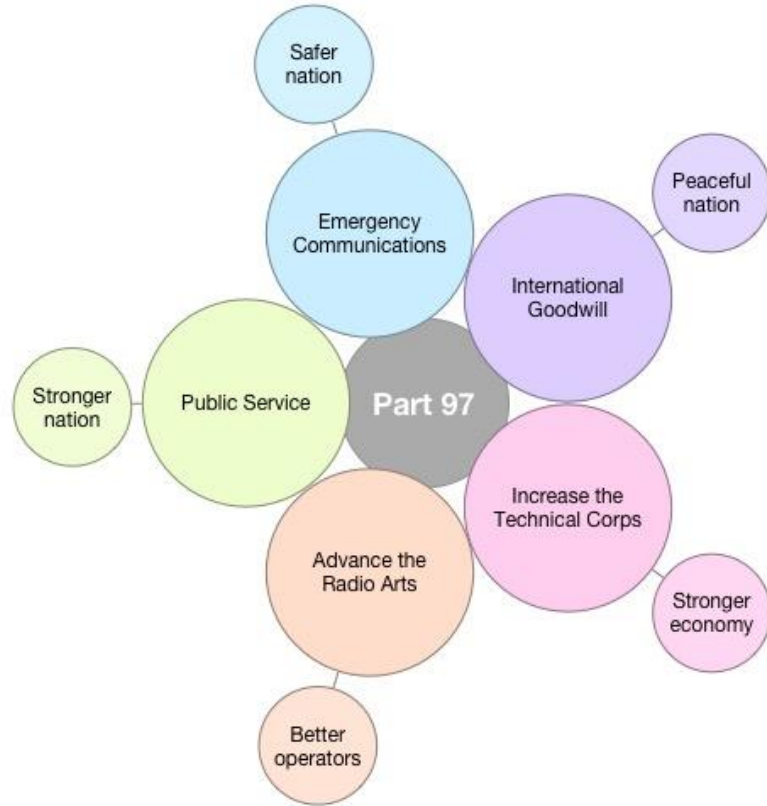

Office Hours

30 May 2023

Open Research Institute



What is the amateur radio service?

We Aren't Even Close to Being "Done"

Huge amount of untapped designs

- G2QM "Aerials" RSGB-Bulletin - 1958
- DSP (TMS32010) project (unpublished)
AMSAT/TAPR - 1988
- "...inexorable march to software radio as the standard for radio in amateur radio circles."
- ARRL SDR working group - 2008

Aerials for Confined Spaces

It is assumed that a length of wire suitably placed, insulated and fed with alternating current from a transmitter acts as an aerial and that the amount of radiation from any portion of it is proportional to the square of the current in that portion.

Radiation Resistance

As a measure of the amount of radiating power of an aerial a fictitious resistance, called the "radiation resistance," is assumed. This must not be confused with the impedance at the feed point, for only in the special case of centre-fed dipoles are these two almost alike in amount. A comparison of the radiation resistance of an aerial with the loss resistance gives an idea of its efficiency as a radiator, though this does not take into account the direction of radiation.

Aerials are usually compared with a half-wave aerial in free space as a standard and this provides a useful starting point for the consideration of aerials shorter than a half-wave. A half-wave aerial can be considered in two ways. First, it acts as a tuned coil so that its spread inductance and capacitance tune to the frequency for which it is designed. Secondly, it is of such a length that when the travelling wave supplied by the transmitter is reflected out of phase at the far end, the point of maximum current is in the centre, the feeding end being a point of high impedance.

The power radiated by a short section of a half-wave aerial (and hence the contribution of that section to the radiation resistance) is proportional to $\sin^2 \theta$ where θ is the electrical distance from the free end. To use this to arrive at an approximation to the radiation resistance of a short aerial, without using advanced mathematics, we can plot a curve, letting each 14 ft and a little over represent 10° of a 256 ft half-wave aerial. The area between any part of the curve and the line on which it stands represents the radiation resistance of the part of the aerial represented by that part of the curve.

By M. J. HEAVYSIDE, B.Sc. (Hons.), M.Ed., Ph.D.
(G2QM)*

Efficiency

"What is the value of this gain in radiation resistance?" might be asked. The value is in the increase in efficiency as the radiation resistance rises compared with the loss resistance. If the radiation resistance is 2 ohms and the loss resistance is also 2 ohms, as it might be for a 40 ft length of wire, only half the power supplied is radiated. If the radiation

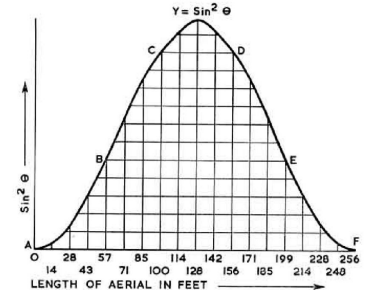


Fig. 1. Curve plotting $\sin^2 \theta$ versus aerial length.

