



2021 Annual Report

Amateur Radio Digital Communications



AMATEUR RADIO DIGITAL COMMUNICATIONS

5663 Balboa Ave - Suite 432 - San Diego, CA 92111-2705 - USA

Letter from the Executive Director



Hello, and welcome!

For ARDC, 2021 was a year of more growth and giving than ever before. We hired five members of staff (six if you include my transition from contractor to staff member), reviewed over 100 grant applications and issued more than 72% of them. It's tremendous to be able to invest in the amateur radio and digital communications communities, and we're just getting started.

During this time, we've learned and grown as an organization. Some of the lessons have been tough – growing pains are real! Looking back, though, I am truly proud of the work we did in 2021.

None of it would be possible, though, without our volunteers (including Board) and committee members, who have contributed hundreds of hours to steer ARDC and provide technical guidance. Without them we would be unable to select effective grants or maintain 44net. Thank you for your dedication and passion.

You'll see the results of this work in the pages that follow.

All the best and 73,

Rosy

Rosy Wolfe – KJ7RYV
Executive Director
Amateur Radio Digital Communications (ARDC)
ampr.org

Cover Photo: MIT Building 54 Radome Cambridge, Credit: Tony Webster

ARDC Values (est. January 2022)

Curiosity. We approach people, projects, and situations with curiosity, asking questions before making assumptions. We actively look for opportunities to learn something new - particularly from our grantees and community members.

Experimentalism. We encourage our staff, volunteers, and grantees to try new things and take risks. Like good engineers and scientists, we ask that they share - and, if appropriate, document - what they learn, in service of supporting future experimentation and learning opportunities.

Respect. Respect may be defined as the due regard for the feelings, wishes, rights, experiences, or traditions of others. We ask that all employees, board members, volunteers and grantees treat one another with this due regard, balancing both human-ness with professionalism in our interactions with one another.

Accountability. According to [Wikipedia](#), 'Accountability' stems from late Latin *accomptare* (to account), a prefixed form of *computare* (to calculate). As an organization that supports engineering as well as financial support and distribution, it's important to us that our equations balance - in our projects, in our accounting, and between one another and the individuals and organizations we work with. If we do something wrong, we aim to make it right. To support healthy and workable relationships, we ask that our community, vendors, and grantees do the same.

Openness & Transparency. ARDC aims to operate in a way that is as open and transparent as possible. This includes publishing information about all of our grants, using and contributing to open source software, and making our tax returns and other records easily accessible. We also expect that our grantees make their work available under [open source licenses](#) or otherwise freely available.

Inclusiveness. One of [our goals](#) is to bring people into amateur radio and digital communications science and technology, both in the United States and internationally. In particular, we aim to help and invite in the kinds of people who have not historically been a part of the fields' mainstream demographics. We rely on the values of Curiosity and Respect to make sure we create activities and spaces that allow for participation from people from all walks of life.

Fairness. As an organization that makes grants, it is important that we weave fairness into all that we do. This includes ensuring that grant and job applications are reviewed with consistent criteria.

Generosity & Gratitude. Last but not least, ARDC is a giving organization, so generosity and gratitude are core to who we are and what we do. This principle includes financial generosity and extends to making time for needed conversations, supporting one another in times of need, assuming best intentions in the event of a conflict, and being grateful that we get to do what we do every day, even the hard ones.

2021 Summary

In 2021, ARDC took some big strides towards reaching [our goals](#) and fulfilling [our mission](#).

Organizational Updates

Following officially hiring Rosy Schechter, KJ7RYV, as a member of staff on Jan 1, 2021 – following being a contractor in 2020 – we also brought five additional staff members on board:

- Chelsea Párraga, KF7FVJ, Grants Manager
- Dan Romanchik, KB6NU, Communications Manager
- John Hays, K7VE, Outreach Manager
- Merideth Stroh, KK7BKI, Administrative Coordinator
- Bdale Garbee, KB0G Accounting Director (Temp)

In December, we held our first organizational offsite. Board and staff met together to discuss some big picture as well as tactical issues. The first output from this work is our new [values statement](#), which you can see on p. 2.

