

ÄRTEN™ project



www.w1sye.org

Amateur Radio Training Experience Network

Experiments in the Ham bands from 1 to 10 GHz (3 to 33 cm)

I think of the SHF bands as the new “short wave radio” of this century, HF(10m to 100m) was considered short wave when Ham radio was established

Now it's time for 3 cm/10 GHz to 30 cm/1 GHz to be a catalyst

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This project includes the use of the AREDN Mesh software

An ARRL/ARDC grant of \$8K was awarded in Dec 2022

ÄRTEN™ - Idea for the name



arten v. (Latin)

*To compel, force, or induce (sb. to do sth.);
to induce or bring about (a result);*

ärten n. (Swedish) - definite singular of ärt

*The **Ä** umlaut (dots) is intended to represent a charge dipole radiating knowledge.*

TEN - A nod to 10 GHz

cm Bands Available to all classes of Amateur Licensees



- 33 Centimeters (902-928 MHz) 13 inches
- 23 Centimeters (1240-1300 MHz) 9 inches
- 13 Centimeters (2300-2310 and 2390-2450 MHz) 5 inches
- 9 Centimeters (3300-3500 MHz) 3.5 inches
- 5 Centimeters (5650.0-5925.0 MHz) 2 inches
- 3 Centimeters (10000.000-10500.000 MHz) 1.2 inches

Already established technology allows us to put them to use in novel ways

- We have these radios in our homes now in low cost WiFi routers at 2.4 and 5 GHz.
- WiFi frequencies can reuse the many *AREDN*[™] equipment solutions

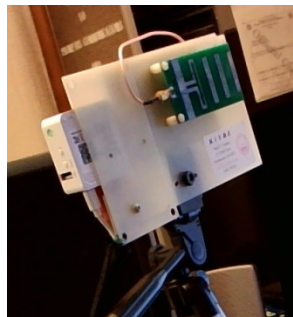
USE IT OR LOSE IT - continuing pressure on the FCC to reallocate spectrum

CONCEPTS



- NCRC will plan and own an array of local mesh nodes and encourage attachment by Hams with an entry level Technician and higher class licenses.
- Traffic will be open using published protocols and not encrypted except in emergencies.
- TLS and other encryption protocols will be monitored and blocked in normal use.
 - This makes **ÄRTEN** an experiment in **cybersecurity**.
- Internet connections are allowed but traffic will be monitored to avoid commercial use.
- Low Cost for personal equipment will encourage youth access
 - Many of the components are available for less than \$50 and a station can be <\$100.
 - Most of this can be done with reprogrammed WiFi routers and home brew antennas,
 - The size of cm band antennas make 3D printing them a reality.
- Make the learning material (youtubes and online documents) available for all.

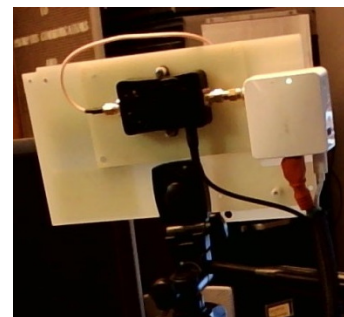
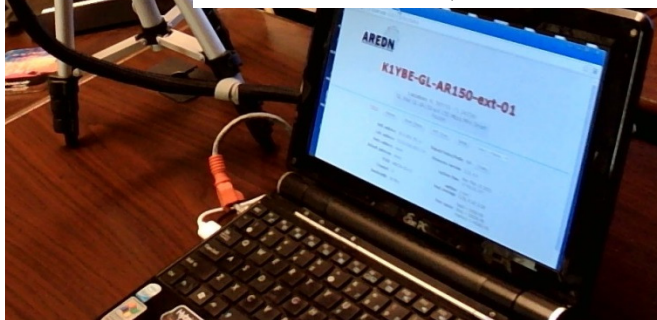
AN EXAMPLE NODE OPERATED AT 3 MILES



< Yagi-Uda side

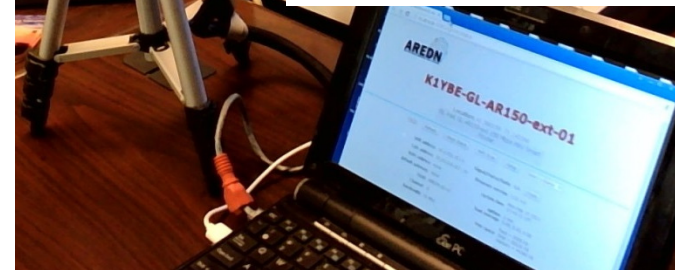
Router/Radio(white) >
4 W Amp (black)

Control Web page
from the router



Equipment:

Approx. \$70
Plus a computer
(Raspberry PI is
adequate)



Current 2023 Initiatives



1) Access to a quality 6GHz VNA and training for RF component and antenna calibration

- 1) Workforce training for RF/ wireless / xG-NR deployments (see next slide)
- 2) Incremental exposure to radio and antenna measurement technologies.
- 3) <https://nediv.arrl.org/2023/02/17/ham-radio-is-a-gateway-to-technology/>

Q. When was the first time you saw and then used a VNA?

2) CO₂ Sensors in farm fields to collect data that illustrates the Oxygen/CO₂ life cycle.