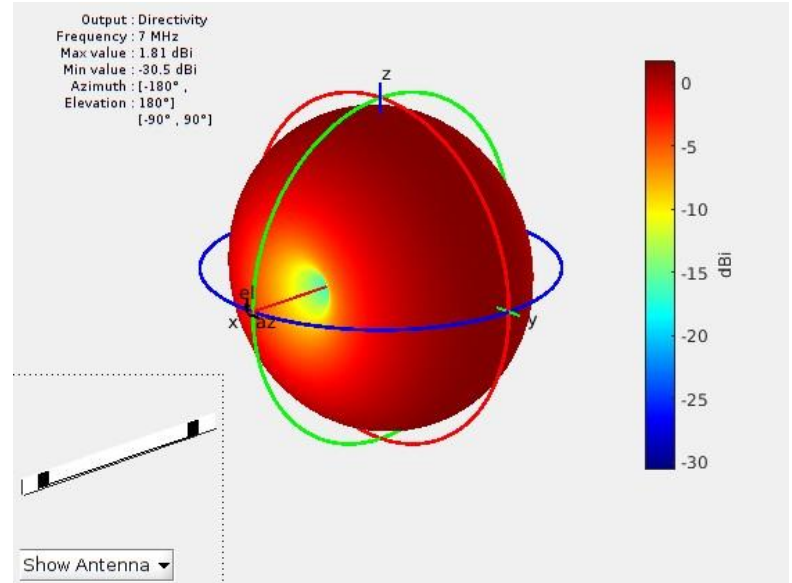
resistance is raised to 40 ohms by increasing the loss resistance only to 4 ohms, then only one eleventh of the power supplied is lost and ten elevenths radiated.

Aerials on the 160 metre band tend to have low radiation

We Aren't Even Close to Being “Done”

Let some sun shine in

- The “Dumbbell” Project, Meander Dipoles
- GNU Radio is widely used in amateur and experimental radio.
- An RTL-SDR + Raspberry Pi + free firmware from GitHub = powerful SDR receiver for ~\$100*



So What's the Problem? Org looking out

Getting The Word Out

- Do you like ads?
- Severe channel fragmentation
- Fighting against well-funded automatic algorithms
- Making the mistake of believing the source code or schematic speaks for itself
- People have limited time

Toxic Politics

- Amateur radio is not immune from censorship, harassment, exclusion, racism, sexism, and bigotry.
 - Organizations formed in an era where top-down authoritarian leadership styles were considered normal and successful may still use these styles.
-

Traditional Path to Getting Involved in the Technical Side of the Hobby: Clubs

1835 Tocqueville "Democracy in America" wrote about how prominent voluntary private associations were in the organization of social, political, and economic affairs.

Education

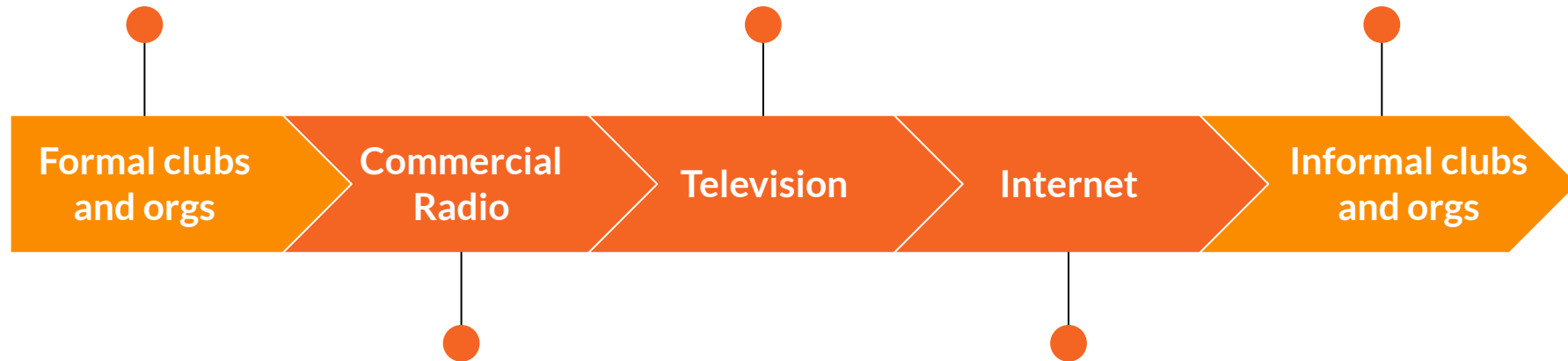
Entertainment

Socializing

Credentials

The trend really picked
up with the rise of
television.