Grants

ARDC awarded more than [\\$8 million USD](#) to organizations whose projects and programs align with our goals. Following are some examples (not an inclusive list):

Scholarships

- [American Radio Relay League \(ARRL\) Foundation Scholarships](#): ARDC funded approximately 25% of the scholarships awarded by the ARRL Foundation for the 2021-2022 school year.

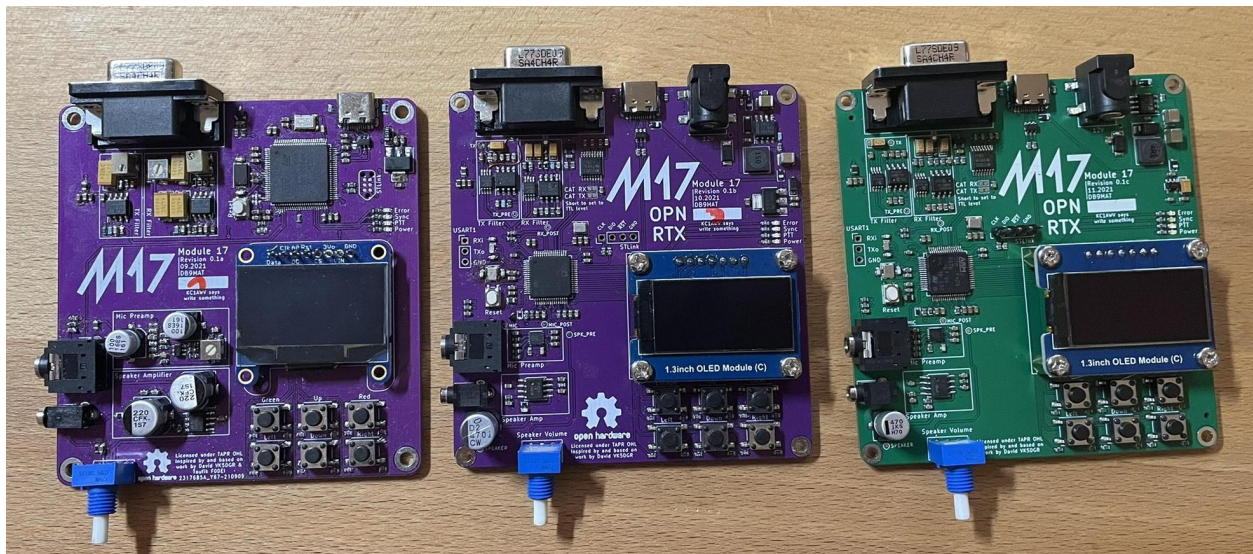
***At right:** Frances “Frankie” Bonte, KE8HPA, is studying materials engineering at Case Western Reserve University on an ARDC scholarship.*

- [Society of Women Engineers 2021 Programs](#): This grant funded 30 scholarships for women pursuing engineering careers, as well as programs designed to help women in engineering excel professionally and showcase their achievements.
- [OMIK Scholarship Fund](#): This grant allows OMIK – an international, multi-racial, multi-cultural amateur radio organization, and the largest predominately Black amateur radio association in the US – to award up to 10 scholarships of \$5,000 each and provide winners with amateur radio starter kits.



Amateur radio infrastructure and development projects

- [Rocky Mountain Hams 5 GHz Microwave Network](#): This grant funded improvements to RMHAM's microwave network and several emergency communications trailers.
- [M17 Project](#): This grant funds the ongoing development of the M17 protocol, an innovative, open-source digital communications protocol.
- [Locating RFI sources in Los Angeles County, CA](#): With this grant, the ARRL Los Angeles section was able to purchase a Fluke ii910 Acoustic Imager, which enables them to more quickly and accurately identify sources of interference.



The M17 Project is working on both hardware and software for a new digital radio protocol that will be completely open source. Photo: M17 Project

Education

- [Operation Hamulanche](#): With this grant, teachers at the Woodridge Middle School are teaching STEM subjects using hands-on, radio-related activities.
- [Julia Robinson Mathematics Festival](#) (JRMF): JRMF used this grant to create easy-to-understand and accessible educational materials that enable kids to peer behind the curtain and understand the mathematical concepts underpinning the “magic” of wireless communication.



