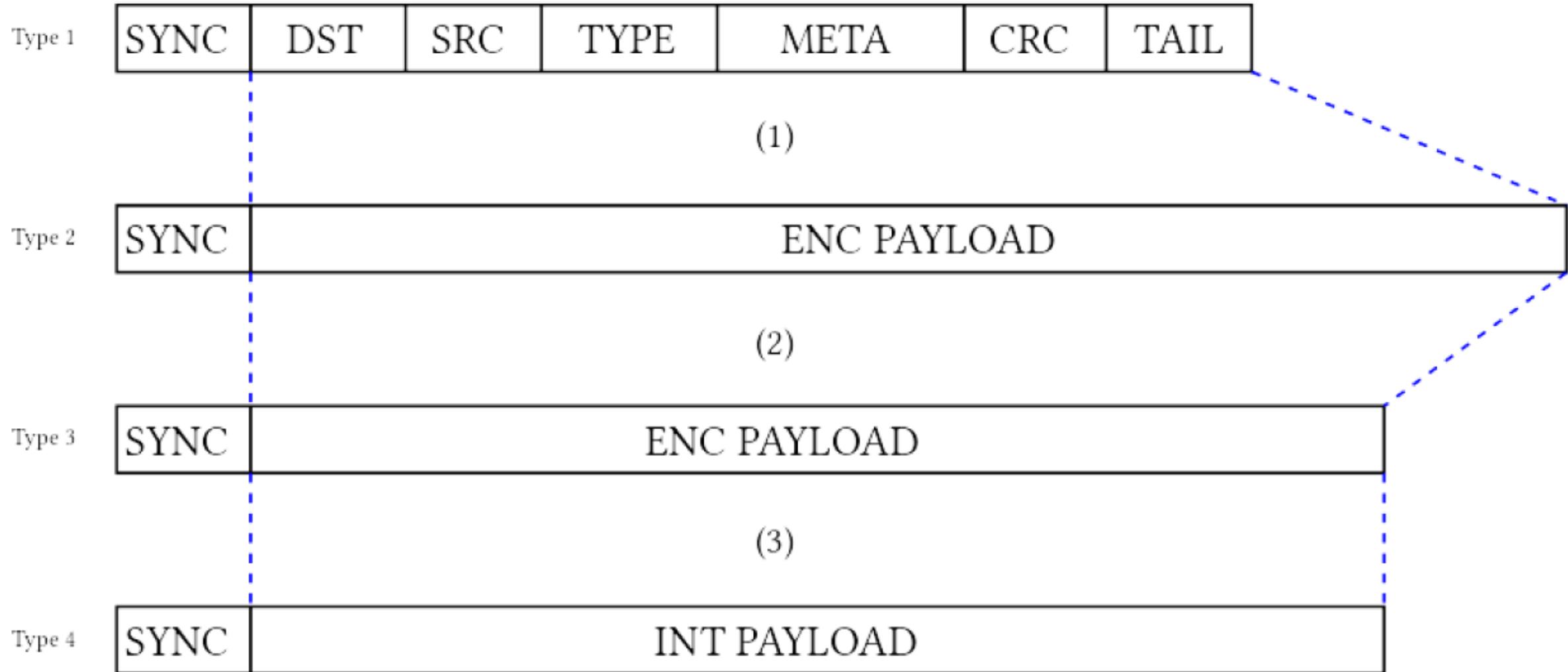
Questions ?

Technical Backup

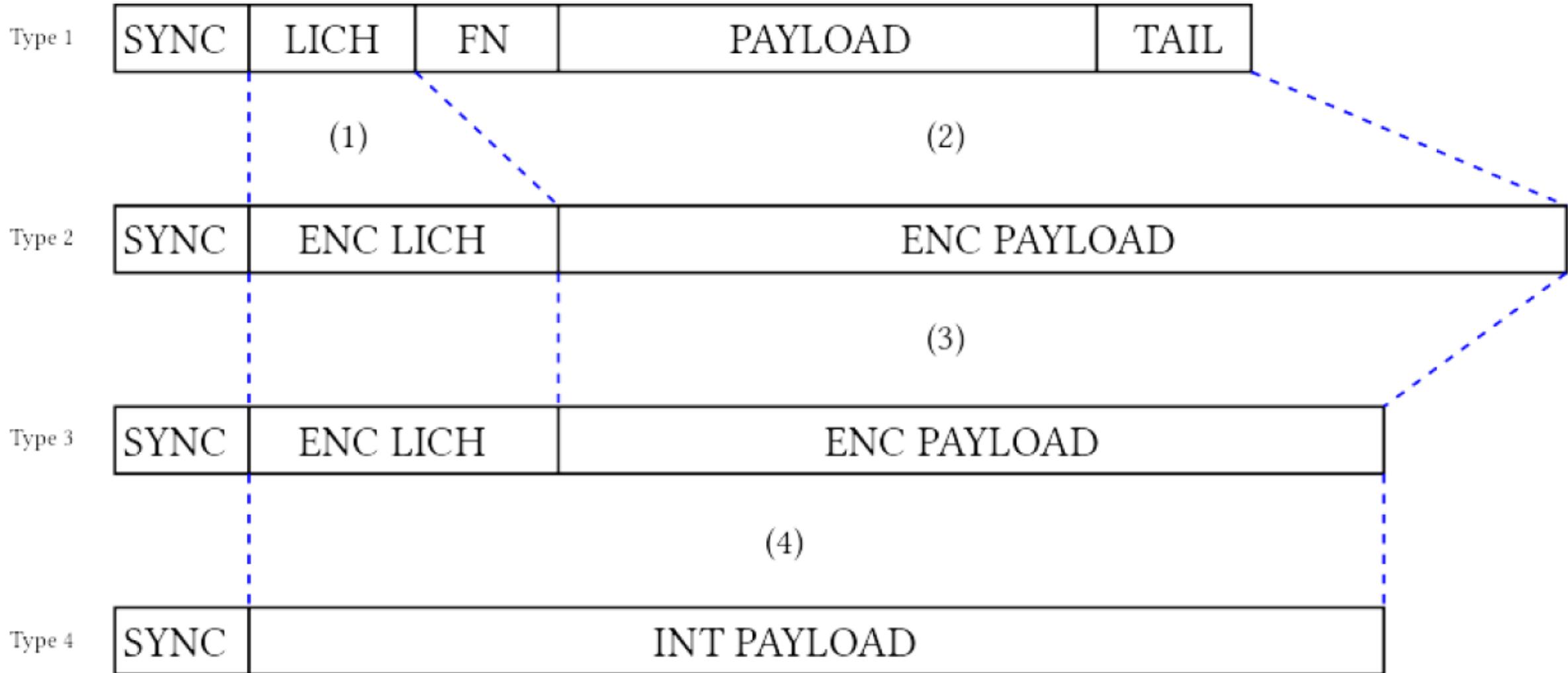
M17 Frame Sequence



M17 Link Setup Frame (LSF)



M17 Voice frame



Error-control coding

- Golay (24, 12)
- Punctured convolutional coding
- Bit interleaving (re-ordering)