Socializing



People started getting
entertainment and
news at home.

Credentials for a huge variety of
things, entertainment, mobile
communications, education, and
some socializing.

Ad Hoc Networks, Responsive Clubs

Informal Groups

- No dues, no bylaws - but they're out there getting things done and you can find them
- **Some** subject matter conferences, interest groups, mailing lists, web forums, buying "clubs" (122 GHz), build-a-thons, open source projects.

Modernized Clubs

- Hybrid Meetings
 - Websites with activity reports which are findable with an internet search
 - Dedication to responding to new people of all types
 - Meeting people where they are!
-

Formal vs. Informal: We Need Both

ARRL, Traditional Clubs

- Can and does lobby Congress for spectrum defense
- Can own property like a repeater site
- Can protect members from liability so that they can do things together like have Field Day

SDMG, DEFCON Groups

- Flexible and responsive
 - Very low cost
 - Can come and go and work on whatever you want
 - Flat organizational structure
 - No liability protection - mainly social
-

Why do we care about how clubs and organizations have changed?

**the technical
is social
before it is technical**

**The way we do
technical work
has evolved
because our
companies and
clubs and
organizations
have changed**

1. Digital document storage accessible from almost anywhere at any time
2. Cheap gain
3. Cheap computing
4. Cheap PCBs made in days
5. Cheap components*

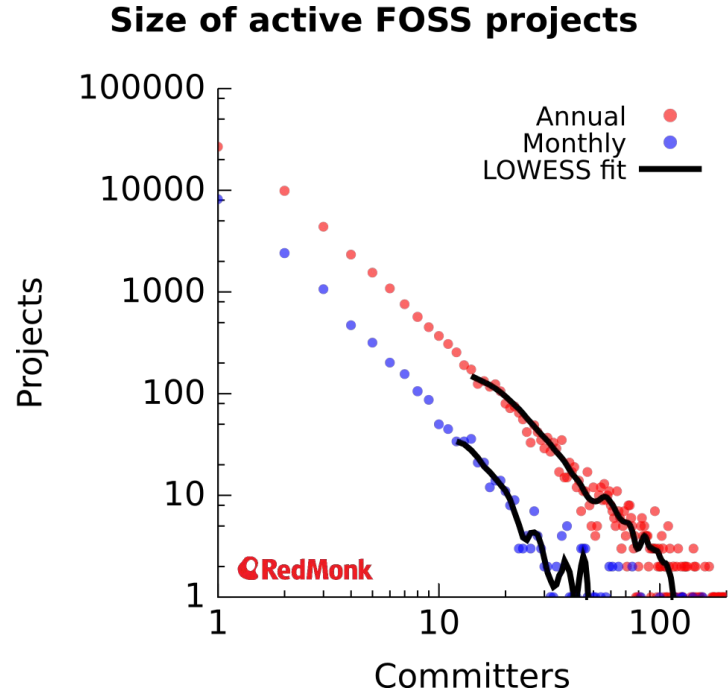
Amateur Technical Projects: Statistics

Size

Similar to the Free and Open Source Software community, most amateur radio technical projects have one active person.

This is a logarithmic graph!

51% have only 1 contributor, while 19% have 2, 9% have 3, 5% have 4, and 3% have 5. Overall, 87% of projects have 5 or fewer committers per year. The largest few have ~100 committers.



Technical Project Structures

The Triangle

- Document Repository with Version Control (GitHub, GitLab, Sourceforge)
- Mailing list or forum (Groups.io, mailman, Facebook)
- Chatroom (Slack, Discord, Matrix, IRC)

Governance

- "Do-ocracy"
 - Founder-leader
 - Self-appointing council or board
 - **Electoral**
 - **Corporate-backed**
 - Foundation-backed
-

Summary

Technical Project Lineup at Open Research Institute, a 501(c)(3) non-profit R&D firm directly benefiting amateur radio.

100% Open Source Designs

Remotely accessible lab benches, diverse and active board of directors, multiple sources of funding.



<https://openresearch.institute/getting-started>

“High Flyer” Haifuraiya ハイフライヤ

Open Source High Earth Orbit or
Geosynchronous Orbit Amateur
Communications Satellite
Transponder and Electric
Propulsion Motors

Broadband microwave digital communications transponder for space or terrestrial deployment. Frequency division access on the 5 GHz uplink, time division on the 10 GHz downlink. Field Programmable Gate Array (FPGA) from Xilinx and advanced RF system on chip from Analog Devices are used. Hardware, software, firmware, mechanical, and regulatory work required. Advanced systems design, link budgeting, and control systems architecture involved.