The Julia Robinson Mathematics Festival (JRMF) creates easy-to-understand and accessible educational materials for kids that enable them to understand the mathematical concepts of wireless communication. Image: JRMF

Diversity in amateur radio and engineering

- [Make Operating Radio Easier \(MORE\)](#): The goal of this program is to train and license 500 new U.S. Radio Amateurs, with 50% non-male and 60% between ages 12-18.
- [Addressing Gender and Diversity Imbalances in Engineering](#): The primary focus of this Olin College project is to enable access to underrepresented communities and motivate students to participate in amateur radio and undergraduate research.

Digital Communications Research

- [Network Analytics Tools for Understanding Wireless Systems](#): This grant will allow Purdue University researchers to develop ready-to-use, easy-to-understand, wireless network analytics tools.
- [Controlling Commodity NB-IoT Devices via Of-the-Shelf Amateur Radios: A Software-Centric Solution](#): This grant will allow UCLA researchers to demonstrate how to use off-the-shelf amateur radios to access and control commodity narrow-band Internet of Things devices.

Open Source

- [Reproducible Builds](#): Makes sure that people who install binary open source software can be sure it hasn't been subverted by malware, and that it matches its published source code. This grant funds ongoing collaboration that aims, in part, to make progress on the Debian installer and the development of the diffoscope tool.
- [Outreachy: Paid Remote Scholarships](#): With this grant, Outreachy will continue to provide over 50 Free and Open Source Software (FOSS) developer internships per round to anyone who faces under-representation, systemic bias, or discrimination in the technology industry of their country.

Outreach and Engagement

Throughout the year, ARDC has strived to engage with the amateur radio, education, and scientific research communities.

Conferences and Hamfests

- [QSO Today Virtual Ham Expo](#)
- [Huntsville Hamfest](#)
- [TAPR Digital Communications Conference](#)
- [GNU Radio Conference](#)
- [Pacificon](#)

In the News

- Was mentioned in the [Boston Globe](#) in relation to saving MIT's iconic radome (see cover photo).
- Appeared on amateur radio podcasts and YouTube channels, including [Linux in the Ham Shack](#), [Ham Nation](#), [RATPAC](#), and [ICQPodcast](#).
- Published multiple press releases that were picked up by the amateur radio media outlets, including ARRL, CQ, QST, *Amateur Radio Newsline*, and *This Week in Amateur Radio*.
- Published five [newsletters](#) and increased the number of subscribers from less than 80 to more than 320.

Community Engagement

- Held well-attended community meetings in [February](#) and [July](#).
- Held a Visioning and Goals session in November 2021 with members of the amateur radio community to identify the challenges and opportunities in amateur radio. More information about the outputs of this workshop, as well our Dec. 2021 Offsite, will be coming out in 2022.
- Reached out directly to organizations in the amateur radio, education, open source, and scientific research communities to solicit grant proposals, many of which have resulted in active grants.
- Set up [ARDC Twitter](#) and [Vimeo](#) accounts, and revived the [ARDC LinkedIn page](#).

Grants & Gifts

Total grants & gifts distributed in 2021: 77

Total amount distributed in 2021: ~\$9,050,000

In 2021, ARDC had its most ambitious grantmaking year yet. We expanded to impact new countries and regions within the United States, and made connections with dozens of new organizations. Conservatively, ARDC grants now directly impact over 55,000 people worldwide. You can read descriptions of all of our 2021 awarded grants [on our website](#).

At right: The Karuk, Yurok, and Hoopa Valley Tribes – all of whom lack sufficient access to digital communications – are all working together to create a comprehensive communications strategy that includes both WiFi and amateur radio. Photo: Enertribe, Hoopa Valley Tribe Case Study



Grants Distribution & 2021 Granting Goals

ARDC's 2021 grants were distributed in three categories: Support & Growth of Amateur Radio, Education, and Technical Innovation.

