

# HamRadio.Tools

*Modern infrastructure for a modern amateur radio ecosystem*

Introduction to The Holy Cluster dev team

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<https://hamradio.tools/>





# Who we are?

# About HamRadio.Tools team

- **Who we are**
  - HamRadio.Tools is an **open, community-driven technical initiative**
  - Built by radio amateurs, for radio amateurs
  - Focused on **infrastructure, interoperability and longevity**
  - Not a replacement of existing communities, **an evolution layer**
- **What problem we address**
  - Amateur radio data infrastructure is:
    - fragmented
    - legacy-bound
    - fragile under load
  - Existing clusters were designed with the mentality of decades ago, **before the ham radio operations and Internet scale we have today**
- **Our mission**
  - Build **open, scalable, protocol-first foundations** for ham radio data

# A bit of history about this initiative

Date	Action
Fall 2015	Idea sparked during a conversation with other hams in Fall 2015 after a ham convention in Spain. The discussion started due to attacks to cluster with fake data.
2016	- Initial conversation with other peers to decide which data the cluster should carry on. - Initial code were started by March 2016.
2017-2019 (low time for radio)	- Code expanded in modularity. - A technical member of <a href="#">URE</a> (Unión Radioaficionados Españoles) asked for a grant(*) to get the code from GitHub and integrate it in their WebCluster ( <a href="#">link</a> ) initiative.
2020-2021	Pandemic provided extra time for radio, [un]fortunately.
2022-23	A coffee with other peer hams in <a href="#">Radio Club Lugones</a> sparked again the same cluster improvement idea.
2024	- Research on needs started; numerous 1-to-1 talks with DX-mans and activators to gather ideas on what a new cluster should provide in terms of functionality. Designing a UI was not in scope. - Initial code from scratch
2025	- Main code block finished; time to beta test the system. - Begin of idea socialization among selected groups of hams, dev teams, and so. - We discovered “The Holy Cluster” 😊
2026	Go live!

(\*) Grants were never necessary as code is always contributed to community in either MIT or Mozilla Public License 2.0

# Project objectives

# ***What we are building (and why)***

HamRadio.Tools does not aim to be or become a product; it's a set of coordinated components with core objectives for the community:

- **Next-generation MQTT DX cluster**
  - Real-time, low-latency, globally distributed
  - Designed for scale, filtering and trust models
- **Modern interfaces**
  - Fast, filterable and readable DX & data streams (read only)
  - Designed for humans, not terminals
  - Able to integrate via API
- **Open callbook**
  - Free, and Free as is in “Gratis”
  - API-driven
  - Designed for integration, not scraping
- **API/SDK/Companion software**
  - Empowers ham radio programs
  - Bridges obsolete or legacy logging software
  - Allows old tools to survive in a modern ecosystem

# How we got here

- **The technical limitations became clear:**
  - Identity problems
  - Monolithic architecture
  - Tight coupling
  - Scaling pain points
  - Protocol rigidity
  - Lack of trust in community
  - Lack of support for new initiatives needing telemetry.
- **The turning point**
  - We didn't abandon the idea
  - We **re-thought the foundation again**
- **Result**
  - HamRadio.Tools emerged as:
    - Independent
    - Protocol-focused
    - Built for **the next 10–20 years**, not the next contest

# Project structure

- **Core (dev) team**
- Focus:
  - MQTT cluster design
  - Data schemas
  - Filtering, trust, and abuse mitigation
  - Performance, reliability, scalability
- Responsibilities:
  - Cluster protocol
  - Message formats
  - AuthN/AuthZ models
  - Inter-cluster federation
- **Admins team**
- Focus:
  - Support with companion tools
  - User experience
  - Visualization & accessibility
- Responsibilities:
  - Logging bridges
  - Developer tooling
  - Documentation & onboarding

# Two teams always in sync

## Core (dev) team

- EA1HET, Jonathan
- EA1GIY, Hugo



## Admins team

- EA1ITM, José
- EA11234FD Rafa
- EA4ETJ, Edu
- EA4HPS, Dani



# What makes this different?

- **Protocol-first**
  - JSON today
  - Protobuf / AVRO tomorrow
  - Backward compatibility as a rule
- **Filtering at the core**
  - Not clients fighting noise
  - The network itself helps reduce abuse
- **Federated by design**
  - Clubs, regions, communities keep autonomy
  - Global visibility without hard central control
- **Built for the future**
  - Radio → Internet → Mesh → LoRa → Unknown next step
  - Same data model, different transports
- **Open documentation**
  - Specs, not screenshots
  - Everything is documented at <https://hamradio.tools/docs>

# Technology stack

# **Something... *boring, proven, scalable***

Design philosophy: we prefer simple systems that can be composed over complex systems that can't be understood or explain

- **Python**
  - APIs
  - Data processing
  - Integration glue
- **Rust**
  - High-performance services
  - Telemetry & ingestion
  - Memory-safe concurrency
- **PostgreSQL**
  - Persistent structured data
  - Callbook & metadata
- **Redis / Dragonfly DB**
  - Caching
  - Rate limiting
  - Fast lookup tables
  - Cluster-wide state
- **MQTT (EMQX / Mosquitto)**
  - Core transport layer
  - Pub/Sub by design
  - Efficient over unreliable links
  - Perfect match for radio-driven data

# תודה רבה (Todá Rabá)

Muchas gracias !! ☺

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