<https://openresearch.institute/getting-started>



Ribbit Radio

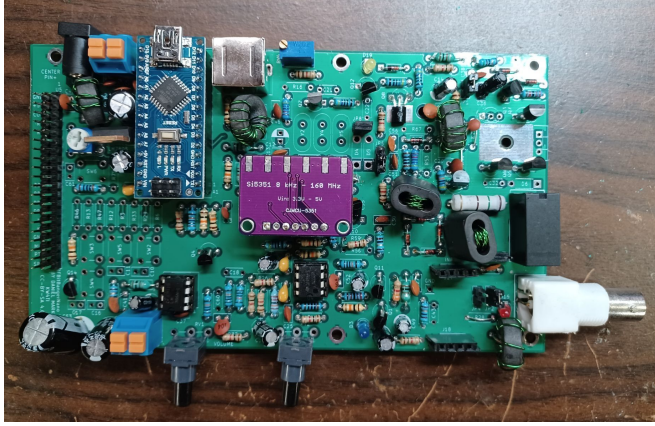
A new digital text messaging
mode for HF/VHF/UHF
recreational and emergency
communications

Ribbit Radio works from your smart phone. Android and Apple versions are testing right now in both app stores. You can be a part of the test team today. This the first open source amateur radio app on the market. It is free.

It allows you to turn any radio into a digital messaging station. Type an SMS into your phone and the app plays a resilient digital signal from the phone speaker into the microphone of your radio.

Software design, systems architecture,
user interface design involved.

<https://openresearch.institute/getting-started>



RF Bit Banger

Low power HF Kit radio that is designed to be built from your junk box.

RF Bit Banger implements SCAMP, a new digital HF mode with performance on par with FT8 but it allows you to have a QSO.

Design implements a class E amplifier and is perfect for learning about this particular circuit design.

RF modeling, user interface design, software, hardware design involved.

<https://openresearch.institute/getting-started>



Neptune

A point to point digital communications link designed for drones and amateur aerospace.

Designed for 5 GHz, Neptune draws heavily from Long-Term Evolution (LTE) phone signal design. If you have always wanted to learn more about OFDM signals and why they are so heavily used in 5G then you will be interested in this project.

Design deployed on a Xilinx FPGA paired with an RF system on chip from Analog Devices.

Software, hardware, firmware, communications theory involved.

<https://openresearch.institute/getting-started>



Opulent Voice

High-fidelity digital voice for 70cm and above. Uses 16kbps OPUS codec and can transmit data or voice without having to switch to a separate packet mode.

Opulent Voice will be used in space on a NASA sounding rocket this year, is available for any space or terrestrial project to use, and is the native digital uplink mode for High Flyer satellite transponder design.

The custom physical layer is delivered to the receiver through standard internet protocols, which means it can be easily received on a wide variety of equipment.

Software modeling, writing, and networking involved.

<https://openresearch.institute/getting-started>



Dumbbell

Want a 160m antenna but don't have room?

Amateur radio is where overlooked techniques and underutilized bands get new lives.

The Dumbbell antenna is a variant of the meander dipole that uses particular patterns of folded wire loading to achieve very good performance in constrained space.

Software modeling, physical construction involved.

<https://openresearch.institute/getting-started>

—

**“But I’m not
technical enough to
contribute”**

—

You do not have to be an expert to join. You just have to be willing to become more of one along the way.

—

Art, music, swag, shipping, sales, promotion, user interface design, publicity, test and feedback, fundraising, procurement, documentation, social events organizing, and conference organizing are all extremely valuable contributions to any project.

Key Enabling Developments

This is just a small sampling from one volunteer organization out there doing amateur radio work.

YOU can join or start an amateur radio technical project too!

What makes now the best time for amateur radio?

- Internet Communications
 - Open Source licenses and mindset
 - Cheap Computing (GPUs, FPGAs, ASICs, PCs)
 - Cheap Gain
 - Plentiful Microwave Part\$
 - Regulatory Relief
 - Modern Organizational and Governance Models
-

What's next?

Help Wanted

Get past the dt-bindings error in building embedded linux (mathworks buildroot) for Neptune (California, USA)

Getting Remote Lab South more recognition and more FPGA and microbiology customers (Arkansas, USA).

Build some meander dipole HF antennas to prove out the promise seen in our simulations (Slack).

Help build and test RFBitBanger designs (Slack).

Plenty more! <https://openresearch.institute/getting-started>