Support & Growth of Amateur Radio (\$3,668,640)

In addition to a \$1.6 million gift to MIT to restore its iconic radome and 18-foot dish, our largest grant to date, a grant that stands out to us in 2021 is the \$600,000 grant to the ARRL Foundation to set up a grant program for clubs. The program will accept grant applications from amateur radio clubs – both ARRL-affiliated clubs and non-affiliated clubs – in amounts of up to \$25,000. These grants will allow clubs to continue to provide and expand leadership opportunities and all of the other important services they have traditionally provided, including emergency and public service communications and recruiting and training new radio amateurs.

Organization	Grant Amount
University of Arizona - <i>Digital Mode and Long-Term Equipment Investments</i>	\$8,287
University of Oregon - <i>Ducks on the Air Mobile Radio Stations</i>	\$25,606
University of Southern Mississippi Amateur Radio Club - <i>Install Repeater</i>	\$ 8,098
PAPA System - <i>Microwave Backbone Network</i>	\$ 157,425
OH-KY-IN ARS: - <i>Portable Satellite Ground Station</i>	\$5,288
OH-KY-IN ARS - <i>Repeater Site Internet Connectivity</i>	\$11,752
Lake Monroe - <i>Public Relations Trailer</i>	\$13,797
Intrepid DX group - <i>Annual Youth "Dream Rig" Essay Contest</i>	\$1,500

Virginia Tech Foundation - <i>4-H Youth Station and Outreach</i>	\$33,900
MIT - <i>Radome Renewal</i>	\$1,620,000
Rio Hondo Amateur Radio Club - <i>Loaner Radios & Repeater Replacement</i>	\$4,454
Ski Country Amateur Radio Club - <i>Microwave System Replacement</i>	\$3,516
Tillamook Emergency Comms - <i>Emergency Volunteer Corps of Nehalem Bay</i>	\$34,101
YASME Foundation - <i>Virgin Islands Amateur Repeater Group</i>	\$ 33,000
Lee County Amateur Radio Emergency Service - <i>Mobile Emergency Communication</i>	\$40,600
Mississippi Valley Amateur Radio Association - <i>Emergency Communications Bus</i>	\$116,399
Southwest Louisiana Amateur Repeater Club - <i>Hurricane Laura Recovery</i>	\$95,000
Blount Emergency Amateur Radio Service - <i>Communications Trailer</i>	\$ 11,750
The Lamorinda CERT Foundation - <i>Walnut Creek SHAMS Amateur Radio Club</i>	\$23,220
Chippewa Valley Amateur Radio Club - <i>Repeater Coverage Expansion</i>	\$ 53,200
ARRL Foundation - <i>Club grants</i>	\$600,000
ARESLAX, Inc. - <i>Radio Frequency Interference</i>	\$23,600

Education (\$4,140,089)

In 2021 ARDC made a total of 22 grants in the education category.

ARDC provided \$1,546,686 to five scholarship programs through the ARRL Foundation, the Society for Women Engineers, OMIK Scholarship Fund, Olin College, and Colorado School of Mines. A scholarship through UC San Diego, endowed in 2020, continued supporting students.

In all, scholarships granted in 2021 are poised to help 98 students attend college this year. Recipients major in computer science, engineering, math, and other fields related to our mission. Many are licensed amateur radio operators and are selected, in part, because of their involvement in the ham community. This year, ARDC focused on larger scholarships, including a grant to the Colorado School of Mines to completely eliminate debt for four students.

An additional \$2,593,403 went to support education programs. Some of these projects include: installing amateur radio stations in museums for visitors to see demos from local clubs, mentorship programs for youth, supplying makerspaces with amateur radio equipment, and bolstering K-12 STEM programs.

Our largest education grant went to [Amateur Radio on the International Space Station \(ARISS-USA\)](#) to fund the Student and Teacher Education via Radio Experimentation and Operations (STEREO) program. The five-year, \$1.3M grant will enable ARISS to conduct teacher workshops that will help them write winning ARISS contact proposals, and learn about space and amateur radio lessons they can bring into the classroom. ARISS will send educational wireless electronics kits to US and international schools to prepare them for a radio contact with the ISS, assuring the continuation of future ISS astronaut contacts in its years before decommissioning.