- 1) Weather and solar irradiance data will also be collected to help understanding of the measurements
- 2) APRS reporting of CO₂ concentration will be prototyped.
- 3) Data will be provided to local Middle and High schools for classroom project analysis.

3) Exposure to Networking

- 1) Mesh nodes allow any IP application to be used. Nodes provide complex functions like Remote Radio control as well as simple MESHCHAT
- 2) Advanced monitoring of mesh traffic can be used to demonstrate and implement cyber security techniques
- 3) QSOs by chat messaging would use CW procedures to teach these messaging skills.

4) Radio fun

- 1) While Mesh radio at 2397 MHz is the initial deployment for sensor data transmission, the equipment can be use to connect with nodes being deployed in many Mesh projects including the NE Mesh initiative making . ***CQ MESH and POTA are near term realities***

Projected Job Growth - 5G



SUMMARY TABLE 1: THE THREE WAVES OF WIRELESS JOB GROWTH

		MAIN LOCUS OF JOB GROWTH	PERCENT OF ECONOMY AFFECTED	JOBS CREATED (AS OF DATE)
Wave 1 The Rise of Wireless	1990 - 2007	Wireless industry , providing mobile voice/text/email services	1%	200,000 (2007)
Wave 2 The App Economy	2007 - 2019	Digital industries such as entertainment, finance, communications and social networks	20%	2.2 million (2019)
Wave 3 The 5G Revolution	2019 - 2034	Digital plus physical industries such as agriculture, energy, construction, manufacturing, transportation, education, healthcare, government (including defense)	100%	4.6 million (2034) 106,000 (2020)

Data: Bureau of Labor Statistics; Progressive Policy Institute; Indeed.com; author projections

Other mesh projects - Much is happening



Western States have been deploying emergency and dense city networks for some years now. This was the impetus behind the development of the AREDN mesh software

www.arednmesh.org

ARRL NE-DIV has a working group on Spectrum Protection and Use that meets on Mesh status on alternate meetings.

[https://nediv.arrl.org/spectrum-protection-utilization/#New England Mesh Networking](https://nediv.arrl.org/spectrum-protection-utilization/#New_England_Mesh_Networking)

AR|DC grants have been issued to RI (Fire Tower Sites) and Maine (15 sites) to build out wireless amateur radio mesh networks on 2.4 and 5.8 GHz with the larger goal of linking the New England region

- Bill Richardson, NG1P, presented at the Maine State Convention and Hamfest on Saturday March 25.
- <https://www.ardc.net/apply/grants/2022-grants/grant-rhode-island-emergency-mesh-network-and-digital-voice-repeater-network/>

Contest Ideas



Defined awards

ARTEN DYDX - 1 yard at 1-10 GHz = 1 Mile of HF DX

-Encourages short and direct connection (without a repeater)experiments with significant frequency reuse up to about 8 miles (180° great circle)

-Longer connections are classified as Extra Terrestrial and allow Moon-bounce, Moon QSOs, and satellite radio operation projects

ARTEN WAN -I,V,X,L,C “Worked All Nodes” Certificates

FUTURE CONTEST IDEAS



ARTEN WEB “Worked Every Band” Award

ARTEN CAN “Connected to All Nodes” Award

ARTEN WAM “Worked All Modes” Award

ARTEN MEN Moon (ours) - Earth Networked

ARTEN WOMEN World (e.g. Planet) Or Moon (e.g. Europa) to Earth Networked

NEXT STEPS



If the ideas presented interest you and you want further information, send me an email at:

K1YBE@YAHOO.COM

You can follow us at www.w1sye.org

Futures..

- The NCRC General/Extra seminar will highlight details about ARTEN tech as they are already on the license exams.
- Projects building web based HF radio control panels,
- Sending IF I/Q digital samples from a shared remotely controlled dish antenna for local decoding by several operators.
- Any internet availability can be used for testing but commercial internet access(\$/mo) is not needed to operate locally on a HAM mesh network