Education	Amount
California High School - <i>Incorporating Constructivism & the Maker Mentality</i>	\$9,950
Woodridge Middle School - <i>Hamulanche Foxhunting Activities</i>	\$5,453
Museum of Science & Technology - <i>Amateur Radio on the International Space Station</i>	\$4,122
Paradox Sonic Space Research Agency - <i>Development of a U1 CubeSat</i>	\$17,300
Norwich Free Academy - <i>Satellite and ARISS Ground Station</i>	\$9,769
University of Oklahoma - <i>Equipment Upgrade</i>	\$22,983
Social and Environmental Entrepreneurs - <i>Julia Robinson Mathematics Festival</i>	\$112,200
Case Western Reserve University Amateur Radio Club - <i>Senior projects</i>	\$2,000
Bridgerland Amateur Radio Club - <i>Hands-on Space Science</i>	\$17,831
Society of Women Engineers - <i>2021 Programs and Scholarships</i>	\$318,000
ARISS - <i>STEREO</i>	\$1,292,515
Olin College of Engineering - <i>Olin Satellite + Spectrum Technology & Policy Group</i>	\$509,442
Software Freedom Conservancy - <i>Outreachy</i>	\$150,000

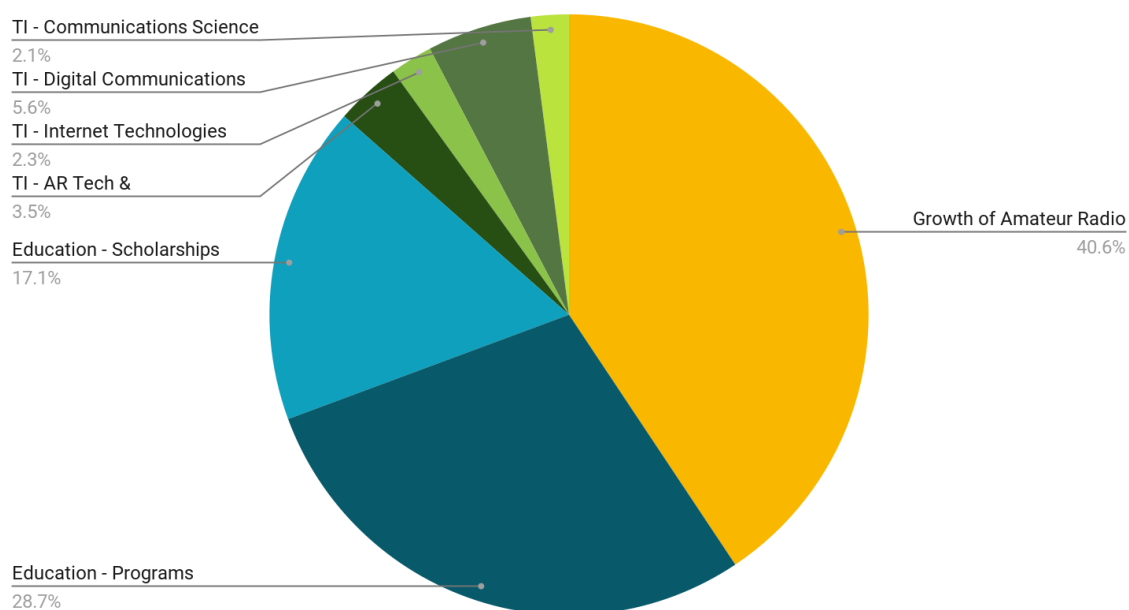
Technical Innovation (\$1,220,157)

A great example of technical innovation is the grant to [Rhizomatica](#) that will allow them to continue their development of the High-Frequency Emergency and Rural Multimedia Exchange System (HERMES). HERMES provides affordable digital telecommunications, including chat, audio, documents, photos, and GPS coordinates over shortwave/HF radio using a simplified visual interface accessed via smartphone or computer. HERMES hardware and software is free and open-source, and available for both civil and amateur radio use.

Technical Innovation - Amateur Radio Technology & Experimentation	
UCLA - <i>Controlling Commodity NB-IoT Devices via Of-the-Shelf Amateur Radios</i>	\$69,053
Open Research Institute - <i>M17</i>	\$250,000
Technical Innovation - Internet Technologies	
Princeton University - <i>Edgescope</i>	\$91,687
Software Freedom Conservancy - <i>Reproducible Builds</i>	\$115,000
Technical Innovation - Digital Communications	
Tucson Amateur Packet Radio - <i>TangerineSDR</i>	\$97,000
Purdue - <i>Network Analytics Tools for Understanding Wireless Systems</i>	\$64,213
Rhizomatica - <i>Digital HF Telecommunications for Civil and Amateur Uses</i>	\$335,940
Allstarlink - <i>Radio over IP (ROIP) App Enhancements</i>	\$12,000
Technical Innovation - Communications Science and Technology	
Technical University of Budapest - <i>Electromagnetic Pollution</i>	€60,000
DARC - <i>OpenWebRX Enhancements</i>	€95,000

The below charts show how funded projects are distributed across ARDC's 2021 Categories.

2021 Grant Categories



Granting Category	Dollars Given	No. Grants	Percent of funding
Growth of Amateur Radio	\$3,689,071	29	41%
Education	\$4,140,089	22	46%
- Scholarships	\$1,546,686	5	17%
- Programs	\$2,593,403	17	29%
Technical Innovation	\$1,373,606	10	14%
- Amateur Radio Tech & experimentation	\$319,053	2	4%
- Internet technologies	\$206,687	2	2%
- Technical Innovation - Digital Communications	\$666,578	4	6%
- Communications science and technology	\$181,288	2	2%

Further information about ARDC's grant making can be found in the [2021 Grant Report](#). The report includes updates on individual projects in addition to metrics on the impacts of our grants.



Countries impacted by ARDC Grants (2019-2021)

End-of-Year Gifts

In addition to the grants listed above, ARDC distributed an additional \$22,000 in small gifts at the end of 2021 to organizations that meet our mission or impact our work.

Python Software Foundation	\$1,000
Wikimedia	\$2,500
Software Freedom Conservancy	\$1,000
Apache	\$1,000
Debian via Software in the Public Interest	\$1,000
Electronic Privacy Information Center (EPIC)	\$1,000
Thunderbird/Mozilla Foundation	\$1,000
Libre Office/The Document Foundation	\$1,000
Internet Archive	\$2,500
Tor Project	\$1,000
Electronic Freedom Foundation (EFF)	\$2,500
HandiHams	\$1,000
Git	\$1,000
Open Street Map Foundation	\$1,000
BusyBox	\$1,000
OpenWRT	\$2,500

2021 Financial Overview

Total 2021 Distribution	
Grants & Gifts*	\$8,050,000
Operations	\$550,000
Total	\$8,600,000

Note: both operational expenses (e.g. staff and most contractor costs) and charitable contributions (e.g. grants and gifts) are counted toward ARDC's 5% required distribution.

The grants and gifts total above reflects the grants whose checks cleared in 2021. These are the grants that will be listed in our 2021 audit and used to determine the charitable contribution portion of our 2021 distribution.

There were a number of board-approved grants whose checks were issued in 2021, but the check did not clear until 2022. These grants will be included in our 2022 audit. Additional grants have been board-approved but are still in contracting and have not yet been issued a check. Those numbers are not included.

2021 Grants Approved	
2021 Grants & Gifts: Checks cleared in 2021, will appear in 2021 audit.	\$8,050,000
2021 Grants & Gifts: Checks cleared in 2022, will appear in 2022 audit	\$1,000,000
Total	\$9,050,000

Our grants distribution was significantly higher than it has been in prior years:

Past grants distribution	
2020	\$3,004,625
2019	\$120,000

This is because, in addition to wanting to significantly ramp up our grantmaking, we learned during our 2020 audit process that we did, in fact, need to meet our 5% distribution requirement in 2020, though information received prior to that indicated that 2021 would be our first year with the requirement. This meant that we under-distributed by about \$2.6 million in 2020 (see our [2020 990-PF, page 9, line F](#)). In response, we ramped up our outreach, which has yielded a fuller-than-ever grants pipeline as we enter 2022.

* **More exact values will be available post completion of our yearly audit** and filing of our 2021 990-PF. For past 990s and financial statements, visit ampr.org/about/legal/.

2021 Board & Advisory Committees

Board

ARDC thanks our 2021 board members for their leadership, expertise, and time. ARDC would not exist without our board members.

- President/CEO: Phil Karn — *KA9Q*
- Treasurer: Bdale Garbee — *KB0G*
- Secretary: John Gilmore — *W0GNU*
- Founding Director: kc claffy — *KC6KCC*
- Director: Robert McGwier — *N4HY*
- Director: Keith Packard — *KD7SQG*

Grants Advisory Committee (GAC)

ARDC succeeded in making these grants thanks in no small part to the Grants Advisory Committee (GAC):

- Chair: John Hays – *K7VE*
- Dewayne Hendricks – *WA8DZP*
- Douglas Kingston – *KD7DK*
- Hank Magnuski – *KA6M*
- Steve Stroh – *N8GNJ*
- Bob Witte – *K0NR*
- Renzo Rossi – *IW0SAB*

Technical Advisory Committee (TAC)

ARDC is grateful to the Technical Advisory Committee for their part in guiding the development of the 44net, including work on a proposal for Points of Presence (PoPs).

- Chair: Jann Traschewski – *DG8NGN*
- Pierre Martel – *VE2PF*
- Tim Požár – *KC6GNJ*
- Adam Lewis – *KC7GDY*
- Caleb Pal – *KD7KAB*
- Antonios Chariton – *SV2OIY*

Looking ahead: 2022

Much got done in 2021, and 2022 has a great deal more in store for us! Here's a quick look:

Grantmaking

We're now getting more applications than ever before! We will now be reviewing applications four times a year, with proposals due on:

- Feb. 15 (34 proposals already received)
- May 1
- July 15
- Oct. 1

More information about this process will be available at ampr.org/apply.

Technology

- Conduct a use assessment of 44Net
- Finalize and launch the new Portal

Grants

- Distribute \$6 million in grants or more
- Move to using the open source grant management software, [Hypha](#)

Communications

- Continue to raise our profile through additional international outreach and engagement with digital communications groups
- Launch a rebranded website

Operations

- Share outputs from our 2021 Vision & Goals session, as well as 2021 Offsite
- Develop a vision statement and continue to refine areas of focus

And that's just a start!

To get involved, ask a question, or share your thoughts about something you'd like to see in 2022, reach out any time: contact@ardc.net.

Visit ampr.org/giving to learn more about ARDC grantmaking.

Final Remarks

When a few of us began to experiment with TCP/IP over ham radio way back in the 1980s, we never dreamed that the block of IP addresses that Hank KA6M obtained for us just by asking would someday become so valuable. But they did, so in 2011 Brian Kantor WB6CYT (SK) created ARDC to hold title. In 2019 he managed the sale of 1/4 of our original allocation that turned ARDC into a serious philanthropic foundation.

Sadly, Brian only lived to see ARDC make its first two grants but I think he'd be happy to see us now. 2021 was a big year for us. We assembled an outstanding professional staff to support the volunteer Board, Grant and Technical Advisory Committees. As you can see from this report, our grant-making machinery is fully up and running.

My early interest in ham radio led to my career in telecom applied research. As the saying goes, "If you can't afford to fail, it's not research!" You'll never know what works until you try – and not long ago, the Internet was one of those blue sky research projects. We have the same philosophy at ARDC, so if you have an idea that fits within our charter, contact us!

I also get to read the thank-yous from students receiving ARDC-supported scholarships. When someone says that ARDC made it possible for them to go to school this year, well, that really makes it all worthwhile.

73,

Phil

Phil Karn - KA9Q
President
Amateur Radio Digital Communications (ARDC)
ampr.org